Rebuilding Analysis for Pacific Ocean Perch for 2003
(May 2003)

Andre E. Punt[1], Owen S. Hamel[2] and Ian J. Stewart[1]

1. Introduction

The Pacific Fishery Management Council (PFMC) adopted Amendment 11 to its Groundfish Management Plan in 1998. This amendment established a definition for an overfished stock of 25% of the unfished spawning biomass ($0.25B_0$). NMFS determined that a rebuilding plan was required for Pacific Ocean perch (*Sebastes alutus*) in March 1999 based on the most recent stock assessment at that time (Ianelli and Zimmerman, 1998). The PFMC began developing a rebuilding plan for Pacific Ocean perch (based upon a rebuilding analysis; August 1999; A. MacCall, pers. comm.) and submitted this plan to NMFS in February 2000. However, NMFS deferred adoption of the plan until the stock assessment was updated and reviewed, which was later that year (Ianelli *et al.*, 2000). Punt (2002a) conducted a rebuilding analysis for Pacific Ocean perch based on the stock assessment conducted by Ianelli *et a*l. (2000) that was consistent with the Terms of Reference for rebuilding analyses developed by the PFMC SSC (SSC, 2001). That rebuilding analysis is henceforth referred to as "the previous analysis".

The Pacific Ocean perch stock assessment has now been updated (Hamel *et al.*, 2003). This assessment, similar to that of Ianelli *et al.* (2000), involves fitting an age-structured population dynamics model to catch, catch-rate, length-frequency, age-composition, and survey data. Ianelli *et al.* (2000) and Hamel *et al.* (2003) both present results based on maximum likelihood and Bayesian estimation frameworks. The rebuilding analysis conducted by Punt (2002a) was based on the estimates corresponding to the maximum of the posterior density function (the MPD estimates) from Model 1c of Ianelli *et al.* (2000) because the STAR panel that evaluated the 2000 Pacific Ocean perch stock assessment selected this model variant as the "best assessment" (PFMC, 2000). In contrast, the STAR panel that evaluated the 2003 assessment of Pacific Ocean perch endorsed both the MPD estimates and the distributions for the model outputs that arose from the application of the MCMC algorithm to sample equally likely parameter vectors from the posterior distribution (PFMC, 2003).

This revision to the rebuilding analysis for Pacific Ocean perch involves a number of selections. Some of these selections are taken to be the same as those on which the rebuilding analysis conducted by Punt (2002a) was based. In contrast, the outcomes from the Pacific Ocean perch STAR panel and the contents of Amendment 16 to the Groundfish FMP lead to the following new issues that require resolution (the selections on which the 2002 rebuilding analysis was based are listed in parenthesis):

a) Should be projections be based on the MPD estimates or the sample from the full Bayesian posterior (MPD estimates).
b) Should $T_{\max}$ (the maximum allowable rebuild period[3]) be re-estimated given that estimates of commercial selectivity-at-age and natural mortality have changed, or should $T_{\max}$ be fixed at

[1] School of Aquatic and Fishery Sciences, Box 355020, University of Washington, Seattle, WA 98195-5020, email: aepunt@u.washington.edu.
[2] Northwest Fisheries Science Center, NOAA Fisheries, 2725 Montlake Blvd. E, Seattle, WA 98112.
[3] The maximum allowable rebuild period, $T_{\max}$, is defined as ten years if the resource can be rebuilt to $0.4B_0$ in fewer than ten years or the minimum possible rebuild period, $T_{\min}$, plus one mean generation.

the year, 2042, determined during the previous rebuilding analysis (T_{max} was estimated; there was no previous rebuilding analysis).

c) Should the OY for 2004 be computed using a harvest strategy that is based on a pre-specified value for: (a) P_{max} (the probability of recovery to the proxy for B_{MSY} of $0.4B_0$ by T_{max}), (b) T_{target} (the year in which the probability of recovery to the proxy for B_{MSY} of $0.4B_0$ equals 0.5), or (c) the fishing mortality rate during the rebuilding period (P_{max} was pre-specified).
d) How should future recruitments be generated: (a) by resampling historical recruitments, (b) by resampling historical recruits / spawning output ratios, or (c) by generating recruitments from the fitted stock-recruitment relationship (resampling historical recruitments).

In the absence of explicit guidance on appropriate selections, an attempt has been made in this document to present results for a range of variants of the rebuilding analysis. The next section elaborates on the various specifications and identifies a set of rebuilding analyses to capture the factors outlined above. This section is followed by a section that outlines the results. The final section of this document lists detailed results for the Groundfish Management Team's preferred set of specifications.

2. Specifications

2.1 Selection of B_0

It is common (and indeed recommended by the SSC) to define B_0 in terms of the recruitment in the first years of the assessment period. However, this rebuilding analysis and that of Punt (2002a) determines B_0 from the fitted stock-recruitment relationship because this seems inherently more consistent with the assumptions underlying the original stock assessment. The MPD estimate of B_0 is 39,198 units of spawning output[4] while the posterior median and 90% intervals for B_0 are 37,230 units of spawning output and (29,035; 47,393). These values for B_0 are substantially lower than that on which the previous rebuilding analysis was based (60,212 units of spawning output). The change to B_0 is due primarily to the revisions to the historical catches. The MPD estimate of the depletion of the spawning output of the start of 2003 is 0.254 while posterior median and 90% intervals are 0.277 (0.201; 0.384).

2.2 Generation of future recruitment

Recruitment in the assessment and projection models for Pacific Ocean perch relate to the abundance of animals aged 3 years. The assessment of Pacific Ocean perch by Ianelli *et al.* (2000) and Hamel *et al.* (2003) both include the assumption that, *apriori*, recruitment is related to spawning output according to a Beverton-Holt stock-recruitment relationship. The rebuilding analysis conducted by Punt (2002a) ignored this relationship and instead based the projections on resampling historical recruitments from those for the years 1965-98. This approach was consistent with the then SSC practice.

Figure 1 plots the MPD estimates of recruitment and recruits / spawning output from the assessments conducted by Ianelli *et al.* (2000) and Hamel *et al.* (2003). The rationale for generating future recruitment by sampling historical recruitment for the previous rebuilding analysis was that 1965-98 was a period of relative stability in recruitment while the recruitment estimates for 1999 and 2000 were highly imprecise. In contrast to recruitment, recruits / spawning output showed an increasing trend over time. The situation is now slightly more complicated because there is no longer an obvious increasing trend in recruits / spawning output with time. One of the reasons for the change in results from the 2000 to the 2003 assessment is that the assumed variability of recruitment was increased

[4] Spawning output is defined in termsof mt of mature females.

from 0.76 to 1 and the recruitment residuals were assumed to temporally uncorrelated *apriori*. Although resampling historical recruitment (now from the years 1965-2001) forms the base-line for the analyses of this document, sensitivity is also explored to generating future recruitment by resampling recruits / spawning output and by using the fitted stock-recruitment relationship.

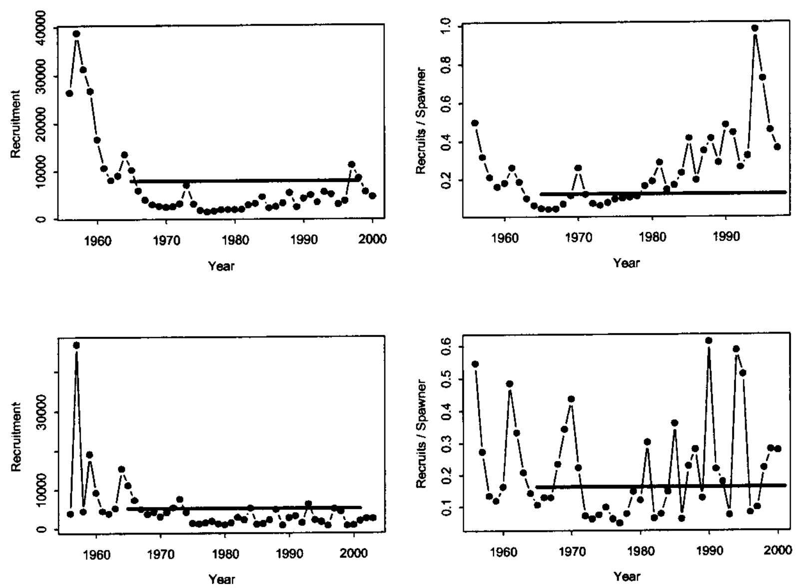

Figure 1 : Recruitment and recruits per spawner for assessments of Pacific Ocean perch conducted in 2000 and 2003 (upper and lower panels respectively). The horizontal line in the left panel indicates the recruitment corresponding to B_0 (the range of this line indicates the years used when generating future recruitment) and that in the right panel indicates the virgin recruits per spawner ratio.

2.3 Mean generation time

The mean generation time is defined as the mean age weighted by net spawning output (see Figure 2 for a plot of net spawning output *versus* age based on the MPD estimates). The estimate of natural mortality from the 2003 assessment is slightly higher than that from the 2000 assessment with the consequence that the "best estimate" of the mean generation time is now 29 / 28 years (MPD estimates / full posterior estimates) instead of 30 years.

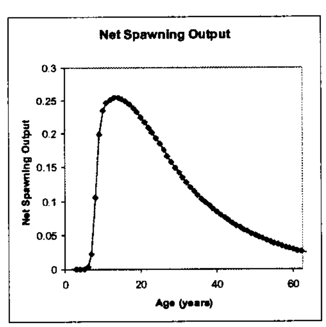

Figure 2 : MPD relationship between net spawning output and age for Pacific Ocean perch.

2.4 The harvest strategies

As noted in the introduction, there are many different ways to define the rebuilding harvest strategy. Table 1 summarizes those options considered in the analyses of this paper. The rebuild fishing mortality of 0.01025yr^{-1} is taken from the rebuild fishing mortality computed by Punt (2002a) after accounting for the difference in selectivity at the reference age (age 10). Results are not shown for different choices for T_{target} because T_{target} and P_{max} are highly correlated. Results (OYs and probabilities of recovery) for different choices for T_{target} can be determined by interpolation.

Table 1: Harvest strategy options considered in this document.

Case	Future recruitment	T_{max}	$F_{rebuild}$	P_{max}
A	Recruits	2042	0.01025	Re-estimated
B	Recruits	2042	Re-estimated	0.5, 0.6, 0.7, 0.8
C	Recruits	Re-estimated	Re-estimated	Re-estimated
D	Recruits / spawner	2042	0.01025	Re-estimated
E	Recruits / spawner	2042	Re-estimated	0.5, 0.6, 0.7, 0.8
F	Recruits / spawner	Re-estimated	Re-estimated	Re-estimated
G	Beverton-Holt s-r	2042	0.01025	Re-estimated
H	Beverton-Holt s-r	2042	Re-estimated	0.5, 0.6, 0.7, 0.8

The options in Table 1 explore the sensitivity of the results to the method used to generate future recruitment, how T_{max} is determined (re-estimated or fixed to the value selected in the previous rebuilding analysis) and to the harvest strategy (pre-specified rebuild fishing mortality or pre-specified probability of recovery to $0.4B_0$ by T_{max}).

2.5 Other specifications

The calculations of this document were performed using Version 2.6 of the rebuilding software developed by Punt (2002b) and the results are based on 1,000 Monte Carlo replicates (analyses based on the MPD estimates) and 5,000 Monte Carlo replicates (analyses based on the random samples from the full Bayesian posterior distribution). The selection of 1,000 replicates is based on the evaluation of Monte Carlo precision conducted by Punt (2002a). The analyses based on full posterior distribution involve 5 simulations for each of 1,000 samples for the posterior.

The definition of "recovery by year *y*" in this analysis is that the spawning output reaches $0.4B_0$ by year *y* (even if it subsequently drops below this level due to recruitment variability). Appendix 1 lists the MPD estimates for the biological and technological parameters and the age-structure of the population at the start of 2000 / 2003, while Appendix 2 lists the MPD time-series of recruitment and spawning output. The input to the rebuilding program for the 'Cases A/B' rebuilding analysis for the case in which the projections are based on the MPD estimates is given as Appendix 3. The catch for 2003 was set to 377t (the Council-selected *OY* for 2003).

3. Results

3.1 Time-to-recovery

Figure 3 shows the distribution for the number of years beyond the year 2000 that it would have taken to recover to $0.4B_0$ had there been no harvest since 2000 and future recruitment is generated by resampling historical recruitments (the base-case analysis). Results are shown for analyses based on the MPD estimates (left panel) and the full Bayesian posterior (right panel). As expected, the distribution based on the full Bayesian posterior has a much longer tail than that based on the MPD estimates. The median time to recover to 0.4 B_0 in the absence of catches with 50% probability is

T_{min}. The values for T_{min} (17 and 14 years respectively for the MPD and full Bayesian results) are greater than the value of T_{min} from the previous rebuilding analysis (12 years). If T_{max} is determined using the new information on the biology and the age-structure of the population in 2000, it changes from 2042 to 2046 if the calculations are based on the MPD estimates but remains at 2042 if the calculations are based on the full Bayesian posterior distribution.

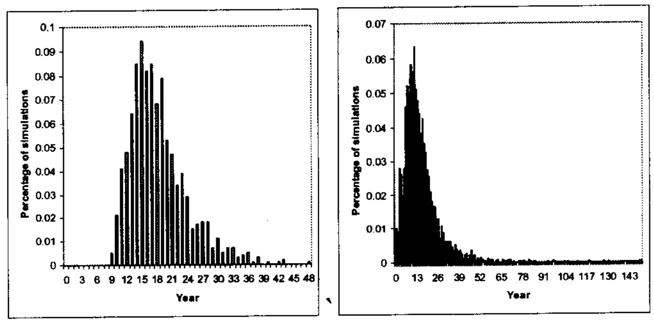

Figure 3 : Time to recover to $0.4B_0$ in the absence of catches from 2000 for the base-case analysis. The results based on the MPD estimates are shown in the left panel and those based on full Bayesian posterior in the right panel.

3.2 OYs and fishing mortalities

Tables 2 and 3 list some key output statistics for six rebuild strategies (probabilities of recovery in the maximum allowable rebuild period of 0.5, 0.6, 0.7 and 0.8, the 4-10 rule and the strategy of setting fishing mortality from 2004 equal to $0.01025 yr^{-1}$). Table 2 lists results based on the MPD estimates. Results are shown in Table 2 for the base-case analysis of Punt (2002a) as well as for each of the analysis options outlined in Table 1. Table 3 lists results based on the full Bayesian posterior; note that the results for cases A-C are listed together because if, as noted above, future recruitment is generated by resampling historical recruitments and T_{max} is re-estimated, the estimate of T_{max} equals the value (2042) calculated previously by Punt (2002a). The probabilities of recovery in Tables 2 and 3 are not exactly 50, 60, etc. because of the limited number of recruitments on which the projections are based, and the accuracy of the numerical search procedure employed.

Table 2: Four management-related quantities for six rebuild strategies for the projections based on the MPD estimates.

Scenario / Quantity	**Rebuild Strategy**					
	P_{max}=0.5	P_{max}=0.6	P_{max}=0.7	P_{max}=0.8	40-10 rule	Fixed F
2002 Rebuilding analysis (T_{max}=2042)						
Fishing mortality rate	0.0107	0.0094	0.0079	0.0065		
OY_{2002} (mt)	456.7	402.2	339.3	277.3	773.3	
P_{max}	50	60.1	70.1	80	0.3	
T_{target}	2042	2031.7	2025.2	2019.7	N/A	
Cases A / B (T_{max}=2042)						
Fishing mortality rate	0.0293	0.0259	0.0218	0.0181		0.01025
OY_{2004} (mt)	448.7	396.9	334.7	278.8	449.3	158.1
P_{max}	50.0	60.0	69.9	80.1	12.2	93.9
T_{target}	2042.0	2036.6	2031.6	2028.6	N/A	2023.3
Case C (T_{max}=2046)						
Fishing mortality rate	0.0313	0.0281	0.0245	0.0208		0.01025
OY_{2004} (mt)	478.3	431.1	375.5	318.9	449.3	158.1
P_{max}	50.0	60.1	70.0	80.1	14.1	96.4
T_{target}	2046.0	2039.9	2034.9	2030.8	N/A	2023.3
Cases D / E (T_{max}=2042)						
Fishing mortality rate	0.0106	0.0084	0.0061	0.0034		0.01025
OY_{2004} (mt)	162.9	129.3	94.9	52.9	449.3	158.1
P_{max}	50.1	60.1	69.9	80.1	0.0	51.6
T_{target}	2042.0	2038.5	2035.6	2032.4	N/A	N/A
Case F (T_{max}=2057)						
Fishing mortality rate	0.0167	0.0146	0.0128	0.0102		0.01025
OY_{2004} (mt)	256.4	225.6	197.1	157.2	449.3	158.1
P_{max}	50.0	60.1	70.0	80.1	0.1	79.9
T_{target}	2057.0	2050.9	2046.3	2041.4	N/A	2041.5
Cases G / H (T_{max}=2042)						
Fishing mortality rate	0.0381	0.0326	0.0268	0.0218		0.01025
OY_{2004} (mt)	581.4	498.9	410.2	334.5	449.3	158.1
P_{max}	49.9	60.1	69.9	80.0	40.4	95.5
T_{target}	2042.1	2035.8	2031.4	2028.2	N/A	2022.8

Table 3: Four management-related quantities for six rebuild strategies for the projections based on the full posterior distribution.

Scenario / Quantity	**Rebuild Strategy**					
	P_{max}=0.5	P_{max}=0.6	P_{max}=0.7	P_{max}=0.8	40-10 rule	Fixed F
Cases A / B / C (T_{max}=2042)						
Fishing mortality rate	0.0387	0.0322	0.0257	0.0184		0.01025
OY_{2004} (mt)	664.4	555.1	443.6	318.1	591.6	178.1
P_{max}	50.0	60.0	70.1	80.0	39.6	89.2
T_{target}	2042.0	2032.1	2026.4	2021.5	N/A	2017.9
Cases D / E (T_{max}=2042)						
Fishing mortality rate	0.0182	0.0132	0.0082	0.0029		0.01025
OY_{2004} (mt)	315.5	228.9	142.7	51.1	591.6	178.1
P_{max}	50.0	60.0	69.9	80.0	13.1	65.9
T_{target}	2042.0	2033.3	2027.2	2023.0	N/A	2029.5
Case F (T_{max}=2049)						
Fishing mortality rate	0.0207	0.0162	0.0116	0.0064		0.01025
OY_{2004} (mt)	358.3	281.1	201.9	112.2	591.6	178.1
P_{max}	50.0	60.1	70.0	80.0	14.2	73.1
T_{target}	2049.0	2038.4	2031.2	2025.6	N/A	2029.5
Cases G / H (T_{max}=2042)						
Fishing mortality rate	0.043	0.034	0.0248	0.0156		0.01025
OY_{2004} (mt)	737.1	584.9	428.6	271	591.6	178.1
P_{max}	50.0	60.0	70.0	80.0	51.6	85.2
T_{target}	2042.0	2031.7	2025.3	2020.3	2039.9	2018.5

4. Selection of a preferred variant

The Council interim choice for P_{max} is 70% (J. DeVore, PFMC, pers. commn). The range for the 2004 OY in Tables 2 and 3 for this choice for P_{max} is 95t – 444t. The results for a fixed rebuild fishing mortality of 0.01025yr^{-1} should be interpreted with some caution because the commercial selectivity pattern on which the projections are based from the 2003 assessment differs notably from that based on the 2000 assessment (Figure 4).

The Groundfish Management Team (GMT) selected four of the cases in Table 2 and 3 for further examination. These four cases differ in terms of the parameters on which the projections are based (MPD estimates or Bayesian posterior values) and whether future recruitment is generated by resampling historical recruitments or historical recruits / spawning output ratios (i.e. cases C and F in Tables 2 and 3). All four cases involve re-estimating T_{max} rather than fixing it equal to 2042.

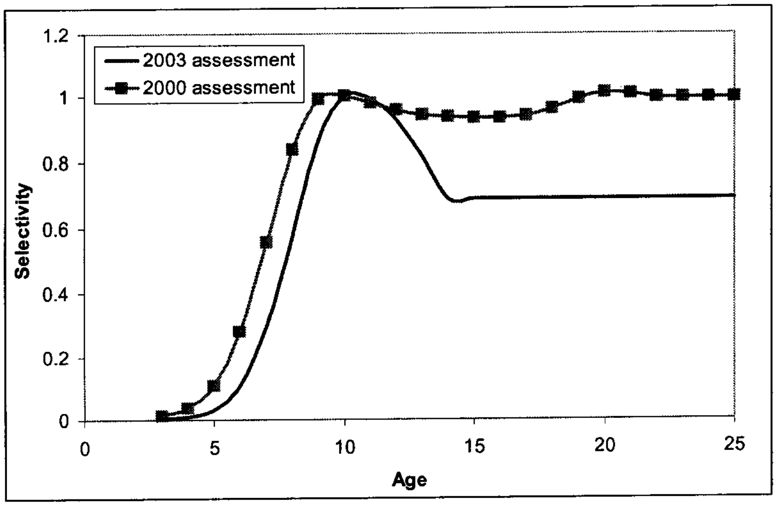

Figure 4 : The selectivity patterns on which (a) the projections of the present paper are based (2003 assessment) and (b) the projections of Punt (2002a) were based (2000 assessment).

Figures 5 and 6 contrast the time-trajectory of the probability of recovery for the six rebuild strategies for the four "preferred variants", along with the envelopes (5%, 25%, 50%, 75% and 95%) of the time-trajectories for catch and the ratio of spawning output to $0.4B_0$.

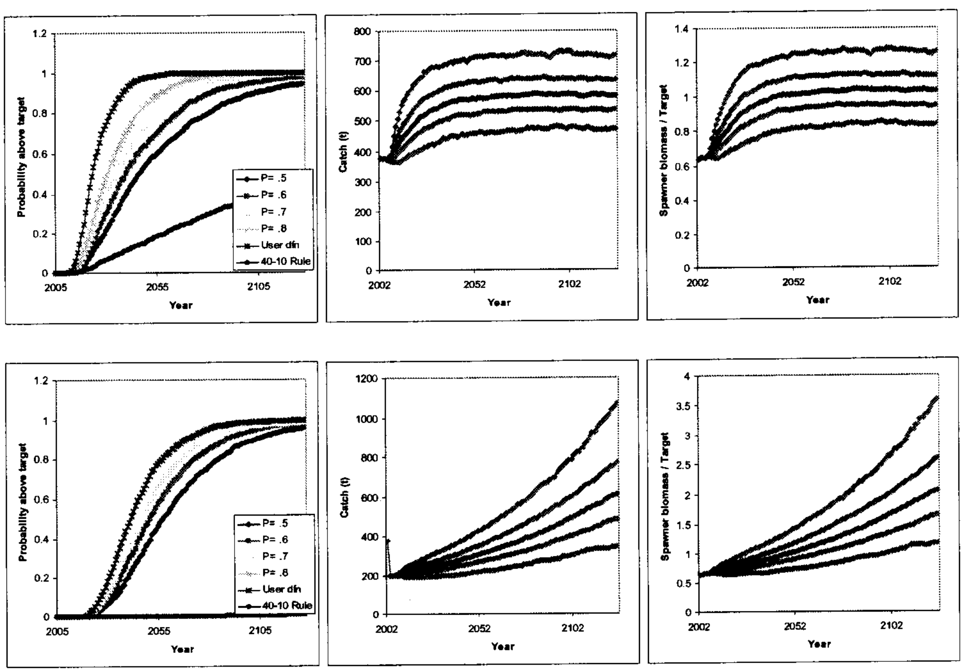

Figure 5 : Time trajectories of the probability of recovery for five rebuild strategies, of the catch for a 0.7 probability of recovery, and of the spawning output expressed relative to $0.4B_0$ for a 0.7 probability of recovery. The upper panels pertain to the projections based on generating future recruitment by resampling from the historical recruitments and the lower panels pertain to the projections based on generating future recruitment by resampling historical recruits / spawning output ratios. The results in this figure are based on the MPD estimates of the model parameters

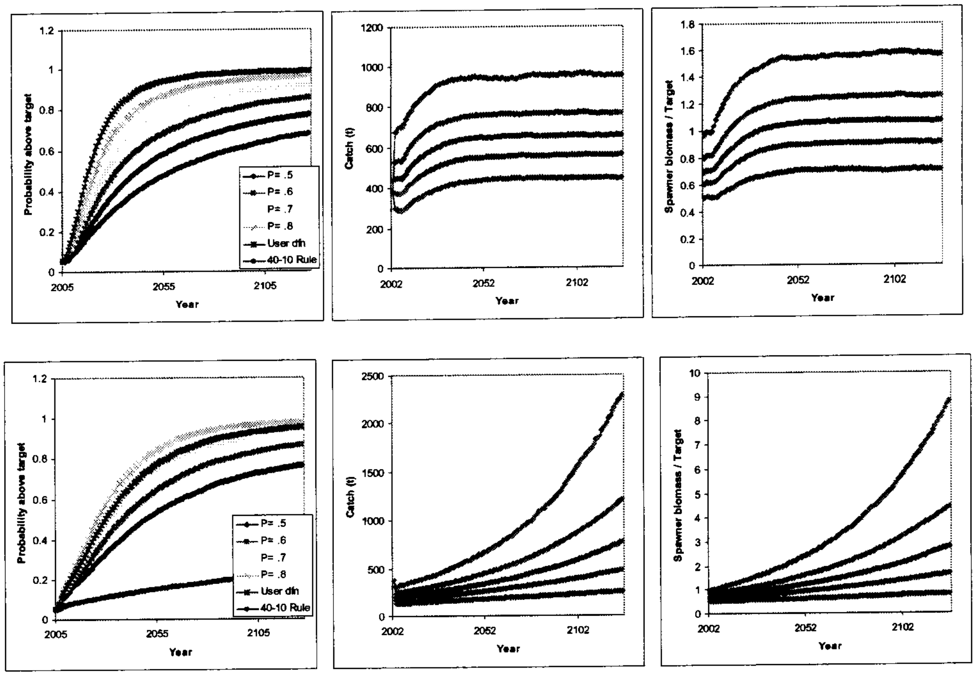

Figure 6 : Time trajectories of the probability of recovery for five rebuild strategies, of the catch for a 0.7 probability of recovery, and of the spawning output expressed relative to $0.4B_0$ for a 0.7 probability of recovery. The upper panels pertain to the projections based on generating future recruitment by resampling from the historical recruitments and the lower panels pertain to the projections based on generating future recruitment by resampling historical recruits / spawning output ratios. The results in this figure are based on 1,000 parameters vectors sampled from the posterior distribution.

Appendix 4 lists the envelopes for the annual catch and the ratio of the spawning output to the target level for a 0.7 probability of rebuild. Note that this ratio is calculated each point in time – the probability of having reached $0.4B_0$ sometime before a given year is at least as great as that listed in Appendix 4 and shown in the right panels of Figures 5 and 6 for that year. Appendix 5 lists the annual catches (2003+) for five of the six harvest strategies in Tables 2 and 3 as well as for a harvest strategy for there is a 50% probability of rebuild by T_{mid} (the average of T_{min} and T_{max}) for each of the four "preferred variants".

The GMT requested that the STAT team evaluate the consequences of catches of 200t and 400t over the next ten years (2004-2013). Table 4 therefore lists the value of the ratio of the spawning output at the start of 2014 to the target spawning output for three harvest regimes (constant fishing mortality equal to that needed to achieve of 0.7 probability of recovery by T_{max}, a constant catch of 200t and a constant catch of 400t) for each of the four "preferred variants.

Table 4: Spawning output at the start of 2014 expressed relative to the target spawning output (median and 90% intervals) for three harvest regimes and four cases.

Case	Constant fishing mortality (P_{max}=0.7)			Constant 200*t* catch			Constant 400*t* catch		
MPD estimates									
C	0.651	0.753	0.905	0.699	0.808	0.972	0.642	0.750	0.914
F	0.654	0.722	0.819	0.653	0.723	0.824	0.596	0.665	0.766
Bayesian outputs									
C	0.554	0.825	1.230	0.604	0.908	1.361	0.552	0.847	1.292
F	0.541	0.810	1.241	0.534	0.814	1.263	0.481	0.754	1.189

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Appendix 1 : Biological and technological parameters used for the rebuilding analyses based on the MPD estimates.

Age	Fecundity	Weight (kg)	Selectivity	N (2000)	N (2003)
3	0.000	0.169	0.002	800	2464
4	0.000	0.241	0.008	636	2337
5	0.000	0.317	0.032	3846	1700
6	0.004	0.396	0.110	4316	682
7	0.028	0.474	0.298	528	541
8	0.137	0.550	0.580	1240	3259
9	0.274	0.622	0.868	1490	3623
10	0.339	0.690	1.000	3950	437
11	0.375	0.752	0.991	770	1015
12	0.404	0.809	0.928	1556	1212
13	0.431	0.861	0.815	1160	3212
14	0.454	0.908	0.687	288	628
15	0.475	0.950	0.687	1649	1276
16	0.494	0.987	0.687	657	956
17	0.510	1.021	0.687	331	238
18	0.525	1.050	0.687	255	1360
19	0.538	1.076	0.687	1165	542
20	0.550	1.099	0.687	442	273
21	0.560	1.119	0.687	500	210
22	0.569	1.137	0.687	234	961
23	0.576	1.153	0.687	125	364
24	0.583	1.166	0.687	143	413
25+	0.589	1.178	0.687	4291	3954

Appendix 2 : MPD historical series of spawning output and recruitment.

Year	Recruitment (age 3)	Spawning output
1956	3898	35119
1957	46839	33896
1958	4409	32733
1959	19185	32215
1960	9260	31789
1961	4415	31817
1962	3821	33501
1963	5197	35107
1964	15426	34744
1965	11164	34427
1966	7295	31909
1967	4954	23135
1968	3643	17328
1969	4141	15549
1970	2982	17377
1971	4071	18321
1972	5329	18779
1973	7584	18995
1974	4095	18695
1975	1329	18446
1976	1149	18501
1977	1376	18459
1978	1806	18847
1979	1123	18680
1980	875	18097
1981	1454	17154
1982	2762	16238
1983	2185	15567
1984	5176	14384
1985	1017	13285
1986	1189	12317
1987	2132	11581
1988	4795	11166
1989	745	10762
1990	2646	10283
1991	3133	9813
1992	1376	9190
1993	6303	8965
1994	2149	8629
1995	1648	8342
1996	656	8259
1997	5065	8218
1998	4275	8468
1999	670	8776
2000	800	8872
2001	1889	9052
2002	2464	9372
2003	2464	9946

Appendix 3 : The input file for the base-case rebuilding analysis (MPD estimates)

#Title
POP - STAR panel model
Number of sexes
1
Age range to consider (minimum age; maximum age)
3 25
Number of fleets
1
First year of projection
2003
Year declared overfished
2000
Is the maximum age a plus-group (1=Yes;2=No)
1
Generate future recruitments using historical recruitments (1) historical recruits/spawner (2) or a stock-recruitment (3)
1
Constant fishing mortality (1) or constant Catch (2) projections
1
Pre-specify the year of recovery (or -1) to ignore
38
Fecundity-at-age
3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25
3.84E-06 4.03E-05 0.000392248 0.003560962 0.028260766 0.1374925 0.273954602 0.338584679 0.375081501 0.404469053 0.430553194
0.453991276 0.4749965 0.493739 0.510395 0.52515 0.53818 0.549655 0.559745 0.568595 0.576345 0.58313 0.589055
Age specific information (Females then males) weight selectivity
#
0.169105 0.240603 0.317273 0.395966 0.474162 0.54997 0.62206 0.689572 0.752022 0.80921 0.861146 0.907988 0.949993 0.987478 1.02079 1.0503
1.07636 1.09931 1.11949 1.13719 1.15269 1.16626 1.17811
0.002154 0.008375 0.032416 0.110330 0.297810 0.579697 0.868444 1.000000 0.990673 0.927875 0.814533 0.686966 0.686966 0.686966 0.686966
0.686966 0.686966 0.686966 0.686966 0.686966 0.686966 0.686966 0.686966
M and initial age-structure
#
0.0526361 0.0526361 0.0526361 0.0526361 0.0526361 0.0526361 0.0526361 0.0526361 0.0526361 0.0526361 0.0526361 0.0526361 0.0526361
0.0526361 0.0526361 0.0526361 0.0526361 0.0526361 0.0526361 0.0526361 0.0526361 0.0526361 0.0526361
2463.69 2337.28 1699.75 682.296 541.265 3259.45 3622.79 437.317 1015.29 1211.88 3212.1 628.309 1276.09 955.836 237.811 1360.39 542.225
272.914 210.123 960.879 364.385 412.502 3954.24
Initial age-structure
799.597 635.505 3846.28 4316.28 527.898 1240.19 1489.59 3949.7 770.03 1555.66 1160.42 288.259 1648.98 657.25 330.808 254.698 1164.71
441.684 500.008 233.711 125.105 143.106 4291.15
Year for Tmin Age-structure
2000
Number of simulations
1000
recruitment and biomass
Number of historical assessment years
49
Historical data
year recruitment spawner in B0 in R project in R/S project
1955 5279.19 39291.2 1 0 0
1956 3897.88 35118.8 0 0 0
1957 46838.90 33895.8 0 0 0
1958 4409.30 32733.1 0 0 0
1959 19184.60 32215.0 0 0 1
1960 9260.10 31789.3 0 0 1
1961 4415.37 31816.8 0 0 1
1962 3820.53 33500.9 0 0 1
1963 5196.77 35106.9 0 0 1
1964 15426.00 34744.3 0 0 1
1965 11164.10 34427.2 0 1 1
1966 7294.69 31908.9 0 1 1
1967 4953.68 23135.0 0 1 1
1968 3642.96 17328.3 0 1 1
1969 4140.89 15549.4 0 1 1
1970 2981.68 17377.4 0 1 1
1971 4071.25 18321.4 0 1 1
1972 5329.40 18778.6 0 1 1
1973 7583.54 18994.9 0 1 1
1974 4095.29 18695.3 0 1 1
1975 1329.08 18445.7 0 1 1
1976 1148.89 18500.8 0 1 1

1977 1376.37 18459.0 0 1 1
1978 1806.22 18847.0 0 1 1
1979 1122.56 18680.1 0 1 1
1980 875.23 18096.5 0 1 1
1981 1453.82 17154.3 0 1 1
1982 2761.61 16237.8 0 1 1
1983 2184.85 15566.5 0 1 1
1984 5175.53 14384.4 0 1 1
1985 1016.60 13284.5 0 1 1
1986 1189.49 12317.3 0 1 1
1987 2131.66 11580.9 0 1 1
1988 4795.20 11165.8 0 1 1
1989 744.88 10761.7 0 1 1
1990 2645.72 10282.6 0 1 1
1991 3133.39 9812.9 0 1 1
1992 1375.93 9190.4 0 1 1
1993 6303.47 8964.7 0 1 1
1994 2148.51 8628.6 0 1 1
1995 1647.70 8341.7 0 1 1
1996 656.19 8258.9 0 1 1
1997 5064.59 8218.2 0 1 1
1998 4275.34 8468.3 0 1 1
1999 669.92 8775.7 0 1 1
2000 799.60 8872.3 0 1 1
2001 1888.79 9051.8 0 1 1
2002 2463.69 9371.7 0 0 0
2003 2463.69 9945.9 0 0 0
Number of years with pre-specified catches
1
catches for years with pre-specified catches
2003 377
Number of future recruitments to override
0
Process for overiding (-1 for average otherwise index in data list)
Which probability to product detailed results for (1=0.5; 2=0.6; etc.)
3
Steepness sigma-R Auto-correlation
0.531877 1.00 0.00
Target SPR rate (FMSY Proxy)
0.5
Target SPR information: Use (1=Yes) and power
0 20
Discount rate (for cumulative catch)
0.1
Truncate the series when 0.4B0 is reached (1=Yes)
0
Set F to FMSY once 0.4B0 is reached (1=Yes)
0
Percentage of FMSY which defines Ftarget
0.9
Maximum possible F for projection (-1 to set to FMSY)
2
Conduct MacCall transition policy (1=Yes)
0
Defintion of recovery (1=now only;2=now or before)
2
Results for rec probs by Tmax (1) or 0.5 prob for various Ttargets (2)
1
Produce the risk-reward plots (1=Yes)
0
Calculate coefficients of variation (1=Yes)
0
Number of replicates to use
20
Random number seed
-89102
Conduct projections for multiple starting values (0=No;else yes)
0
File with multiple parameter vectors
MCMC.POP
Number of parameter vectors
1000

```
# User-specific projection (1=Yes); Output replaced (1->6)
1 5
# Catches and Fs (Year; 1/2 (F or C); value); Final row is -1
2004 1 0.01025
-1 -1 -1
# Split of Fs
2003 1
-1 1
```

Appendix 4 : The envelopes (5%, 25%, 50%, 75% and 95% distribution points) for the annual catch and the annual ratio of the spawner output to $0.4B_0$ for a 0.7 probability of recovery.

(a) Projections based on the MPD estimates; Future recruitment = recruits

Year	Spawner output / $0.4B_0$					Annual catch (t)				
	5%	25%	50%	75%	95%	5%	25%	50%	75%	95%
2003	0.6343	0.6343	0.6343	0.6343	0.6343	377.0	377.0	377.0	377.0	377.0
2004	0.6509	0.6509	0.6509	0.6509	0.6509	375.5	375.5	375.5	375.6	375.6
2005	0.6486	0.6486	0.6486	0.6486	0.6486	375.8	375.8	375.9	376.0	376.1
2006	0.6458	0.6458	0.6458	0.6459	0.6459	373.0	373.2	373.5	373.9	374.6
2007	0.6497	0.6498	0.6501	0.6505	0.6511	370.7	371.5	372.6	374.5	377.2
2008	0.6560	0.6571	0.6587	0.6619	0.6661	366.6	369.5	373.0	378.5	387.4
2009	0.6554	0.6614	0.6692	0.6834	0.7036	365.4	372.4	381.7	393.1	413.9
2010	0.6497	0.6654	0.6854	0.7096	0.7571	365.3	380.0	395.7	414.6	450.9
2011	0.6445	0.6752	0.7035	0.7368	0.7993	363.9	388.3	409.0	435.7	483.2
2012	0.6449	0.6860	0.7195	0.7630	0.8377	363.6	395.2	420.6	453.6	507.1
2013	0.6461	0.6966	0.7382	0.7871	0.8678	363.5	401.1	431.7	467.7	531.3
2014	0.6510	0.7074	0.7527	0.8094	0.9048	367.9	408.0	440.5	480.2	551.1
2015	0.6589	0.7206	0.7675	0.8268	0.9350	373.6	413.6	449.4	488.9	564.6
2016	0.6645	0.7302	0.7829	0.8460	0.9597	378.4	420.4	455.6	497.5	573.4
2017	0.6724	0.7400	0.7963	0.8656	0.9873	382.1	427.7	462.0	505.6	586.6
2018	0.6802	0.7526	0.8068	0.8844	1.0101	388.0	433.3	468.6	516.7	597.6
2019	0.6906	0.7640	0.8238	0.9014	1.0276	390.8	437.9	478.7	528.3	605.3
2020	0.6952	0.7738	0.8414	0.9191	1.0478	391.9	445.3	486.0	536.3	619.1
2021	0.6993	0.7877	0.8512	0.9340	1.0692	394.6	451.2	491.5	542.7	623.0
2022	0.7015	0.7967	0.8644	0.9526	1.0886	398.7	456.4	499.4	548.7	633.0
2023	0.7055	0.8076	0.8781	0.9635	1.1026	402.5	459.6	506.7	556.2	637.2
2024	0.7149	0.8140	0.8912	0.9745	1.1111	404.2	463.7	513.4	563.9	643.4
2025	0.7213	0.8226	0.9013	0.9887	1.1302	407.2	467.4	515.3	570.6	647.1
2026	0.7272	0.8272	0.9081	1.0020	1.1443	412.6	473.9	519.5	575.0	661.8
2027	0.7345	0.8340	0.9159	1.0112	1.1513	415.9	476.3	522.5	578.5	663.8
2028	0.7385	0.8407	0.9212	1.0122	1.1601	417.5	478.6	527.1	580.7	669.8
2029	0.7410	0.8439	0.9326	1.0205	1.1756	419.9	479.5	533.1	583.5	674.7
2030	0.7482	0.8523	0.9404	1.0277	1.1801	421.8	483.1	536.1	586.2	677.7
2031	0.7525	0.8567	0.9451	1.0306	1.1828	420.7	487.0	537.9	591.0	675.9
2032	0.7520	0.8629	0.9474	1.0392	1.1833	425.0	493.4	539.0	594.9	681.1
2033	0.7543	0.8688	0.9547	1.0473	1.1869	428.7	495.3	542.4	598.3	678.3
2034	0.7627	0.8766	0.9597	1.0540	1.1855	432.2	498.4	546.7	602.0	678.1
2035	0.7696	0.8806	0.9656	1.0570	1.1886	438.2	498.7	548.9	603.2	680.2
2036	0.7764	0.8837	0.9700	1.0633	1.1943	443.5	502.3	553.7	607.0	685.1
2037	0.7838	0.8881	0.9766	1.0675	1.2035	440.1	502.7	553.8	611.0	686.6
2038	0.7841	0.8916	0.9766	1.0776	1.2055	442.2	506.5	558.8	612.8	686.5
2039	0.7893	0.8931	0.9815	1.0791	1.2088	445.9	507.2	559.5	613.3	692.5
2040	0.7892	0.8982	0.9910	1.0803	1.2124	450.9	511.2	561.9	614.4	693.7
2041	0.7965	0.9063	0.9951	1.0834	1.2178	448.5	513.6	564.4	618.6	690.4
2042	0.7984	0.9107	0.9985	1.0874	1.2150	450.4	516.0	564.6	619.0	698.9
2043	0.7991	0.9150	1.0013	1.0864	1.2246	447.2	520.9	565.9	619.9	698.1
2044	0.7949	0.9220	1.0044	1.0903	1.2259	448.3	519.5	569.9	622.0	696.7
2045	0.7972	0.9214	1.0088	1.0938	1.2297	454.1	521.1	571.3	621.1	699.7
2046	0.8060	0.9216	1.0087	1.0937	1.2340	454.7	520.8	571.2	620.9	702.8
2047	0.8059	0.9259	1.0112	1.0969	1.2351	453.7	520.1	572.2	623.0	703.7

2048	0.8067	0.9244	1.0101	1.0997	1.2308	453.9	521.0	570.1	626.2	695.6
2050	0.8120	0.9208	1.0101	1.1077	1.2366	458.8	518.4	571.4	628.8	706.9

(b) Projections based on the MPD estimates; Future recruitment = recruits / spawner

Year	Spawner output / $0.4B_0$					Annual catch (t)				
	5%	25%	50%	75%	95%	5%	25%	50%	75%	95%
2003	0.6343	0.6343	0.6343	0.6343	0.6343	377.0	377.0	377.0	377.0	377.0
2004	0.6509	0.6509	0.6509	0.6509	0.6509	197.1	197.1	197.1	197.1	197.1
2005	0.6543	0.6543	0.6543	0.6543	0.6543	198.9	199.0	199.0	199.0	199.1
2006	0.6571	0.6571	0.6571	0.6572	0.6572	199.1	199.2	199.2	199.4	199.7
2007	0.6664	0.6665	0.6666	0.6668	0.6673	199.2	199.5	199.8	200.3	201.5
2008	0.6775	0.6781	0.6790	0.6806	0.6845	197.9	198.7	199.8	201.3	204.8
2009	0.6800	0.6834	0.6877	0.6955	0.7125	197.3	199.4	202.0	205.5	212.5
2010	0.6734	0.6823	0.6928	0.7085	0.7369	196.5	200.6	205.5	212.5	223.0
2011	0.6657	0.6814	0.6989	0.7239	0.7570	194.1	200.7	207.6	218.2	231.5
2012	0.6615	0.6824	0.7053	0.7376	0.7791	191.0	200.2	208.9	222.1	238.6
2013	0.6566	0.6844	0.7133	0.7493	0.8008	189.0	200.0	211.1	225.4	243.6
2014	0.6544	0.6873	0.7215	0.7624	0.8186	188.1	200.9	213.5	228.1	249.5
2015	0.6517	0.6912	0.7308	0.7714	0.8346	188.2	202.7	216.1	230.5	253.8
2016	0.6520	0.6957	0.7357	0.7805	0.8458	188.0	204.2	218.3	233.7	257.1
2017	0.6496	0.7024	0.7421	0.7892	0.8633	188.8	206.4	220.0	236.0	261.4
2018	0.6526	0.7056	0.7495	0.7978	0.8739	190.2	207.9	222.3	239.4	265.3
2019	0.6526	0.7110	0.7569	0.8107	0.8901	190.1	210.4	224.5	243.8	270.8
2020	0.6496	0.7175	0.7657	0.8246	0.9125	189.5	211.1	227.1	246.9	275.6
2021	0.6468	0.7198	0.7733	0.8340	0.9273	190.0	212.4	228.9	249.8	281.1
2022	0.6521	0.7233	0.7803	0.8470	0.9454	191.3	213.7	231.8	252.9	284.1
2023	0.6584	0.7288	0.7864	0.8545	0.9550	192.4	215.2	234.1	256.3	287.3
2024	0.6610	0.7317	0.7957	0.8659	0.9745	193.1	215.5	237.7	259.0	294.1
2025	0.6602	0.7359	0.8033	0.8774	0.9956	193.6	217.1	238.5	260.7	297.9
2026	0.6633	0.7398	0.8097	0.8828	1.0025	194.2	219.0	241.5	264.0	301.8
2027	0.6652	0.7472	0.8202	0.8915	1.0183	194.9	221.2	242.8	266.4	306.5
2028	0.6674	0.7508	0.8267	0.9021	1.0439	193.8	222.5	244.8	269.7	312.2
2029	0.6686	0.7571	0.8311	0.9141	1.0585	195.2	224.0	247.2	273.7	319.3
2030	0.6707	0.7650	0.8404	0.9282	1.0693	196.9	225.6	249.7	276.1	319.7
2031	0.6756	0.7694	0.8498	0.9334	1.0859	195.9	226.8	251.9	278.5	324.2
2032	0.6713	0.7758	0.8572	0.9428	1.1018	196.3	228.7	254.0	281.6	326.0
2033	0.6707	0.7798	0.8656	0.9571	1.1094	197.1	230.4	256.4	285.1	332.9
2034	0.6708	0.7870	0.8701	0.9708	1.1172	197.8	232.0	258.5	290.4	336.6
2035	0.6646	0.7925	0.8803	0.9845	1.1351	196.0	234.2	261.1	293.0	341.6
2036	0.6667	0.7967	0.8905	0.9980	1.1505	196.4	235.1	264.8	297.6	344.4
2037	0.6740	0.8031	0.9019	1.0080	1.1692	198.3	237.4	266.3	300.6	349.8
2038	0.6791	0.8119	0.9080	1.0159	1.1826	198.5	239.6	268.4	303.3	355.1
2039	0.6808	0.8152	0.9120	1.0287	1.1987	200.3	241.9	271.1	305.9	358.5
2040	0.6880	0.8231	0.9193	1.0394	1.2175	202.4	244.7	274.3	308.8	365.4
2041	0.6934	0.8368	0.9280	1.0469	1.2405	203.9	246.6	276.2	310.5	370.4
2042	0.6977	0.8424	0.9400	1.0500	1.2565	205.5	248.5	279.8	313.7	374.4
2043	0.6984	0.8479	0.9482	1.0674	1.2694	207.1	250.7	281.7	317.9	377.4
2044	0.7064	0.8516	0.9608	1.0851	1.2840	207.0	252.4	285.2	321.9	384.3
2045	0.7112	0.8598	0.9715	1.0907	1.2982	207.4	253.3	287.8	325.8	388.8
2046	0.7137	0.8638	0.9797	1.1069	1.3103	209.1	255.1	291.7	330.0	397.4
2047	0.7207	0.8711	0.9906	1.1173	1.3348	212.0	257.0	292.4	334.7	401.7
2048	0.7236	0.8825	0.9998	1.1344	1.3497	213.8	258.8	295.2	338.3	407.1
2049	0.7247	0.8842	1.0067	1.1426	1.3720	214.3	261.3	298.7	341.5	410.6

2050	0.7335	0.8908	1.0160	1.1563	1.3885	214.6	265.5	301.2	345.7	419.3

(c) Projections based on the Bayesian estimates; Future recruitment = recruits

Year	Spawner output / $0.4B_0$					Annual catch (t)				
	5%	25%	50%	75%	95%	5%	25%	50%	75%	95%
2003	0.5053	0.6048	0.6939	0.7975	0.9618	377.0	377.0	377.0	377.0	377.0
2004	0.5167	0.6232	0.7146	0.8208	0.9960	298.8	374.4	443.6	527.3	672.9
2005	0.5133	0.6190	0.7103	0.8229	0.9942	299.3	373.6	447.3	532.6	679.1
2006	0.5094	0.6152	0.7102	0.8160	0.9894	290.8	372.1	446.9	537.1	695.3
2007	0.5076	0.6171	0.7143	0.8241	0.9974	289.5	373.2	449.2	534.3	698.0
2008	0.5067	0.6218	0.7242	0.8410	1.0342	287.6	373.8	450.4	537.6	698.2
2009	0.5105	0.6307	0.7406	0.8643	1.0843	294.2	382.3	459.6	549.7	717.1
2010	0.5163	0.6429	0.7558	0.8855	1.1182	303.5	394.5	474.1	569.5	738.0
2011	0.5276	0.6588	0.7739	0.9091	1.1462	312.0	407.2	487.8	583.9	756.3
2012	0.5370	0.6744	0.7921	0.9301	1.1695	320.5	417.0	499.8	600.0	772.6
2013	0.5444	0.6887	0.8092	0.9508	1.2027	327.6	425.4	511.7	613.1	783.7
2014	0.5537	0.7015	0.8252	0.9696	1.2303	335.7	433.5	521.0	625.8	801.2
2015	0.5608	0.7124	0.8405	0.9878	1.2508	339.9	440.9	528.9	636.0	811.3
2016	0.5680	0.7250	0.8558	1.0072	1.2761	346.6	448.7	537.0	644.6	820.9
2017	0.5738	0.7347	0.8692	1.0245	1.3025	352.7	456.1	544.1	653.0	826.8
2018	0.5837	0.7448	0.8809	1.0377	1.3245	354.9	461.4	553.3	659.8	839.2
2019	0.5927	0.7564	0.8926	1.0533	1.3406	359.6	467.8	559.0	667.2	847.6
2020	0.6007	0.7684	0.9053	1.0680	1.3475	365.4	473.3	564.7	676.2	855.6
2021	0.6101	0.7779	0.9151	1.0784	1.3651	369.7	480.1	572.1	681.4	865.9
2022	0.6155	0.7867	0.9287	1.0929	1.3805	374.9	484.9	578.1	688.6	871.9
2023	0.6251	0.7942	0.9395	1.1044	1.3945	378.2	490.0	583.7	695.1	872.7
2024	0.6309	0.8030	0.9478	1.1153	1.4057	379.3	493.2	587.9	697.6	884.5
2025	0.6355	0.8111	0.9564	1.1246	1.4161	386.6	498.7	591.0	704.9	892.5
2026	0.6427	0.8162	0.9626	1.1337	1.4265	390.4	503.7	596.4	710.6	899.3
2027	0.6465	0.8236	0.9705	1.1412	1.4362	395.7	506.3	600.9	713.6	905.9
2028	0.6492	0.8319	0.9784	1.1487	1.4436	397.3	511.0	603.5	717.9	910.4
2029	0.6520	0.8374	0.9863	1.1555	1.4526	399.5	515.2	606.5	719.1	913.9
2030	0.6580	0.8430	0.9912	1.1600	1.4539	405.2	518.2	612.6	721.1	917.4
2031	0.6611	0.8497	0.9969	1.1668	1.4563	407.4	519.5	616.2	724.8	919.0
2032	0.6623	0.8517	1.0038	1.1695	1.4672	408.5	523.2	619.2	728.6	923.0
2033	0.6642	0.8575	1.0106	1.1774	1.4786	412.5	524.0	623.9	729.7	924.2
2034	0.6677	0.8628	1.0160	1.1836	1.4866	414.4	527.9	626.2	731.7	930.9
2035	0.6713	0.8633	1.0212	1.1884	1.4936	418.9	530.3	627.8	735.7	933.4
2036	0.6764	0.8678	1.0251	1.1946	1.5046	418.0	534.6	629.9	738.6	929.7
2037	0.6769	0.8709	1.0254	1.1976	1.5119	418.8	537.0	631.8	741.4	932.3
2038	0.6795	0.8735	1.0268	1.2059	1.5185	423.4	538.0	633.7	741.3	933.4
2039	0.6830	0.8777	1.0311	1.2093	1.5207	427.0	537.9	636.7	744.4	938.1
2040	0.6837	0.8787	1.0345	1.2128	1.5291	427.3	540.8	637.3	746.2	940.1
2041	0.6889	0.8814	1.0354	1.2137	1.5308	428.4	542.1	639.1	749.6	938.5
2042	0.6897	0.8850	1.0373	1.2169	1.5314	426.8	545.2	641.1	750.9	936.8
2043	0.6946	0.8852	1.0421	1.2176	1.5489	428.0	546.0	641.9	752.2	939.2
2044	0.6937	0.8884	1.0430	1.2205	1.5433	431.1	548.7	642.2	753.0	943.0
2045	0.6963	0.8912	1.0447	1.2281	1.5479	433.0	548.3	644.0	754.0	939.3
2046	0.6988	0.8936	1.0461	1.2316	1.5457	434.0	547.5	644.2	753.6	943.6
2047	0.7009	0.8958	1.0461	1.2333	1.5447	434.3	548.9	646.9	754.4	948.0
2048	0.7016	0.8956	1.0505	1.2363	1.5374	435.1	549.2	646.5	758.4	946.1

2049	0.7011	0.8960	1.0509	1.2361	1.5399	438.4	548.6	647.0	756.3	942.6
2050	0.7065	0.8972	1.0535	1.2350	1.5387	438.4	549.8	648.9	759.4	944.1

(d) Projections based on the Bayesian estimates; Future recruitment = recruits / spawner

Year	Spawner output / $0.4B_0$					Annual catch (t)				
	5%	25%	50%	75%	95%	5%	25%	50%	75%	95%
2003	0.5053	0.6048	0.6939	0.7975	0.9618	377.0	377.0	377.0	377.0	377.0
2004	0.5167	0.6232	0.7146	0.8208	0.9960	135.8	170.4	201.9	239.8	306.7
2005	0.5188	0.6260	0.7195	0.8318	1.0053	137.2	171.6	205.8	246.0	313.8
2006	0.5191	0.6284	0.7262	0.8361	1.0121	134.1	172.6	208.2	249.8	324.9
2007	0.5246	0.6377	0.7386	0.8524	1.0276	134.1	174.3	210.1	251.1	332.4
2008	0.5280	0.6471	0.7546	0.8763	1.0799	133.0	173.5	211.3	253.4	332.4
2009	0.5290	0.6553	0.7672	0.8990	1.1256	135.3	176.9	213.6	258.9	340.8
2010	0.5331	0.6596	0.7755	0.9134	1.1485	137.6	179.7	217.8	264.3	349.2
2011	0.5332	0.6641	0.7848	0.9247	1.1706	137.9	181.1	219.7	268.8	355.1
2012	0.5358	0.6685	0.7941	0.9389	1.1920	137.9	182.5	221.8	271.1	358.5
2013	0.5408	0.6753	0.8008	0.9482	1.2195	139.6	184.0	223.9	274.1	362.3
2014	0.5406	0.6814	0.8100	0.9608	1.2410	140.4	185.5	226.2	275.1	366.4
2015	0.5405	0.6890	0.8187	0.9743	1.2625	141.9	186.8	228.5	278.9	372.2
2016	0.5435	0.6924	0.8290	0.9854	1.2860	142.9	188.5	230.8	282.9	378.3
2017	0.5454	0.6998	0.8379	0.9986	1.3064	144.4	191.2	233.7	287.2	383.2
2018	0.5498	0.7041	0.8451	1.0117	1.3268	146.1	193.1	235.5	291.1	387.9
2019	0.5517	0.7094	0.8556	1.0263	1.3507	146.1	193.9	238.1	294.1	396.1
2020	0.5543	0.7149	0.8674	1.0372	1.3770	147.3	195.5	241.6	298.7	400.9
2021	0.5577	0.7196	0.8746	1.0516	1.3995	149.3	198.2	243.6	301.8	408.9
2022	0.5567	0.7230	0.8850	1.0642	1.4263	149.7	199.5	245.9	305.9	415.4
2023	0.5599	0.7291	0.8944	1.0789	1.4516	150.8	201.3	248.5	309.9	422.0
2024	0.5654	0.7337	0.9046	1.0989	1.4842	150.8	203.4	251.0	313.9	430.4
2025	0.5658	0.7387	0.9154	1.1142	1.5144	151.1	204.8	253.0	317.7	432.6
2026	0.5656	0.7437	0.9221	1.1310	1.5450	151.9	206.0	257.0	321.7	439.9
2027	0.5669	0.7509	0.9350	1.1459	1.5774	153.0	207.8	260.3	324.7	447.3
2028	0.5718	0.7583	0.9431	1.1616	1.6028	154.9	209.5	263.0	329.8	453.2
2029	0.5720	0.7638	0.9554	1.1732	1.6250	155.9	211.7	265.7	335.0	462.8
2030	0.5728	0.7719	0.9667	1.1916	1.6521	156.6	213.6	268.4	338.6	471.6
2031	0.5734	0.7774	0.9765	1.2101	1.6764	157.0	216.6	271.1	343.2	482.0
2032	0.5742	0.7855	0.9874	1.2277	1.7097	158.0	217.9	273.9	347.9	489.8
2033	0.5749	0.7916	0.9985	1.2464	1.7333	158.7	218.7	276.6	352.7	497.5
2034	0.5788	0.7980	1.0086	1.2620	1.7703	161.6	220.5	280.6	357.6	506.6
2035	0.5819	0.8059	1.0206	1.2812	1.8123	161.2	223.9	283.8	361.9	513.7
2036	0.5841	0.8124	1.0314	1.2972	1.8414	162.5	225.7	286.1	366.2	518.6
2037	0.5864	0.8214	1.0388	1.3113	1.8778	162.9	227.7	288.2	370.1	529.0
2038	0.5903	0.8274	1.0516	1.3321	1.9031	164.1	229.5	292.4	374.2	537.9
2039	0.5916	0.8355	1.0666	1.3476	1.9311	166.1	232.3	295.6	379.2	546.6
2040	0.5892	0.8387	1.0777	1.3604	1.9577	167.0	234.2	298.8	383.4	559.3
2041	0.5910	0.8453	1.0895	1.3795	1.9909	168.3	236.6	302.3	387.5	570.3
2042	0.5950	0.8511	1.1029	1.4014	2.0280	170.6	238.6	304.9	392.2	580.3
2043	0.5986	0.8604	1.1160	1.4241	2.0786	170.8	240.3	309.1	397.8	582.9
2044	0.5989	0.8694	1.1273	1.4470	2.1096	170.2	242.6	312.6	403.9	593.2
2045	0.6042	0.8756	1.1402	1.4719	2.1440	171.7	243.8	315.9	411.7	607.5
2046	0.6026	0.8845	1.1513	1.4904	2.1953	173.6	246.3	319.5	417.6	613.1
2047	0.6036	0.8907	1.1642	1.5154	2.2389	174.5	248.6	323.2	424.6	624.4
2048	0.6094	0.8986	1.1772	1.5420	2.2827	175.3	251.2	326.9	430.6	632.9
2049	0.6118	0.9051	1.1899	1.5582	2.3110	176.0	253.1	329.4	436.1	645.5

2050	0.6174	0.9116	1.2018	1.5791	2.3467	176.8	255.1	333.3	441.1	651.5

Appendix 5 : Median annual catches (t) for the six rebuilding strategies.

(a) Projections based on the MPD estimates; Future recruitment = recruits

Year	Prob=0.5	Prob=0.6	Prob=0.7	Prob=0.8	40-10 rule	T_{mid}
2003	377	377	377	377	377	377
2004	478	431	376	319	449	352
2005	476	430	376	320	443	353
2006	471	426	373	319	433	351
2007	468	424	373	319	434	351
2008	467	424	373	320	441	351
2009	476	433	382	328	459	360
2010	492	448	396	341	491	373
2011	507	463	409	353	523	386
2012	520	475	421	363	553	397
2013	533	487	432	373	581	408
2014	542	496	441	381	604	416
2015	551	505	449	390	629	425
2016	558	512	456	396	647	431
2017	564	519	462	402	660	438
2018	572	526	469	407	679	444
2019	584	537	479	417	702	454
2020	591	544	486	424	718	461
2021	596	550	492	429	732	466
2022	606	558	499	436	751	474
2023	614	566	507	442	764	481
2024	620	572	513	448	776	487
2025	622	575	515	451	774	489
2026	625	578	520	455	779	494
2027	629	582	523	458	786	496
2028	634	586	527	462	785	501
2029	641	593	533	467	792	507
2030	643	596	536	470	792	510
2031	644	597	538	473	799	512
2032	646	599	539	474	793	513
2033	649	602	542	478	797	516
2034	654	606	547	481	808	520
2035	656	609	549	483	812	522
2036	661	614	554	487	815	527
2037	662	614	554	487	822	527
2038	667	619	559	492	824	532
2039	667	620	559	493	821	533
2040	670	622	562	496	821	536
2041	671	624	564	497	825	537
2042	672	624	565	499	827	538
2043	675	627	566	499	828	539
2044	678	630	570	503	836	543
2045	680	632	571	505	830	545
2046	679	632	571	505	822	545
2047	679	632	572	505	823	546
2048	676	630	570	504	825	544
2049	675	628	569	503	821	543
2050	678	630	571	506	818	545

(b) Projections based on the MPD estimates; Future recruitment = recruits / spawner

Year	Prob=0.5	Prob=0.6	Prob=0.7	Prob=0.8	40-10 rule	T_{mid}
2003	377	377	377	377	377	377
2004	256	226	197	157	449	179
2005	258	227	199	159	443	181
2006	258	227	199	160	433	182
2007	258	228	200	160	432	182
2008	257	228	200	161	434	182
2009	260	230	202	163	437	184
2010	263	234	206	166	439	188
2011	266	236	208	168	438	190
2012	267	237	209	169	439	191
2013	269	239	211	171	442	193
2014	272	242	213	173	446	196
2015	274	245	216	175	448	198
2016	277	247	218	177	449	200
2017	278	248	220	179	446	202
2018	281	251	222	181	449	204
2019	283	253	225	183	451	206
2020	286	256	227	185	451	209
2021	287	258	229	187	451	211
2022	290	261	232	190	456	213
2023	293	263	234	192	457	216
2024	296	267	238	195	462	219
2025	297	267	238	196	458	220
2026	300	270	242	199	461	223
2027	301	271	243	200	459	224
2028	303	274	245	202	458	226
2029	305	276	247	204	455	228
2030	308	279	250	207	458	231
2031	310	281	252	209	458	233
2032	312	283	254	211	456	235
2033	314	285	256	213	458	237
2034	316	287	258	215	456	240
2035	319	290	261	218	460	242
2036	322	294	265	221	464	246
2037	324	295	266	222	464	247
2038	326	297	268	224	458	249
2039	328	300	271	227	457	252
2040	331	303	274	230	459	255
2041	333	305	276	232	460	257
2042	337	309	280	235	462	261
2043	338	310	282	237	468	263
2044	342	314	285	241	469	266
2045	344	316	288	243	469	269
2046	348	320	292	247	466	272
2047	348	321	292	248	465	273
2048	351	324	295	250	463	276
2049	354	327	299	254	466	279
2050	357	330	301	256	468	282

(c) Projections based on the Bayesian estimates; Future recruitment = recruits

Year	Prob=0.5	Prob=0.6	Prob=0.7	Prob=0.8	40-10 rule	T_{mid}
2003	377	377	377	377	377	377
2004	664	555	444	318	592	505
2005	663	557	447	323	578	508
2006	655	553	447	325	564	506
2007	653	554	449	327	563	507
2008	649	553	450	330	570	507
2009	657	562	460	338	586	517
2010	673	577	474	350	617	532
2011	688	593	488	362	651	547
2012	702	605	500	372	683	559
2013	715	618	512	382	713	572
2014	723	627	521	390	733	580
2015	732	636	529	398	754	590
2016	740	644	537	404	771	598
2017	748	652	544	410	784	605
2018	754	660	553	417	792	614
2019	762	667	559	423	805	620
2020	767	673	565	428	821	626
2021	775	680	572	435	838	633
2022	780	686	578	440	844	639
2023	784	692	584	445	854	645
2024	788	695	588	450	857	649
2025	791	699	591	452	861	652
2026	796	703	596	457	864	657
2027	800	709	601	462	870	662
2028	802	711	604	464	875	664
2029	806	714	607	467	882	667
2030	811	720	613	471	889	674
2031	816	724	616	475	889	677
2032	819	728	619	478	890	681
2033	822	731	624	482	894	685
2034	822	732	626	484	891	687
2035	823	734	628	487	892	689
2036	826	737	630	488	897	691
2037	826	738	632	490	900	693
2038	831	740	634	492	901	694
2039	832	742	637	495	902	698
2040	833	743	637	496	901	698
2041	834	744	639	498	900	699
2042	836	747	641	500	904	702
2043	837	747	642	500	904	702
2044	837	749	642	501	907	703
2045	839	750	644	502	904	704
2046	841	751	644	504	905	704
2047	841	753	647	505	905	708
2048	841	753	646	506	900	708
2049	840	752	647	506	897	707
2050	839	753	649	508	899	709

(d) Projections based on the Bayesian estimates; Future recruitment = recruits / spawner

Year	Prob=0.5	Prob=0.6	Prob=0.7	Prob=0.8	40-10 rule	T_{mid}
2003	377	377	377	377	377	377
2004	358	281	202	112	592	265
2005	363	286	206	115	577	269
2006	364	288	208	117	563	271
2007	365	290	210	118	560	274
2008	365	290	211	119	560	274
2009	367	293	214	121	556	277
2010	372	297	218	124	559	281
2011	373	299	220	125	552	283
2012	375	302	222	127	550	285
2013	377	303	224	128	550	287
2014	379	306	226	130	548	290
2015	381	309	229	132	545	293
2016	383	310	231	133	547	295
2017	385	313	234	136	546	298
2018	387	315	236	137	544	299
2019	389	318	238	139	542	302
2020	392	322	242	141	540	306
2021	393	324	244	143	535	308
2022	394	325	246	145	532	310
2023	397	328	249	147	531	313
2024	400	331	251	149	532	315
2025	401	333	253	150	529	317
2026	404	337	257	153	531	321
2027	408	340	260	155	532	324
2028	410	343	263	157	534	328
2029	413	346	266	159	532	331
2030	415	349	268	161	531	333
2031	416	351	271	163	532	336
2032	419	354	274	166	528	339
2033	421	356	277	168	529	341
2034	424	360	281	171	529	345
2035	427	363	284	174	528	348
2036	430	366	286	175	527	351
2037	431	368	288	178	526	353
2038	434	372	292	180	529	357
2039	436	374	296	182	527	359
2040	439	378	299	185	521	364
2041	441	382	302	187	521	367
2042	443	383	305	190	518	369
2043	446	388	309	193	517	374
2044	449	391	313	196	522	377
2045	451	394	316	199	517	380
2046	454	397	319	202	517	383
2047	458	401	323	204	518	387
2048	460	405	327	207	517	391
2049	463	408	329	210	517	393
2050	464	410	333	212	518	396

PACIFIC OCEAN PERCH
STAR Panel Meeting Report

Northwest Fisheries Science Center
Seattle, Washington
14-18 April 2003

STAR Panel Members
Ray Conser, Southwest Fisheries Science Center, SSC, Reviewer
Jean-Jacques Maguire, Halieutikos Inc, Center for Independent Experts, Reviewer
Richard Methot, Northwest Fisheries Science Center, Chairman
Paul Spencer, Alaska Fisheries Science Center, Reviewer

PFMC Committee representatives
Rod Moore, West Coast Seafood Processors Association, GAP
Mark Saelens, Oregon Department of Fisheries & Wildlife, GMT

STAT Team Members Present
Owen Hamel, Northwest Fisheries Science Center
André Punt, University of Washington
Ian Stewart, University of Washington & Northwest Fisheries Science Center

Overview

The STAR panel (Panel) reviewed stock assessments of Pacific ocean perch (POP) and widow rockfish over the course of a 5-day meeting in Seattle, WA (14-18 April 2003) – see separate Panel report on the widow assessment. This POP assessment employs a model similar to that used in the previous stock assessment (June 2000), and incorporates updates to survey and fishery data. The assessment region covers the Columbia and Vancouver INPFC areas ranging from southern Oregon to the USA-Canada border. This area encompasses the most southern part of the range of POP. Linkages with POP in British Columbia (via movement of adults or larval transport) are assumed to be negligible in this assessment. The methods and results were presented clearly in the assessment document. The Panel commends the stock assessment team for their work, and on their cooperation in conducting additional analyses and revisions in response to this review.

Major sources of information include:

1. Landed catch, as recorded by comprehensive catch landing receipts and historical data from foreign and domestic fisheries.
2. Age and size composition of the landed catch.
3. Bottom trawl research surveys conducted triennially (1977-2001) in the 30-200 fathom depth range provide the primary, long-term index of POP abundance ("shelf survey"). Additional indices of abundance from (i) deep water (100-700 fa) trawl surveys conducted annually since the mid-1990's ("slope survey"); (ii) trawl surveys targeted on POP in 1979 and 1985; and (iii) a fishery logbook CPUE index covering early years of the target fishery (1956-73).
4. Age and size composition from the shelf and slope surveys.

The overall conclusion is that the stock is relatively stable at a low level of abundance with some slight increase in recent years. The current (2003) spawning stock biomass is near 25% of the unfished biomass (B_0) – the PFMC threshold for designating a stock as overfished – and well below the rebuilding target (40% of B_0). POP fisheries have a history of being sustained by large, but infrequently occurring year-classes. There appears to be no evidence of a strong year-class in recent years.

The assessment model explicitly estimates maximum sustainable yield (MSY) and the biomass that would produce MSY (B_{MSY}). The reliability of a predictive stock-recruit relationship is critical for good model-based estimates of these important management reference points. While MSY and B_{MSY} model-based estimates are informative and consistent with the assumptions and structure used in the model, the estimates can vary considerably in successive stock assessments. For operational management purposes, stability in MSY and B_{MSY} estimates is critical. To date, the PFMC has employed proxies for MSY-based reference points (rather than assessment model-based estimates) for all groundfish, including POP. For reasons of both stability and consistency, the Panel recommends that the proxies continue to be used for POP management.

List of Analyses Requested by the STAR Panel

The draft assessment report assumed age at 50% maturity was 10 years, but a more appropriate estimate is 8 years, as recommended by the 2000 STAR Panel. *At the request of the Panel, the maturity schedule was revised to reflect 50% maturity at age-eight for final model runs.*

A highly informative prior on M was used in the assessment document. Based on a sensitivity run made during the Panel meeting that indicated the prior was not influential, the Panel requested a run using a non-informative prior on M for the base case. *The STAT reported that after further consideration of the issue, the informative prior on M was preferable when estimating M in the model. This was acceptable to the Panel.*

For the base case run, the Panel requested the full list of all parameters estimated (including derived parameters), their MLE's, CV's, and indication when bounds are hit. Additionally, to provide median and mean of posterior for those parameters with MCMC results available; to provide the correlation matrix for final base case in electronic form. *Due to the volume of information, it proved impractical to provide these data during the meeting. However, these items should be provided in next draft of the assessment document.*

The Panel requested a series of runs designed to explore the effect of various model structures and assumptions employed in the draft POP assessment (see list below). *For the most part, the STAT carried out all of the requested model runs and summarized the results during the Panel meeting.*

(a) use uniform prior (in log-space) on survey catchability
(b) correct prior on steepness from Dorn's meta-analysis
(c) use uniform prior on steepness
(d) set serial correlation parameter on recruitment to zero (from 0.4)
(e) set standard deviation about spawner-recruit relationship to 1.0 (from 0.76)
(f) increase maximum age of fishery selectivity to 22 (from 14)
(g) use uniform prior on natural mortality
(h) use uniform prior (in log-space) for catchability of all surveys
(I) no recruitment bias correction for full time series
(j) no recruitment bias correction for equilibrium period
(k) correct q estimates for POP and slope surveys (were too small by factor of approx. 1.8)
(l) run new base case incorporating (b), (c), (d), (h), (j), and (k)
(m) run MCMC for new base case

Comments on Technical Merits:

(1) STOCK BOUNDARIES – The Panel noted that POP fishery and survey catches are continuously distributed across the USA-Canada boundary. The current assessment considers only the USA resource, and does not include Canadian data. The POP resource in Canadian waters is thought to be considerably larger than that in USA waters (at least 2 times larger, *cf.* Schnute et al., CSAS Res. Doc. 2001/138). The effects of movement of POP and their larvae into or out of the assessed USA area are unknown.

(2) STOCK-RECRUITMENT RELATIONSHIP – A Beverton-Holt stock-recruitment relationship (B-H SR) is an integral part of the stock assessment model. Its parameters are estimated as part of the suite of 250+ parameters in the model. It plays a key role in estimating recruitment in all years and particularly, in establishing the equilibrium age structure and recruitment for the early period (1935-56 and perhaps several years afterwards) – where catch-at-age data do not exist. It is central to the estimation of unfished biomass (B_0) in this assessment. If used in updating the POP rebuilding plan, it will be quite influential there as well. Other stock-recruitment relationships may be as appropriate for POP, e.g. the Ricker stock-recruitment relationship. Recognizing the possible effects of POP concentrations in Canadian waters on this assessment – see Item (1), above – and, in particular, the potential misunderstanding of the true spawner-recruit relationship derived from USA data alone, the Panel felt that further examination and sensitivity analysis of other SR relationships during the Panel meeting would not be productive. Further, the Panel cautions against use of the fitted BH S-R outside of the context of the stock assessment model. Rather, the fitted relationship should be considered a loose proxy for a suite of variables that contribute to the abundance of age 3 POP found in USA waters. Among other factors, these variables may include spawners in Canadian waters, environmental effects on survival of larvae and juveniles, etc. In particular, if recruitment in recent decades is low because of hydro-climatically unproductive conditions, the compensation implied by the fitted SR relationship may overestimate the rate of POP rebuilding if these conditions persist or underestimate if the future climate shifts to a more productive state for POP.

(3) CATCHABILITY OF THE SHELF SURVEY – The catchability (q) of the triennial shelf survey is an influential parameter in the POP assessment model. Largely because this survey represents the only long-term index of abundance for POP, its q is the key factor in estimating absolute biomass. In the previous assessment, difficulties were encountered in obtaining reasonable estimates of q. Through a reformulation of the selectivity function and consequent change in the definition of q, the estimation was much improved in this year's assessment. However, the estimated $q = 0.25$ is smaller than most other west coast rockfish (especially darkblotched) taken in the same survey. Further, POP surveys in the Gulf of Alaska and the Aleutian Islands – using similar design, gear, and analysis methods – have estimated a much larger catchability ($q \approx 1.5$).

(4) MCMC ANALYSIS – For many important management-related parameters, the maximum likelihood estimates (MLE) in the draft assessment document differed

appreciably from the median of the posterior and from the mean of the posterior – the latter two estimated via Markov Chain Monte Carlo (MCMC) analysis. The Panel explored these differences as a modelling diagnostic and through this discussion, an inconsistency in the MLE estimation was discovered during the meeting. After code modifications, subsequent runs showed much smaller differences than those in the draft document. A larger issue remains, however, in that some differences are expected even with technically sound models, and it is not clear which of these measures should be used as the point estimates required by the PFMC process. The MCMC approach is technically sound and better characterizes uncertainty than *ad hoc* approaches used in the past. The Panel endorses its use in deriving management-related state variables and the uncertainty associated with them. However, the use of MCMC in conjunction with MLE-based assessment models does cause some ambiguity. The PFMC will need advise – perhaps from the SSC – on whether to use the (i) MLE, (ii) median of the posterior, or (iii) mean of the posterior when point estimates are needed.

(5) INTERMEDIATE RESULTS AND DIAGNOSTICS - The Panel had difficulty providing critical peer review of the POP assessment model in the available time. The POP assessment model is more complex than other models used for PFMC assessments. The large number of parameters estimated (>250) coupled with a variety of priors, penalty functions, and constraints tax the ability of reviewers to fully understand the nuances of model behavior using only the traditional tables and figures provided in stock assessment documents. Further, the use of numerically intensive MCMC analysis for estimation of posterior distributions (used for quantifying uncertainty and central tendency) further exacerbates the problem. While the Panel encourages this type of "cutting edge" modelling, there is concomitant responsibility to provide a broader suite of intermediate results and model diagnostics in addition to those provided when less complex models are used for assessment. Because the volume of these data can be quite large, providing them in electronic form is more practical than via traditional hard copy, e.g. creating a data CD to accompany and to be referenced from the assessment document. Appendix A provides a partial list of intermediate results and diagnostics that should be provided. Assessment authors with experience using these more complex models are encouraged to augment the Appendix A list with diagnostics and other output data summarizations that they have found useful in understanding the behavior of their own models.

(6) TREATMENT OF BIAS IN RECRUITMENT ESTIMATES – During the Panel meeting, an inconsistency in recruitment estimates was noted for the equilibrium period (prior to 1956) for which no ageing information is available and the post-1956 years for which age composition samples have some influence – see Item (4), above. The "quick fix" for the problem during the Panel meeting was to (log) bias correct the expected value for the post-1956 estimates while using uncorrected estimates for the equilibrium period. Further research is needed to ensure that this is the best solution for the problem.

(7) HISTORICAL RECRUITMENT PATTERN – The model-based estimate of the long-term recruitment pattern, 1956-2003, may be problematic due to sparse and biased POP age composition samples. During the early period, 1956-65, no age samples were taken.

Ageing work carried out on fishery samples during 1966-80 was subsequently determined to be biased. No fishery age samples are available from the period 1981-98. Unbiased fishery age samples were taken during 1999-2002. Some age composition samples were taken on research surveys, 1985-2002, to augment the fishery samples. However, the surveys were generally carried out on a triennial basis with limited age samples taken.

Areas of Disagreement:

All potential areas of disagreement were resolved, and the Panel reached consensus for all conclusions.

Unresolved Problems and Major Uncertainties:

In general, the Panel concluded that the large variance in some parameter estimates (e.g. SSB in 2003) and moderate sensitivity to modeling assumptions (e.g., the difference between results from alternative model scenarios) are to be expected given the sparseness of fishery data and nonexistence of surveys in the early period; followed by both low fishery sampling intensity and low frequency of surveys in subsequent years.

Recommendations for Future Research:

1. The accuracy and precision of stock status evaluations would be increased if more resources were devoted to data collection. For example, the assessment would improve if the 1995 survey ages were processed. While data collection and sampling have improved within the past few years, it is critically important to maintain these levels into the future. More specifically, discard rates must be monitored, age composition of catch must be sampled, and the increased frequency of surveys must be maintained.

2. The feasibility of assessing the resource as a trans-boundary stock should be considered.

3. Develop model diagnostics and tools for analysis of voluminous model output to better understand model performance and to better convey results to reviewers and to user groups.

4. Explore the use of constant fishery selectivity, versus changes in selectivity indexed to known events such as mesh size changes, versus constrained time-varying fishery selectivity. Investigation and guidance on these two issues would be useful for all assessments that use similar models.

5. Research on POP maturity should be carried. There remains considerable uncertainty regarding the maturity ogive used in the current model.

6. If the spawner-recruit relationship is to be used in future modelling, an exploration of the

effects on recruitment of factors other than SSB in USA waters should be carried out. Among other factors, environmental changes and the potential contribution of spawners in Canadian waters should be explored.

7. Weighting of the various indices, including iterative re-weighting of the series and the weights of individual points within each series, should be investigated further. Extend inverse weighting to age and size compositions.

8. Sample sizes for age compositions should be specified and their effect explored.

9. The Soviet exploratory fishing data from 1953 to 1978 has some potential to be processed into an index of POP distribution and abundance. The geographic coverage was somewhat inconsistent between years and the information has not been quantitatively included in the assessment, but the data are consistent with a substantial decrease in stock biomass in late 1960s, as indexed by the domestic CPUE series. Analysis of these data may also provide better understanding of the POP stock structure at that time.

10. For future STAR Panel reviews, a local area network (LAN) should be set up in the meeting room. This will allow for better dissemination of the results of model runs made during the meeting, facilitate distribution and editing of the draft Panel report, and provide high-speed internet access for work carried out during the meeting.

APPENDIX A

Intermediate Results and Diagnostics Needed for Future STAR Panel Review of POP Stock Assessment Modelling Results

[1] Matrix of predicted catch numbers by age and year. Similar matrices for stock numbers and instantaneous fishing mortality rates. Observed catch numbers at age for years with age composition data.

[2] Table of parameters estimated, values at the global solution, CVs, flags identifying parameters that hit constraints or significant penalties.

[3] Details of the phased estimation of parameters. Trace of initial parameter values at the beginning of each phase plus values of parameters (estimated and fixed) and likelihood components at the end of each stage of estimation (including at the global solution).

[4] Correlation matrix for estimated and derived parameters. Correlation among selected parameter estimates should be examined carefully. Particularly those parameters directly related to management advice, e.g. recent-period estimates of recruitment, catchability, selectivity, spawning biomass, etc.

[5] Examination of the response surface at the global solution - especially with respect to changes in key management parameters. For example, convergence checks using different initial value vectors. Likelihood profiling on key management parameters can also be informative here.

[6] Residuals summarized and plotted by various types (including but not limited to size/age composition residuals).

[7] Influence of priors. Plot priors vs. their respective posterior, including implied priors for key management parameters.

[8] Compare and contrast results obtained from other assessment methods, e.g. by applying commonly used age-structured models to the predicted catch-at-age data from more complex models.

[9] Provide MCMC diagnostics:
- for key management parameters, plot of prior and posterior with the value of the MLE, mean of the posterior, and median of the posterior shown;
- autocorrelation at various lags.

Exhibit B.3
Attachment 4
June 2003

Status of the widow rockfish resource in 2003

Xi He, Stephen V. Ralston, Alec D. MacCall,
Donald E. Pearson, and Edward J. Dick

National Marine Fisheries Service
Southwest Fisheries Science Center
Santa Cruz Laboratory
110 Shaffer Road
Santa Cruz, CA 95060

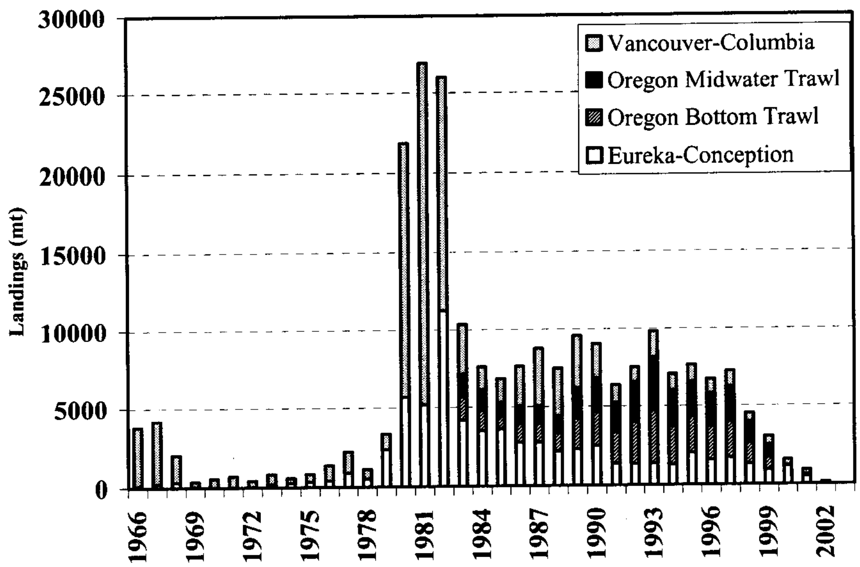
(Draft submitted to the June 2003 Council Meeting)

May 2003

Executive Summary

Stock: This assessment applies to widow rockfish (*Sebastes entomelas*) located in the territorial waters of the U.S., including the Vancouver, Columbia, Eureka, Monterey, and Conception areas designated by the International North Pacific Fishery Commission (INPFC). The stock is assumed to be a single mixed stock and subject to four major fisheries (see figure below).

Catches: The earliest records of foreign landings of widow rockfish were in 1966. U.S. catches of widow rockfish began in 1973 (117 mt), peaking in 1981 (26,938 mt, see figure below). Since the 1981 peak there has been a steady decline in the landings of widow rockfish to 1,794 in 2001 and to 263 mt in 2002 (2002 catch estimate may not be completed). Catches were mostly from commercial fisheries. Catches from recreational fisheries ranged from 3 mt in 2002 to 375 mt in 1982. The dominant gear type historically has been the midwater trawl. During the early 1990s, bottom trawl catches nearly matched the midwater trawl catches. Since the late 1990s, midwater trawl again became the dominant gear type.



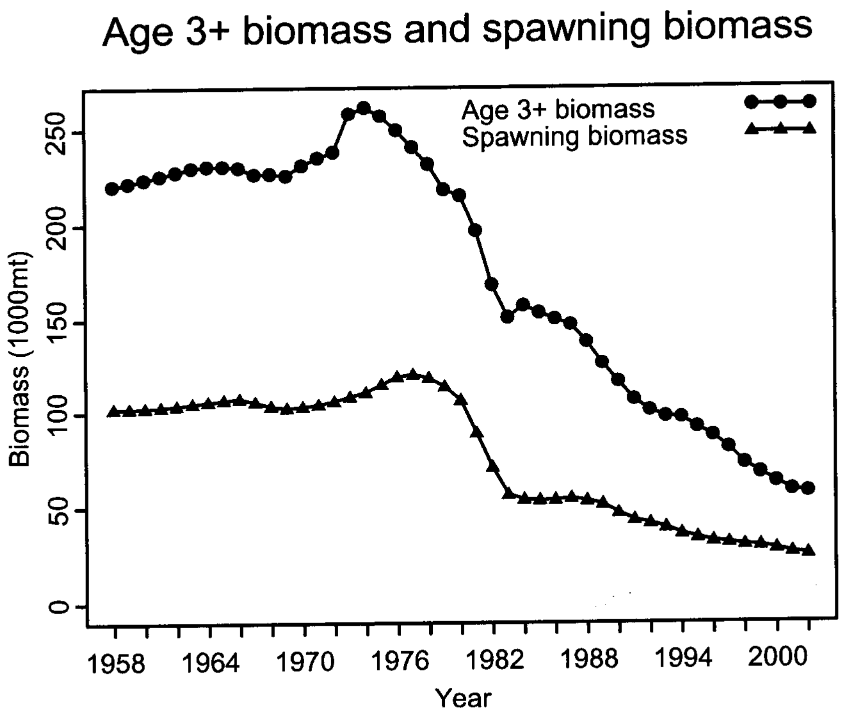
Data and assessment: The last assessment of widow rockfish was conducted in 2000 using an age-based population model. All fishery data, including landings, age composition, and logbook catch rates, were recently downloaded from the PacFIN, CALCOM, and NORPAC databases, or provided by state agencies. The data sets were then re-analyzed and compared to the data compiled in the previous assessments. Unlike the previous assessments which used a general linear model to derive annual indices of CPUE, this assessment used a Delta-GLM (generalized linear model) method to derive indices. Like the last assessment, an age-based population model was used in this assessment, and the model was programmed in AD Model Builder (ADMB) (Williams et al. 2002). However, the ADMB code was substantially modified to allow more flexibility in data inputs, fishing fleet modification, and the ability to produce data files for further rebuilding analysis. Likelihood functions were also modified to formats similar to those used in the stock synthesis program. In addition, the Markov Chain Monte Carlo (MCMC) simulation was enabled in the model, allowing approximation of the Bayesian posterior distributions for key parameters of interests.

Unresolved problems and major uncertainties:

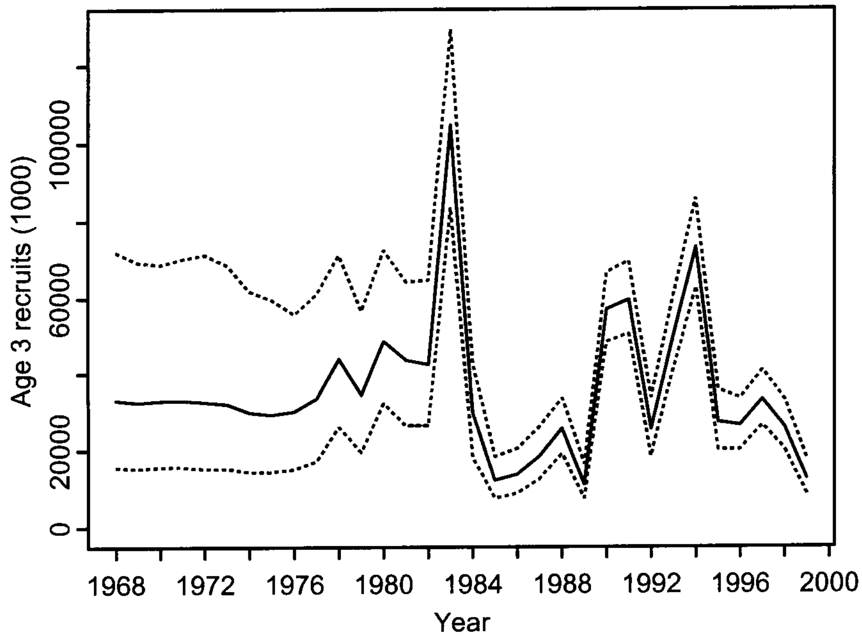
1. The primary source of information on trends in abundance of widow rockfish comes from the Oregon bottom trawl logbook data, which is a questionable source of information for widow rockfish. In addition, no information after 1999 in the Oregon bottom logbook trawl data can be used in the assessment because the catch rates were very low due to trip limits and other management regulations.
2. Natural mortality has been fixed at 0.15 based on previous assessments, but the validity of this estimate is uncertain.
3. The stock is arbitrarily defined from the USA-Canada border and south even though the species does exist in Canadian waters and a fishery developed since the mid-1980s. The current assessment assumes that the Canadian fishery has no influence on the resource in US waters. This assumption needs to be evaluated. If it is concluded that the catches in Canadian waters have no influence on the resource in US waters, the current approach can be continued. Otherwise, it may be necessary to do a joint assessment.
4. The 2002 juvenile index derived from the Santa Cruz laboratory midwater trawl survey is considerably higher than any other estimates since 1989. The index is derived from sampling in a relatively small geographical area compared to the expected distribution of the juveniles and the index is expected to be sensitive to changes in distribution and not only changes in juvenile abundance. If the 2002 year-class is as large as the index suggests, it could result in substantial stock increases. However, the relationship between the index and subsequent recruitment has been highly variable, and given the concerns about the reliability of the index, there remains considerable uncertainty about the size of the 2002 year-class.
5. The value of the power in the curvilinear relationship between the juvenile index and subsequent recruitment is a major source of uncertainty on current stock status and recent trends. This subject requires further research in order to identify reasons for the existence of such a curvilinear relationship and for reducing the range of possible values for the exponent.
6. Similar to other rockfish species in the area, the biomass of widow rockfish has decreased steadily since the early 1980s and recruitment during that period is estimated to have been considerably smaller than before the mid 1970s. The reason for the lower recruitment since the early 1980s could be due to lower spawning stock biomass, but it could also be due to a lower productivity regime. If recruitment is currently low because of hydro-climatically unproductive conditions, it may not be possible to rebuild to the target biomass until more productive conditions occur. If the conditions improve, rebuilding could be faster than expected.

Reference points: The percentage ratio of spawning output in 2002 to unfished spawning output (B_0) is the population status. A population status below 25% indicates an overfished stock, and the population statuses between 25% and 40% indicate a precautionary zone. A population status over 40% is a healthy stock.

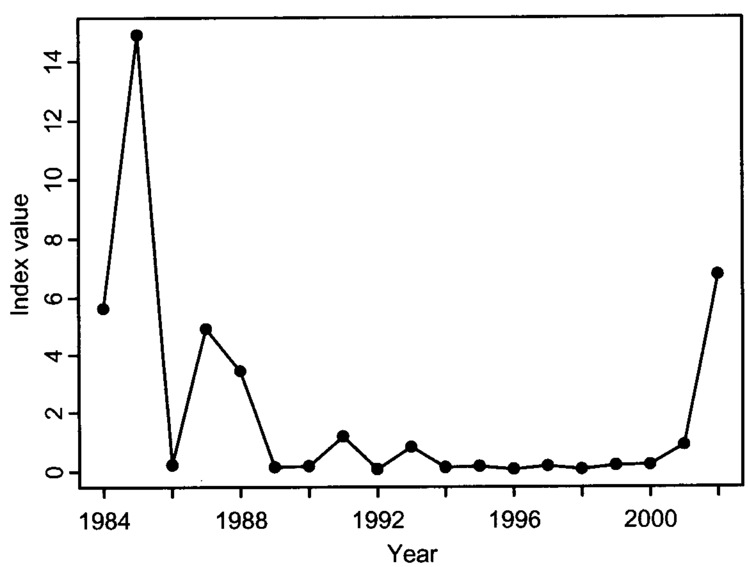
Stock biomass: Stock biomass has shown a steady decline since 1974, soon after the fisheries for widow rockfish began. Spawning biomass peaked in 1977 and has shown a steady decline since then.



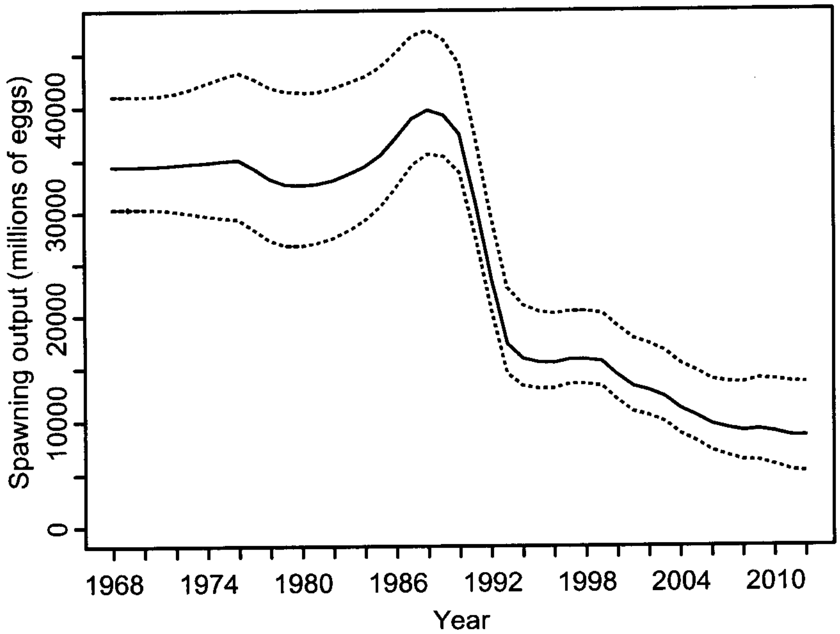
Recruitment: The model estimated time series of recruitment of age 3 fish from 1958 to 1999. It shows high variability in the early years of the time series, but in recent times has been less variable with a slight decreasing trend which seems to be following the decreasing trend in biomass.



The most recent midwater juvenile survey by the Santa Cruz Laboratory, however, showed a great increase of age 0 fish abundance in 2002. This datum point has no influence in the current stock assessment, but could have large impacts on the rebuilding analysis. To include the information on this year-class in the future projections, the sizes of the recruitments for 2003-05 (i.e. the 2000-02 year-classes) are pre-specified in the rebuilding analysis rather than being generated by the stock-recruitment relationship (see the rebuilding analysis by He et al (2003) for details).



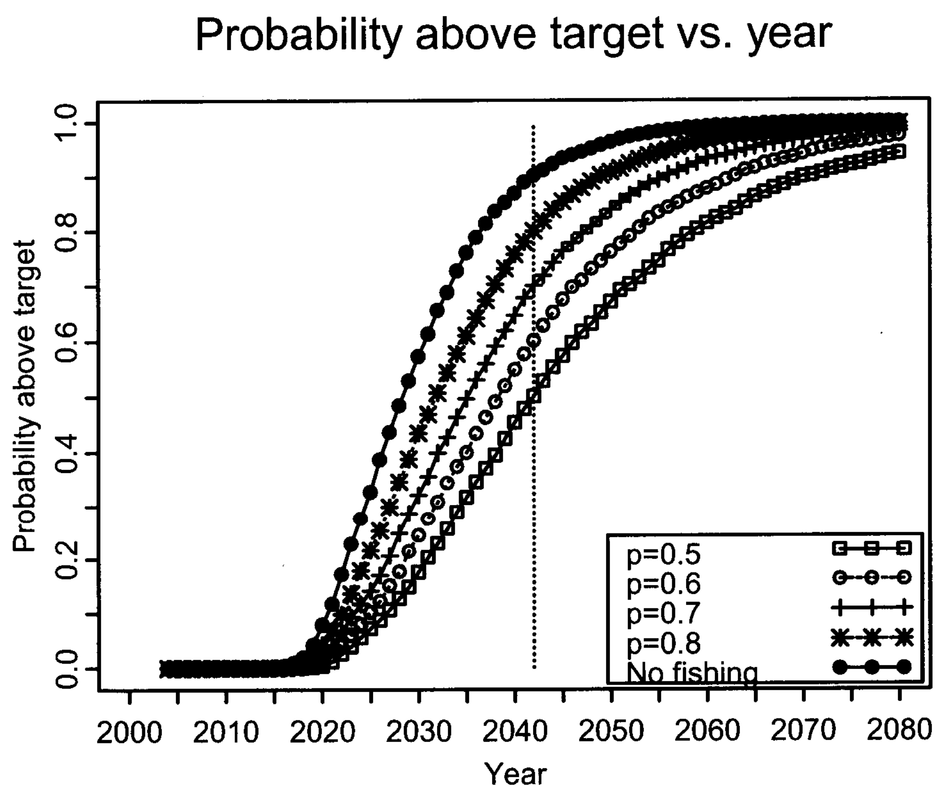
Exploitation status: The point estimate of the current spawning output (9,755), from the base-model run, is at 24.65% of the unfished level (39,567). The unfished spawning output (B_0) is defined as spawning output in 1958. The median estimate of the current spawning output over the unfished level, from a MCMC run, is at 24.82% with a 95% confidence interval of 15.68% and 35.55%, respectively.



Management Performance: See below.

Year	Harvest Guideline	Allowable Biological Catch	Landings	Catch
1989	12100	12400	12479	14856
1990	12400	8900	10113	12039
1991	7000	7000	6290	7488
1992	7000	7000	6036	7186
1993	7000	7000	8190	9750
1994	6500	6500	6366	7579
1995	6500	7700	6952	8276
1996	6500	7700	6478	7712
1997	6500	7700	6989	8320
1998	5090	5750	4090	4869
1999	5090	5750	4450	5298
2000	5090	5750	3809	4535
2001	2300	3727	1794	2136
2002	856	3727	263	313
2003	832	3871		

Forecasts: A forecast based on the base model from the stock assessment and one of rebuilding scenarios (Model 8) is presented below. The rebuilding scenarios were constructed from three factors: (1) whether the recruitments (age 3) for 2003-05 were pre-specified; (2) whether a stock-recruitment relationship or recruits-per-spawner ratios were used to generate future recruitment; and (3) a range of the power coefficient for the midwater juvenile survey index. Model 8 uses the power coefficient from the stock assessment base model, and has recruitments pre-specified for 2003-05 and future recruitment after 2005 generated using recruits-per-spawner ratios. The figure below shows time-series of the probability of the spawning output of widow rockfish exceeding the target ($0.4B_0$) for four rebuilding strategies and a scenario of no fishing. Legends of p=0.5, p=0.6, p=0.7, and p=0.8 correspond to probabilities that the population will be rebuilt by a pre-specified year ($T_{\max}$). The vertical line is T_{target} (=2042), which is the year when the population recovers to the target level at a probability of 50%. The figure indicates that the population will have very small probability (≤ 7.9%) of recovering to the target before 2020 even without fishing, but should recover to the target by 2042 with at least 50% of probability. As expected, the probability is the highest (=90.2%) with no fishing, and the probability is the lowest (=50%) for p=0.5. The Optimum Yields (OY) for 2004 corresponding to p=0.5, p=0.5, p=0.7, and p=0.8 are 354mt, 284mt, 212mt, and 123mt, respectively (see He et al (2003) rebuilding analysis for details).



Decision Table: This decision table (see below) is taken from a risk analysis of the rebuilding analysis (He et al. 2003). The risk analysis used four catch levels on three rebuilding models. These models use the outputs from the base model in the stock assessment but with assumptions about whether recruitment for 2003-5 should be pre-specified and how future recruitment should be generated. Model 5 has recruitments pre-specified for 2003-05 and future recruitment after 2005 generated using the stock recruitment relationship. Model 2 does not have recruitments pre-specified but future recruitment generated using recruits-per-spawner ratios. Model 8 has recruitments pre-specified for 2003-05 and future recruitment after 2005 generated using recruits-per-spawner ratios. The numbers in bold-italic typeface indicate the basis for the first three catch levels. Abbreviations are: OY = Optimum Yield; RP = recruitment is pre-specified; SR = the stock-recruitment relationship is used to generate future recruitment; and NA = not applicable. Symbols are: OY = Optimum Yield for 2004; F = fishing mortality; P_{max} = probability (%) to rebuild by T_{max}; T_{target} = year in which the probability of recovery is 0.5; and P_{100} = probability (%) of the spawning output being above the current spawning output in 100 years (year 2103).

Catch level (2004 OY (mt))		Model 5 (RP=N, SR=Y)	Model 2 (RP=N, SR=N)	Model 8 (RP=Y, SR=N)
35	OY	***35***	35	35
	F	***0.0012***	0.00115	0.00114
	P_{max}	***49.9***	80.4	87.8
	T_{target}	***2123***	2045	2028
	P_{100}	***91.2***	100.0	100.0
194	OY	195	***194***	194
	F	0.0064	***0.0064***	0.00634
	P_{max}	26.0	***60.1***	72.2
	T_{target}	NA	***2053***	2033
	P_{100}	75.4	***100.0***	100.0
284	OY	283	282	***284***
	F	0.0093	0.00925	***0.0093***
	P_{max}	14.9	46.7	***60.1***
	T_{target}	NA	2058	***2037***
	P_{100}	61.8	100.0	***100.0***
501	OY	502	499	501
	F	0.0165	0.0164	0.0165
	P_{max}	2.6	18.1	30.9
	T_{target}	NA	2081	2052
	P_{100}	27.1	99.6	100.0

Recommendations: Model 8 in the rebuilding analysis uses the base model from this assessment, uses pre-specified recruitments for 2003-05 based on the midwater juvenile survey index, and generates future recruitment by using recruits-per-spawner ratios. Recruits-per-spawner was used in the last assessment and in the last rebuilding analysis to generate future recruitment, and was also recommended by the 2003 STAR panel. Assuming the strong 2002 year-class will recruit to the fishery in 2005, and recruits-per-spawner ratios are proper ways of generating future recruitments, the recommended Optimum Yield (OY) for 2004 would be 284mt. Detailed descriptions on Model 8 and other rebuilding models are presented in He et al. (2003).

Sources of additional information: The California logbook index was examined in the 2000 assessment, and it was decided not to use the data because of concerns about different gear types going into the index calculations (Ralston 1999). Fishery data from Soviet Union vessels operating off the U.S. West Coast from 1970-78 were examined, but poor record keeping and low catches in some years limited the utility of this data. Both data sets were not used in this assessment. Data from the Alaska Fisheries Science Center's triennial bottom trawl survey were not used in this assessment to derive abundance indices for widow rockfish because the survey gear is not designed to catch widow rockfish and the previous assessment (Williams et al. 2000) showed no utility of the data series. However, the STAR Panel has recommended that the triennial trawl survey be analyzed further and be considered for inclusion in the future assessment.

Introduction

Widow rockfish (*Sebastes entomelas*) is an important commercial groundfish species belonging to the scorpionfish family (Scorpaenidae). It ranges from southeastern Alaska to northern Baja California, where it frequents rocky banks at depths of 25-370m (Eschemeyer et al. 1983, Wilkins 1986). In those habitats it feeds on small pelagic crustaceans and fishes, including especially *Sergentes similis*, myctophids, and euphausiids (Adams 1987). There is no evidence that separate genetic stocks of widow rockfish occur along the Pacific coast and the species has been treated as one stock with four separate fisheries (Hightower and Lenarz 1990; Rogers and Lenarz 1993; Ralston and Pearson 1997, Williams et al. 2002).

A midwater trawl fishery for widow rockfish developed rapidly in the late 1970's and increased rapidly in 1980-82 (Gunderson 1984, Fig. 1 and Table 1). Large concentrations of widow rockfish had evidently gone undetected because aggregations of this species form at night and disperse at dawn, an atypical pattern for rockfish. Since the fishery first developed, substantial landings of widow rockfish have been made in all three west coast states.

Management of the fishery began in 1982 when 75,000 lbs trip limits were introduced in an effort to curb the rapid expansion of the fishery (Tables 2-3). These were reduced to 30,000 lbs in 1983 and the fishery was managed by alteration of trip limits within the fishing season. A 10,500 mt/yr Allowable Biological Catch (ABC) for widow rockfish was instituted in 1983 (Table 3), but no harvest guideline was established. This form of management continued with alterations in ABC and trip limits until 1989 when a 12,100 mt/yr harvest guideline was implemented (Tables 2-3). From 1994-1997 the harvest guideline was changed to 6,500 mt and then reduced to 5090 mt/yr for 1998 to 2000. Based on the 2000 stock assessment and the rebuilding analysis of 2001, the harvest guidelines were further reduced to 2,300 mt for 2001, 856 mt for 2002 and then to 832 mt for 2003.

This assessment used an age-based population model similar to those used in previous assessments (Ralston and Pearson 1997, Williams et al. 2000). All data were recently downloaded from the PacFIN, CALCOM, and NORPAC databases, or provided by state agencies. The data sets were then re-analyzed and compared to the data compiled in the previous assessments. Unlike the previous assessments which used general linear model to derive annual indices of CPUE, this assessment used a Delta-GLM (generalized linear model) approach to derive indices. Like the last assessment, an age-based population model was used in this assessment, and the model was programmed in AD Model Builder (ADMB) (Williams et al. 2002). However, the ADMB code was substantially modified to allow more flexibility in data inputs, fishing fleet modification, and the ability to produce data files for further rebuilding analysis. Likelihood functions were also modified to formats similar to those used the stock synthesis program. In addition, the Markov Chain Monte Carlo (MCMC) simulation was enabled in the model, allowing approximation of the Bayesian posterior distributions for key parameters of interests.

Data

Biological information

Growth in length for widow rockfish has been described using von Bertalanffy growth equations in two papers by Lenarz (1987) and Pearson and Hightower (1991). In their analyses it was determined that females attain a larger size compared to males and fish from the northern part of the range tend to be larger at age compared to those in the south. For these reasons we chose to use the sex specific and area specific estimates for length-at-age. Furthermore, we chose to use the estimates listed in Pearson and Hightower (1991), shown below and in Figure 2, because they are from a more recent and comprehensive analysis of widow rockfish growth compared to the analysis by Lenarz (1987). In order to match the fisheries, we used the Columbia-Eureka INPFC area border (43° Lat.) to delineate north from south.

Parameter	Females (north)	Males (north)	Females (south)	Males (south)
L_{inf} (cm)	50.54	44.0	47.55	41.5
K	0.14	0.18	0.2	0.25
t_0	-2.68	-2.81	-0.17	-0.28

Sex specific weight-at-age estimates were computed using the length-at-age estimates above with sex specific length-weight regressions for widow rockfish developed by Barss and Echeverria (1987) (Figure 2). The length-weight regression equation is $W = \alpha L^{\beta}$, where W is the weight (g) and L is the length (cm). The sex specific parameter values used in this assessment are listed below:

Parameter	Females	Males
α	0.00545	0.01188
β	3.28781	3.06631

Estimates of maturity and fecundity of female widow rockfish were obtained from Barss and Echeverria (1987) and Boehlert et al. (1982), respectively. Age specific maturity estimates were taken directly from the literature instead of fitting a parametric model (Figure 3), while age specific fecundity was computed using the weight-fecundity regression:

$$F = 605.71^{W} - 261830.7 \qquad (1)$$

where F is fecundity (# eggs) and W is weight (g). The weight-fecundity regression applied to the southern weight-at-age estimates resulted in negative values for ages 3 and 4. The weight-fecundity regression developed by Boehlert et al. (1982) was based on fish captured from Oregon and apparently does not apply to widow rockfish in the south. The maturity estimates shown in Figure 3 indicate a substantial difference in maturity-at-age between the north and south, with the northern fish maturing at an older age. Lacking any other estimate of fecundity for the south, we applied the weight-fecundity regression from the north and modified the estimates for ages 3-5 to approximate an asymptote to 0 (Figure 3).

Landings

All landings for the period 1966-2002 were summarized into four areas (fisheries): (1) Vancouver-Columbia (VC); (2) Oregon mid-water trawl (ORMWT); (3) Oregon bottom trawl (ORBTWL); and (4) Eureka, Monterey, and Conception (EMC). Landings statistics used in this assessment were derived from four sources. First, all commercial landings from 1980 were extracted from the PacFIN database. Second, the very small annual recreational take of widow rockfish was extracted from the Marine Recreational Fishing Statistics Survey (MRFSS) database. Third, all landings from 1966 to 1972, and some landings from 1973 to 1976 were directly taken from a summary table in Rogers (2003), who recently compiled summaries of foreign catches in the period. Fourth, some landing from 1973 to 1976 and all landings from 1977 to 1979 were directly copied from the last assessment (Williams et al. 2000). Summarized landings by year are presented in Table 1 and Figure 1.

As in the last assessments of widow rockfish, the data were pooled over states into INPFC area blocks. These in turn were collapsed into northern and southern areas, representing the U.S. Vancouver and Columbia areas (VC, ORMWT, and ORBTWL) and the Eureka, Monterey, and Conception areas (EMC), respectively. The northern and southern areas are conveniently delineated by the 43° latitude line. Within the southern area, widow rockfish landings were further condensed by summing over gears (i.e., trawl, other commercial, and recreational), providing annual estimates of landings from the southern area fishery. In the northern area, however, landings were partitioned into three separate fisheries; the Oregon midwater trawl fishery, the Oregon bottom trawl fishery, and the remaining catch of widow rockfish, referred to as the Vancouver-Columbia fishery. Because identification of gear types in Oregon (midwater or bottom trawl) did not begin until 1983, all landings in the northern area prior to that time were assigned to the Vancouver-Columbia "trawl" fishery.

It should be noted that there are some small discrepancies in the landing statistics between those recently extracted from the PacFIN data and those used in the last assessment. Overall, these discrepancies are very small and insignificant, except for the Eureka, Monterey, and Conception area in 1981 and 1983, the new estimates were 1199mt (19%) and 2266mt (35%) less than those in the old estimates, respectively. These discrepancies were probably due to new expansion methods used to compile landing statistics.

Age composition data

Widow rockfish otolith samples collected coastwide since 1989 have been aged at the Santa Cruz (Tiburon) Laboratory using the break and burn aging method (Pearson and Hightower 1991). Prior to 1989, the ages of all Vancouver-Columbia fish were obtained by researchers in the State of Washington, who used surface readings. Prior to 1987, Oregon widow rockfish were aged by investigators in Oregon, who used the break and burn aging method. All California fish were aged by Santa Cruz Laboratory personnel using the break and burn aging technique.

Age validation of widow rockfish was conducted by marginal increment analysis (Lenarz 1987). Hyaline-zone formation, the measure of annual growth, appears to occur between December and April (Pearson 1996). For convenience all widow rockfish are assumed to be born on January 1. Variation in the timing of the hyaline-zone formation occurs between fish from Washington and California, which could affect age determination. Knowledge of the timing variation can be used to avoid mis-ageing and ultimately the variation in hyaline-zone formation is not likely to result in major age discrepancies (Pearson 1996).

Washington provided ageing data from samples collected during commercial market sampling. The data were then expanded using relative catches from US Vancouver and Columbia areas. Oregon provided raw sample data which were expanded using methods described in Sampson and Crone (1997). California age data was extracted and expanded from the CALCOM database (Pearson and Erwin 1997). Summaries of the numbers of fish aged and the number of trips sampled by year were also obtained. The sex specific age composition data and sample size information for the four fisheries is presented in Tables 4-8 and Figures 4-7. As recommended by the STAR Panel, comparisons of age composition data between the previous assessment (Williams et al. 2000) and this assessment are also presented (Figures 8-11).

Midwater trawl pelagic juvenile survey

Every year since 1983 the Groundfish Analysis Branch at the Southwest Fisheries Science Center's Santa Cruz/Tiburon Laboratory has conducted a midwater trawl survey, which is designed to assess the reproductive success of a group of rockfishes, including widow rockfish. The survey is conducted during May-June, the time of year when the pelagic juvenile stage is most susceptible to capture. Studies have shown that abundance statistics summarized from the survey gauge impending recruitment (Adams 1995; Ralston and Howard 1995; Ralston et al. 1996).

The survey index is calculated after the raw catch data are adjusted to a common age of 100-day to account for interannual differences in age structure. The abundance data are gathered during three consecutive sweeps of a series of 36 fixed stations that are arrayed over 7 spatial strata that extend from Carmel (36°30'N) to Bodega (38°20'N). The final index is calculated using Delta-GLM (Generalized Linear Model) method with lognormal error structure (Pennington 1986, 1996, Stefansson 1996):

$$\log(density) = \mu + Y_i + L_k + \varepsilon_{ijkl} \qquad (2)$$

where u is the average $\log(density)$, Y_i is a year effect, L_k is a spatial effect, and ε_{ijkl} is a normal error tern with mean zero and variance σ_ε^2. The back-transformed year-specific index, with bias-correction, was then calculated as:

$$Index_i = \exp\left(\mu + Y_i + \bar{L} + \frac{\sigma_\varepsilon^2}{2}\right)\pi_i \qquad (3)$$

where $\bar{L}$ is mean effect of spatial unit, and π_i is binomial coefficient (proportion of positive CPUE in year i):

$$\pi_i = \frac{\exp(\mu' + y_i' + \bar{L})}{1 + \exp(\mu' + y_i' + \bar{L})} \qquad (4)$$

where μ' is the average, y' is year effect, and $\bar{L}$ is average spatial effect. Coefficient of variance (CV) for each index value was computed from the jack-knife method.

Data from 1983 were deleted from the analysis because of small number of datum points. Because no juvenile widow rockfish were caught in 1992, 1994, and 1996, index values for those years were set to one half of the historical low value, and CVs for those years were set to a high value of 2.0. The resulting indices were entered into the model as relative indices of one year juvenile abundance (Table 9 and Figure 12). The index time series (1984-2002) was then shifted forward three years (1986-2005) to represent the abundance of age-3 widow rockfish, the age of recruitment in the assessment model.

Oregon bottom trawl logbook

Oregon logbook data from 1984 to 1986 were provided by the Oregon Department of Fish and Wildlife, and data from 1987 to 2002 were extracted from the PacFIN database. Catch per unit effort (CPUE) was computed as pounds of fish caught per hour trawled. The data were filtered before the analysis. Only records meeting the following criteria were used in the analysis: (1) the fishing gear code corresponded to bottom trawl or roller gear, (2) hauls were conducted during the months of January, February, or March, and (3) the location of the reported haul fell in the range of 42°30'N to 46°30'N latitude and 124°36'W to 124°54'W longitude. In addition, records associated with any vessel code or spatial unit that had less than 1000 pounds of widow catch over the entire period (1984 to 2002) were also deleted. Data from 2000 to 2002 were not used in the analysis because widow catches in those three years were very low due to trip limits and other management regulations (Tables 2 and 3).

Annual CPUE indices were derived using Delta-GLM (Generalized Linear Model) method similar to that used for deriving midwater trawl pelagic juvenile survey (see previous section), with an additional factor (vessel) included:

$$\log(CPUE) = \mu + Y_i + V_j + L_k + \varepsilon_{ijkl} \qquad (5)$$

where u is the average $\log(CPUE)$, Y_i is a year effect, V_j is a vessel effect, L_k is a spatial (latitude and longitude) effect, and ε_{ijkl} is a normal error tern with mean zero and variance σ_ε^2. The back-transformed year-specific CPUE, with bias-correction, was then calculated as:

$$CPUE_i = \exp\left(\mu + Y_i + \bar{V} + \bar{L} + \frac{\sigma_\varepsilon^2}{2}\right)\pi_i \qquad (6)$$

where $\bar{V}$ and $\bar{L}$ are mean effects of vessel and spatial unit, respectively, and π_i is binomial cofficient:

$$\pi_i = \frac{\exp(\mu' + y_i' + \bar{V}' + \bar{L}')}{1 + \exp(\mu' + y_i' + \bar{V}' + \bar{L}')} \qquad (7)$$

where μ' is the average, y' is year effect, $\bar{V}'$ is average vessel effect, and $\bar{L}$ is average spatial effect. Derived annual CPUE indices are presented in Table 10 and Figure 13.

Pacific whiting bycatch indices

As in the previous assessments (Rogers and Lenarz 1993, Ralston and Pearson 1997, Williams et al. 2002), CPUE indices were computed that measured the incidental catch rate of widow rockfish in the at-sea pacific whiting fishery. Data from the foreign fishery, joint-venture fishery and recent domestic fishery were extracted from the whiting observer databases and were extracted from the NORPAC database.

Full descriptions on how the CPUE indices were derived are in Appendix A. Similar Delta-GLM approaches as used for the Oregon bottom trawl logbook were used in the analysis. Annual CPUE indices for the foreign fishery, joint-venture fishery, and domestic fisheries are presented in Table 11 and Figure 14. As recommended by the STAR Panel, annual CPUE indices from the domestic fishery after 1999 were excluded from the analysis because changes in management measures are expected to have more influence on the CPUE than changes in stock size.

History of modeling approaches

Previous assessments for widow rockfish have been performed in 1989, 1990, 1993, 1997, and 2000 (Hightower and Lenarz 1989, 1990; Rogers and Lenarz 1993; Ralston and Pearson 1997, Williams et al 2000). In 1989 the assessment involved the use of cohort analysis and the stock synthesis program (Methot 1998). In 1993 and 1997, the age-based version of the stock synthesis program was used to assess the status of widow rockfish. In 2000, the assessment of widow rockfish utilized AD Model Builder (ADMB) software (Otter Research, Ltd. 2001), and applied an age-based analysis of the population with methods very similar to those used in the stock synthesis program. The differences between the ADMB model and stock synthesis are minor. The ADMB model estimates landings with a very low coefficient of variation (0.05), while stock synthesis treats landings in a slightly different manner and the initial age composition estimation process is slightly different in the two models. A full description of the ADMB model follows and should clarify any further differences between this model and the stock synthesis program used in past assessments of widow rockfish.

This assessment used the same modeling approach as in 2002. The ADMB code however was substantially modified to allow more flexibility in data inputs, fishing fleet modification, and outputs of data for further rebuilding analysis. Likelihood functions were also modified to formats similar to those used the stock synthesis program. In addition, the Markov Chain Monte Carlo (MCMC) simulation was enabled in the model, allowing approximation of the Bayesian posterior distributions for key parameters of interests.

Model description

General

This assessment uses an age-structured population model similar to the one used in the stock synthesis program (Methot 1998). Full descriptions of the population dynamics, catch equations, and associated likelihood functions are given in Appendix B. The model is written in a C++ software language extension, AD Model Builder (ADMB) (Otter Research, Ltd. 2001), which utilizes automatic differentiation programming (Greiwank and Corliss 1991; Fournier 1996). The ADMB software allows for more rapid and accurate computation of derivative calculations used in the quasi-Newton optimization routine (Chong and Zak 1996). Further advantages of this software include the ability to estimate the variance-covariance matrix for all dependent and independent parameters of interest, likelihood profiling, and a Markov chain-Monte Carlo re-sampling algorithm for probability distribution determination. The ADMB model code and data files are listed in Appendix C and D, respectively.

The population model begins in 1958 and tracks numbers and catches of male and female widow rockfish in age classes 3-20 (age 20 is an age plus group). In the 2000 assessment, a starting year of 1968 was chosen based on the assumption that the 1965 year class was the earliest recruitment which could be reasonably estimated given a starting year of 1980 for the age composition information. In this assessment, the starting year was extended backward to 1958 because the new landing data from 1966 to 1972 were added. Recruitment estimates prior to 1958 are assumed equal to the 1958 estimate in the model, so that the model is estimating recruitment at age 3 for the years 1958-1999.

The data used in this model include 4 fishery catch-at-age compositions (sum across sexes equal to one), landings in weight for each fishery, NMFS Santa Cruz Laboratory midwater juvenile survey index, Oregon bottom trawl logbook CPUE, and three whiting bycatch indices.

Fishing mortality in each year is scaled to the fishery landings assuming a coefficient of variation of 5%. Double logistic selectivity functions by age were estimated for each fishery.

Natural mortality

Natural mortality (M) is assumed to be constant for all ages and in all years. The initial model allowed the model to estimate a slightly higher natural mortality for males than females based on the observation that there were more old females than males in the age data. The model was presented to the STAR Panel. It was noted that greater proportions of males at younger ages could be due to differences in selectivity by gender. Allowing for different natural mortality had little impact on model results and the differences in M were small (<0.01). The STAR Panel considered that until the reason for the difference in age composition has been elucidated, the same natural mortality value should be used for both sexes. Therefore, natural mortality has been fixed at 0.15.

Age compositions

The age data are modeled as multinomial random variables, with the year-specific sample sizes set equal to the number of samples collected, rather than the number of fish, which often overstates the confidence of the data (Table 8) (Quinn and Deriso 1999).

Ageing error

The only information available for determination of ageing error was based on two point estimates of percent ageing agreement from the last two assessments (Rogers and Lenarz 1993; Ralston and Pearson 1997). From the previous assessments an estimate of 75% agreement for age 5 fish and 66% agreement for age 20 fish was modeled by assuming a linear relationship of percent agreement with age. These estimates of percent agreement at age were then fit to a set of age-specific normal distributions, which approximated the level of ageing agreement. The resulting matrix of true age versus reader age was then placed in the model

$$A_t = EA_r \qquad (8)$$

where A_t and A_r are n*n matrices for true age and reader age, respectively, n is number of age classes, and E is a n*n matrix for ageing error with the sum across each column equals to one.

Landings

A constant CV of 0.05 is assumed for landing estimates. Year-specific fishing mortalities are computed for each fishery for those years in which there are landings estimates available. Fishing mortalities were zero from 1958 to 1965 since there are no landings estimates for those years.

Fraction of landings in the north

Since there are area specific (north and south) estimates for weight-at-age and maturity, it is necessary to determine the fraction of the population to which each of these area-specific estimates apply. We used the sum of the domestic landings in the Vancouver-Columbia and both

Oregon trawl fisheries relative to the total landings as an estimate of the proportion of the population to which the northern weight-at-age and maturity functions could be applied. Foreign landings from 1966 to 1976 from Rogers (2003) were not used in computing the fractions. The annual change in this fraction seemed highly variable and not likely to be indicative of true declines in area abundances. For this reason, the time series of proportions of landings in the north were smoothed using a 7-year moving average (Figure 15). The results from the moving average were then put directly into the model, applying the 1973 value to the earlier years.

Discards

The level of discards of widow rockfish is virtually unknown in most of years. Age compositions in discards and landings can be very different (typically small fish being discarded) and can be important in determining discard rates (Williams et al. 1999). In past assessments a value of 6% of total weight was assumed for years 1973-1982 and 16% of total weight for the years 1983-1999 (Hightower and Lenarz 1990). In this assessment, a value of 6% was also applied for years 1966 to 1972. The 16% estimate of discards is based on a dated study by Pikitch et al. (1988), which indicated most of the discards of widow rockfish were induced by regulations. The earlier 6% estimated is based on an ad hoc adjustment of the 16% by previous assessment authors (Hightower and Lenarz 1990). The 16% assumed value has likely become more uncertain in recent years due changes in regulations. For example, the most recent estimate on discard rate from the 2002 observer data, based on 89mt of widow rockfish catch, was 0.1%, which is much lower than the 16% assumed value.

Midwater juvenile trawl survey

The Santa Cruz Laboratory midwater trawl juvenile survey is scaled to represent an index of 100 day-old larvae. For inclusion in the model the time series was lagged to correspond with the appropriate year class. Within the model a catchability coefficient is estimated and a power coefficient is fixed for the midwater trawl survey. The power transformation is included to account for possible density dependent mortality occurring between 100 days of age and age 3 (the age of recruitment in the model), which likely results in higher variance levels in the survey time series relative to age 3 recruitment time series.

Logbook and bycatch indices

The Oregon bottom trawl logbook indices and whiting bycatch indices are treated as biomass indices and are estimated in the model with a catchability parameter for each index. The model has been equipped for the possibility of a power transformation of the indices, but in this case all the time series will be treated with a power of 1.0.

Likelihood component weighting

There are eight likelihood components in the model (Appendix B): age-composition data, landings, recruitment residuals, midwater juvenile trawl survey index and four CPUE indices. Weighting in this assessment model has two levels (Appendix B). First, contribution of each datum point to its likelihood component is weighted by a fixed CV associated with the datum point. Details on how a fixed CV is determined for each component are discussed later. Second, a weighting factor (λ) is assumed for each likelihood component and the final likelihood value for each component is multiplied by its weighting factor (Appendix B). In this assessment model, all weighting factor (λ) have been set to 1, except for the recruitment residual component and the midwater juvenile survey index component, whose weighting factors are set to be 0.5.

Model selection and evaluation

Initial model runs were performed with all auxiliary data included. The relative importance of each data set was examined through an ordinary cross-validation analysis technique, whereby auxiliary components are de-emphasized one at a time and the results compared to each other. This technique allows determination of the contribution of each data source to the overall model fit, as well as to other components in the model. Table 12 shows the results of the cross-validation analysis. It appears that three whiting bycatch indices are less informative than other data sets.

A previous assessment (Williams et al. 2000) evaluated the utility of the midwater juvenile survey index by examining the recruitment estimates from the model run with the midwater trawl likelihood component de-emphasized. It used a power transformation to match the CV of the index to the CV of the recruitment estimates from the model for the time period of overlap. The results indicated a significant correlation ($P < 0.05$) between the recruitment estimates from the model with the midwater trawl component de-emphasized and the power transformed index values (Figure 13 in Williams et al. 2000). It concluded that the midwater juvenile survey was a useful time series of recruitment indicator to be included in the model (see also Ralston et al. 1998, MacCall et al. 1999, and Done et al. 1999). The initial runs of this assessment also allowed the model to estimate the power coefficient (estimated values were about 10). The STAR review suggested the power coefficient to be fixed at 3.0 so that the magnitude of the variability in the survey index would roughly equal to the variability in the recruitment.

A previous assessment (Williams et al. 2000) also evaluated different selectivity functions in relations to the model fits to the data and results. The selectivity functions evaluated included single logistic, double logistic and lognormal functions. Year-specific (time varying) and sex-specific selectivity functions were also evaluated. The evaluation showed the most suitable selectivity function to be combined sex, double logistic selectivity functions with time varying ascending inflection points for the north (Vancouver-Columbia and Oregon trawl fisheries) and south (Eureka-Conception fishery) fisheries. Initially, the same selectivity configuration was used in this assessment. The STAR review later recommended that a non-time-varying selectivity be used. Thus, one selectivity function was used in this assessment.

Initial models used CVs estimated from the data in the likelihood functions. During the STAR Panel review, a constant CV (=0.5) was applied to all CPUE indices. The corresponding root mean square errors (RMSE) were then applied to likelihood functions of all CPUE indices. A CV of 0.5 was also applied to the likelihood function for the recruitment residuals ($\sigma_R = 0.5$).

The base model was tested repeatedly for its parameter estimation, properties of Hessian matrix, and convergence status. The final parameter estimation had a convergence criteria of 10^{-8}, and positive definite Hessian and Cheloski matrices, which are required for successful Markov Chain Monte Carlo (MCMC) simulations. The convergence properties of the model were also tested by running the model 500 times, in which initial values of each parameter were randomly perturbed by 50% of the best fitted value in the base model. Frequency distributions of negative log-likelihood values and the corresponding 2002 status of the population were plotted in Figure 16. Out of 500 runs, 488 of them resulted in proper fits. Although there were some local minima (Fig. 16) in parameter space, 95.9% (473 runs out of 488) of runs converged in the same results as the base model.

Base run results

Results of the base model run are presented in Tables 13-16 and Figures 17-30. Parameter estimates and quadratic-normal approximation standard deviations are shown in Table 13. The resulting time series of total biomass, spawning biomass, spawning output, recruitment, and fishing mortality are presented in Table 14 and Figures 17-20. The fishery-specific selectivity curves are shown in Figure 21. The stock-recruitment relationship is shown in Figure 22. The fits to the landings are shown in Figures 23-24, and the fits to the various indices are shown in Figures 25-29. The fits of the age composition data are shown in Figure 30.

Uncertainty and sensitivity analysis

A sensitivity analysis of the base model was run on different values for natural mortality, ranging from 0.09 to 0.21 (Table 17). The model fitted poorly for natural mortalities ≥ 0.17, indicated by decreases of total likelihood value of more than 5 units. Although the model fitted well for natural mortalities ≤ 0.09, it resulted in seemingly high value of the steepness ($h \geq 0.379$). The model fitted well for natural mortalities of 0.13 and 0.15. The model results, in terms of the population statuses, from both mortalities were very similar (Table 17).

As recommended by the STAR Panel, a sensitivity analysis of the base model was also run on different power coefficients from 1.0 to 5.0 (Table 18). The results show that the lower power coefficients, the lower the spawning outputs in 2002.

A retrospective analysis was performed through a series of the model fits to the data with the most recent data removed. In this exercise, the model was run up to 1997, 1999, 2001, and 2002, respectively (Figure 31). The results indicate that the model is stable as the overall trends in spawning outputs were similar. However, the model only run to 1997 shows low spawning outputs in 1997, indicating that the last few years of data have some influence on previous years estimates.

Rebuilding parameters

Unfished spawning output (B_0=39,567) was calculated from the first year (1958) spawning output. The value is slightly lower than that computed from the average recruitment in the year 1958 to 1979 multiplied by spawning output per recruit (SPR=1.036, B_0=42,601). Difference between two values is very small and both values are well within the 95% confidence intervals (30,148 and 52,597) determined by the likelihood profile run on B_0. The former was used in this stock assessment because it did not depend on how many pre-fishing years should be included in calculating B_0. Mean generation time was 16 years. A separated C++ program was written (embedded in the ADMB program) to produce a data file ("rebuild.dat") that can be directly inputted into rebuilding analysis.

Status of the stock

The percentage ratio of spawning output in 2002 to B_0 is the population status. The point estimate, from the base model run, for the population status in 2002 is 24.65% (spawning output in 2002 = 9,755). The median estimate, from the MCMC runs, for the population status in 2002 is 24.82%, with a 95% confidence interval of 15.68% and 35.55%, respectively (Figures 32 and 33). These results indicate great uncertainty in estimating the population status, and there is large variability in recruitment (Figures 22 and 34). Given that the population status ranged from the overfishing state (<25%) to the precautionary zone (>25% and <40%), rebuilding analysis is needed to determine harvest projections and target fishing mortalities.

Management Recommendations

The stock has declined since fishing began in the later 1970's. This assessment shows that the spawning output in 2002 was just below 25% of unfished spawning output. A rebuilding analysis using the SSC Default Rebuilding Analysis and the base model outputs was conducted to determine harvest levels and related risks of each harvest levels (He et al. 2003). The rebuilding analysis used twelve simulation scenarios constructed from three factors: (1) whether the recruitments (age 3) for 2003-05 were pre-specified from the 2000-02 midwater survey indices; (2) whether a stock-recruitment relationship or recruit-per-spawner ratios were used to generate future recruitment; and (3) a range for the power coefficient for the midwater juvenile survey index. The analysis indicates a wide range of the Optimum Yield (OY) for 2004 (0-582mt), depending on which simulation scenario is used. If the base model outputs of this assessment (power coefficient = 3) is used, the recruitments for 2003-05 are pre-specified, and recruits-per-spawner ratios are used to generate future recruitments, the estimated OY for 2004 is 284mt with a probability of 60% that the stock will be rebuilt by 2037 (Model 8 in He at al. 2003). Details of each simulation model and its associated harvest levels are presented in He at al. (2003).

Research Needs

1. There is no reliable abundance index for widow rockfish. Recent management measures have been such that catches in both the Oregon bottom trawl fishery and Pacific whiting fishery have been insufficient to derive CPUE estimates for 2000-2002, and will most likely not be suitable to derive CPUE estimates in the future. This means that there will be no abundance index available for future assessments on widow rockfish. The triennial bottom trawl survey can be analyzed and be considered for inclusion in the assessment, although the index has showed no significant trends of widow rockfish probably due to small catches of widow rockfish in the survey. Both 2000 STAR Panel and 2002 STAR Panel have recommended that a rockfish survey by hydro-acoustics or other methods be initiated, possibly in cooperation with the fishing industry.
2. Long-term recruitment index is a key datum series in the stock assessment. Continuation of the midwater juvenile trawl survey and possible increases in sampling intensity and coverage will improve estimation confidence and data quality.

3. For the next assessment, new data should be systematically compared with data and results with those of the 2003 assessment. The next assessment should explicitly report progress on the recommendations made in the 2003 Panel report.
4. Preliminary information for 2002 suggest that discards may have decreased substantially compared to the assumed 16% currently used. New discard data should be analysed and, if warranted, past discard estimates should be adjusted.
5. The assessment assumes a unit stock from the USA/Canada border and south, but there is little information to ascertain the stock structure of widow rockfish. This should be studied through genetic studies and other stock identification techniques.
6. Investigate with recent data whether growth and maturity in the northern area and in the southern area are really different.
7. The model included estimation of a stock-recruitment relationship. Such a relationship can stabilize estimation of recruitments from data-poor portions of the time series, and it can provide a basis for calculation of B_0 and future recruitments. However, inclusion of a relatioship with a particular parametric form (the Beverton-Holt or the Ricker relationships) has the potential to influence the trend in recruitment if there are not sufficient data to provide solid information about the trend. Since some assessments use the stock-recruitment relationships internally and others do not, it is recommended that an analysis be conducted to fully investigate the pros and cons of this approach.
8. Considerable uncertainties exist in the estimated stock and recruitment relationship, and it is likely that additional factors besides stock size in US waters are contributing to recruitment variability. The 2003 Panel recommends compiling oceanographic time series and investigating whether these data can be used as covariates in estimating the stock-recruitment relationship of widow rockfish. This investigation should take into account stock structure, including consideration of fish in Canadian waters, and should take a multiple species approach because of the possible synchronicity of rockfish recruitment.
9. Filtering of whiting by-catch data should not exclude tows with widow catches greater than 5 tons nor those outside 2 standard deviations of the standardised values.
10. The current CPUE standardisation treats each 64 Oregon bottom trawlers and 61 geographical units as individual categories. The 2003 Panel recommends that the usefulness of regrouping the vessels and geographical units be investigated. In all standardizations, the straight average index should be compared with the standardized estimates to appraise the magnitude of the effect of the standardization.
11. The Oregon bottom trawl CPUE is an important index in the assessment, yet it is may not be a consistent index of stock size over the period of the assessment because of changes in fishery management and of changes in fishing efficiency of individual fishing units. The data should be analyzed to evaluate the desirability of breaking the series in two or more time periods.
12. The base case model estimates a single selectivity for each of the four fisheries. The 2003 Panel considers that the topic of time-varying selectivity requires further research.
13. Similarly, the weighting of the various indices, including iterative re-weighting of the series and the weights of individual points within each series, should be investigated further.

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Table 1. U.S. total landings (mt) of widow rockfish by four fisheries type from 1966 to 2002.

Year	Vancouver, Columbia	Oregon Midwater Trawl	Oregon Bottom Trawl	Eureka, Monterey, and Conception	Total
1966	3671			96	3766
1967	3900			249	4149
1968	1693			336	2029
1969	356			21	377
1970	554			0	554
1971	701			0	701
1972	410			13	423
1973	617			207	824
1974	293			280	573
1975	454			358	812
1976	948			412	1360
1977	1318			883	2201
1978	605			502	1107
1979	966			2326	3292
1980	16190			5666	21856
1981	21779			5169	26938
1982	14794			11239	26003
1983	3213	1452	1488	4168	10321
1984	1450	3568	1334	3464	9846
1985	1534	3185	871	3552	9142
1986	2551	2977	1171	2727	9426
1987	3712	4985	1170	2717	12583
1988	3076	4102	1126	2148	10452
1989	3375	4871	1971	2262	12479
1990	2232	3235	2168	2478	10113
1991	1148	1846	1940	1356	6290
1992	935	1149	2624	1327	6036
1993	1703	1755	3385	1347	8190
1994	1062	1678	2382	1244	6366
1995	1077	1585	2278	2012	6952
1996	957	1851	2114	1556	6478
1997	1004	2032	2286	1671	6989
1998	539	926	1331	1294	4090
1999	515	2237	796	901	4450
2000	386	2285	18	1120	3809
2001	297	958	44	485	1794
2002	61	148	6	48	263

Table 2. Management performance in obtaining the harvest guideline for widow rockfish. Harvest guideline and allowable biological catch (ABC) are taken from Council documents. Landings are summaries from the NORPAC and CALCOM databases, and landings are catches multiplied by (1.0-discard rate).

Year	Harvest Guideline	Allowable Biological Catch	Landings	Catch
1989	12100	12400	12479	14856
1990	12400	8900	10113	12039
1991	7000	7000	6290	7488
1992	7000	7000	6036	7186
1993	7000	7000	8190	9750
1994	6500	6500	6366	7579
1995	6500	7700	6952	8276
1996	6500	7700	6478	7712
1997	6500	7700	6989	8320
1998	5090	5750	4090	4869
1999	5090	5750	4450	5298
2000	5090	5750	3809	4535
2001	2300	3727	1794	2136
2002	856	3727	263	313
2003	832	3871		

Table 3. Chronology of the regulatory history of widow rockfish by the Pacific Fishery Management Council.

Date	Regulation
10/13/82	75,000 lb trip limit
1/30/83	30,000 lb trip limit
9/10/83	1,000 lb trip limit
1/1/84	50,000 lb trip limit once per week
5/6/84	40,000 lb trip limit once per week
8/1/84	closed fishery with 1,000 trip limit for incidental catch
9/9/84	closed fishery
1/10/85	30,000 lb trip limit once a week or 60,000 lb trip limit once per two weeks, unlimited trips of less than 3,000 lbs
4/28/85	dropped 60,000 lb biweekly option
7/21/85	3,000 lb trip limit, unlimited number of trips
1/1/86	30,000 lb trip limit, only one weekly landing greater than 3,000 lbs
9/28/86	3,000 lb trip limit, unlimited number of trips
1/1/87	30,000 lb trip limit, only one weekly landing greater than 3000 lbs
11/25/87	closed fishery
1/1/88	30,000 lb trip limit, only one weekly landing greater than 3000 lbs, unlimited number of trips less than 3,000 lbs
9/21/88	3,000 lb trip limit, unlimited number of trips
1/1/89	30,000 lb trip limit, only one weekly landing greater than 3,000 lbs
4/26/89	10,000 lb trip limit once per week
10/11/89	3,000 lb trip limit with unlimited number of trips
1/1/90	15,000 lb trip limit once per week or 25,000 lb trip limit once per two weeks with only one landing greater than 3,000 lbs each week
12/12/90	closed fishery
1/1/91	10,000 lb trip limit per week or 20,000 lb trip limit every two weeks with only one landing greater than 3,000 lbs per week
9/25/91	3,000 lb trip limit with unlimited number of trips
1/1/92	30,000 lbs cumulative landings every 4 weeks
5/9/92	change from 3" mesh to 4.5" mesh in codend for roller gear north of Point Arena
8/12/92	3,000 lb trip limit with unlimited number of trips
12/2/92	30,000 lb cumulative trip limit per 4 weeks
12/1/93	3,000 lb trip limit with unlimited number of trips
1/1/94	30,000 lb cumulative limit per calender month
12/1/94	3,000 lb trip limit with unlimited number of trips
1/1/95	30,000 lb cumulative limit per calender month
4/14/95	45,000 lb cumulative limit per calender month
9/8/95	4.5" mesh applies to entire net and bottom trawl
1/1/96	70,000 lb cumulative limit per two months
9/1/96	50,000 lb cumulative limit per two months
11/1/96	25,000 lb cumulative limit per two months
1/1/97	70,000 lb cumulative limit per two months
5/1/97	60,000 lb cumulative limit per two months
1/1/98	limited entry: 25,000 lb cumulative per two month period, open access: 12,500 lb cumulative per two month period
5/1/98	limited entry: 30,000 lb cumulative per two month period

Table 3 (continued). Chronology of the regulatory history of widow rockfish by the Pacific Fishery Management Council.

Date	Regulation
7/1/98	open access: 3,000 lb cumulative per month
10/1/98	limited entry: 19,000 cumulative per month
1/1/99	limited entry: cumulative limits: phase 1 - 70,000 lbs per period, phase 2 - 16,000 lbs per period, phase 3 - 30,000 lbs per period. Open access: 2,000 lbs per month
5/1/99	limited entry: decrease phase 2 and phase 3 limits to 11,000 lbs
7/2/99	open access: 8,000 lb cumulative limit per month
10/1/99	limited entry: vessels in Oregon and Washington using 30,000 lb cumulative monthly limit must have midwater trawl gear aboard or a state cumulative limit will be imposed
1/1/00	Widow rockfish classified as a shelf species for regulatory purposes, 30,000 lbs/2 months for limited entry trawl, 3,000 lbs/month for limited entry fixed gear and open access
1/1/01	20,000 lbs/2 months for months of Jan-Apr and Sep-Oct; otherwise 10,000 lbs/2 months for midwater limited entry. 1,000 lbs/months for small footrope limited entry. 3,000 lbs/month for fixed gear limited entry. Open access: north - 3,000 lbs/month, south - 3,000 lbs per month with some monthly closures in some areas.
7/1/01	North - limited entry midwater trawl limits: 1,000 lbs/month
10/1/01	closed fishery for all except midwater, which may land 2,000 lbs/month in north for October, then 25,000 lbs/2 months.
1/1/02	North - limited entry trawl: closed through November to midwater trawl except for small bycatch in whiting fishery, in November 13,000 lbs/2 month with no more than 2 trips, small footrope trawl1000 lbs/month through September, then closed Sept-Oct, then 500 lbs/month Nov-Dec. South - limited entry trawl: midwater closed year round except for a small bycatch in the whiting fishery, small footrope trawl 1,000 lbs/month through July, then closed
1/1/03	North - limited entry trawl: midwater trawl closed through November except for small amount of bycatch in whiting fishery, 12,000 lbs/2 months for Nov-Dec. small footrope trawl - 300 lbs/month Jan-Apr and Nov-Dec, 1000 lbs/month May-Oct. North - limited entry fixed gear: 200 lbs/month. North - open access gear: 200 lbs/month. South - limited entry trawl: same as north for midwater and small footrope trawl. South - limited entry fixed gear: closed Mar-Apr, then variable 100 lbs/2 months to 250 lbs/2 months. South - - open access gear: same as limited entry fixed gear.

Table 4a. Propotional age composition of males for the Vancouver-Columbia fishery with the sum across sexes equal to 1. Data are from 1980 to 2002.

	Age																
Year	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20+
1980	0.000	0.000	0.009	0.022	0.020	0.056	0.096	0.111	0.046	0.029	0.012	0.013	0.006	0.004	0.002	0.002	0.001	0.003
1981	0.000	0.007	0.024	0.064	0.046	0.024	0.048	0.088	0.068	0.047	0.026	0.017	0.012	0.005	0.004	0.003	0.003	0.009
1982	0.000	0.008	0.030	0.084	0.031	0.045	0.021	0.021	0.033	0.072	0.045	0.034	0.035	0.021	0.014	0.009	0.005	0.017
1983	0.000	0.008	0.154	0.113	0.028	0.017	0.014	0.013	0.014	0.018	0.020	0.015	0.015	0.009	0.006	0.007	0.006	0.020
1984	0.000	0.003	0.054	0.161	0.083	0.033	0.014	0.004	0.006	0.007	0.008	0.013	0.013	0.011	0.007	0.008	0.008	0.029
1985	0.000	0.008	0.075	0.080	0.125	0.066	0.022	0.009	0.004	0.006	0.005	0.006	0.005	0.003	0.006	0.005	0.003	0.028
1986	0.000	0.007	0.060	0.174	0.075	0.049	0.014	0.006	0.005	0.005	0.003	0.003	0.005	0.006	0.003	0.002	0.002	0.029
1987	0.000	0.006	0.024	0.120	0.194	0.046	0.013	0.009	0.003	0.004	0.006	0.004	0.003	0.004	0.004	0.002	0.002	0.011
1988	0.000	0.000	0.015	0.060	0.137	0.199	0.035	0.013	0.005	0.002	0.001	0.003	0.003	0.001	0.000	0.001	0.001	0.014
1989	0.000	0.003	0.018	0.093	0.095	0.157	0.087	0.009	0.004	0.001	0.000	0.001	0.000	0.001	0.000	0.000	0.002	0.008
1990	0.000	0.000	0.025	0.077	0.153	0.068	0.097	0.030	0.011	0.005	0.001	0.000	0.000	0.000	0.001	0.001	0.001	0.007
1991	0.000	0.001	0.010	0.062	0.114	0.107	0.074	0.044	0.050	0.010	0.004	0.003	0.002	0.001	0.004	0.001	0.001	0.018
1992	0.000	0.003	0.020	0.031	0.072	0.077	0.082	0.049	0.052	0.029	0.020	0.008	0.005	0.003	0.002	0.000	0.001	0.012
1993	0.000	0.000	0.017	0.058	0.051	0.063	0.057	0.036	0.029	0.030	0.023	0.020	0.012	0.006	0.005	0.004	0.002	0.014
1994	0.000	0.001	0.011	0.041	0.087	0.057	0.045	0.037	0.028	0.023	0.026	0.016	0.013	0.011	0.005	0.004	0.003	0.017
1995	0.001	0.010	0.031	0.056	0.096	0.100	0.064	0.029	0.031	0.019	0.015	0.024	0.010	0.007	0.006	0.007	0.002	0.012
1996	0.001	0.011	0.054	0.107	0.101	0.061	0.034	0.021	0.015	0.012	0.008	0.007	0.009	0.003	0.004	0.004	0.002	0.008
1997	0.000	0.003	0.037	0.149	0.129	0.050	0.015	0.010	0.006	0.007	0.007	0.008	0.001	0.003	0.003	0.001	0.001	0.004
1998	0.000	0.001	0.014	0.043	0.146	0.110	0.040	0.015	0.007	0.009	0.008	0.003	0.002	0.002	0.007	0.001	0.000	0.006
1999	0.000	0.002	0.011	0.041	0.081	0.107	0.082	0.041	0.023	0.010	0.010	0.009	0.005	0.005	0.004	0.005	0.002	0.005
2000	0.000	0.000	0.005	0.058	0.113	0.071	0.074	0.073	0.038	0.013	0.012	0.005	0.002	0.009	0.006	0.003	0.002	0.005
2001	0.000	0.000	0.004	0.051	0.126	0.084	0.062	0.054	0.037	0.039	0.033	0.008	0.017	0.006	0.006	0.006	0.002	0.006
2002	0.000	0.002	0.020	0.025	0.056	0.097	0.063	0.052	0.023	0.025	0.011	0.014	0.002	0.002	0.005	0.002	0.002	0.003

Table 4b. Propotional age composition of females for the Vancouver-Columbia fishery with the sum across sexes equal to 1. Data are from 1980 to 2002.

	Age																
Year	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20+
1980	0.000	0.000	0.009	0.018	0.014	0.026	0.088	0.142	0.085	0.063	0.035	0.018	0.021	0.019	0.005	0.007	0.006	0.013
1981	0.000	0.007	0.017	0.047	0.044	0.020	0.020	0.062	0.078	0.071	0.037	0.028	0.019	0.010	0.005	0.006	0.005	0.027
1982	0.000	0.008	0.018	0.060	0.029	0.042	0.019	0.015	0.015	0.049	0.040	0.040	0.033	0.032	0.017	0.015	0.006	0.037
1983	0.000	0.006	0.153	0.114	0.040	0.021	0.009	0.014	0.013	0.016	0.029	0.023	0.022	0.013	0.010	0.007	0.005	0.028
1984	0.001	0.002	0.044	0.152	0.075	0.026	0.018	0.005	0.006	0.007	0.011	0.017	0.025	0.024	0.020	0.011	0.014	0.081
1985	0.000	0.008	0.071	0.081	0.117	0.058	0.028	0.009	0.007	0.005	0.008	0.005	0.012	0.010	0.011	0.007	0.008	0.099
1986	0.000	0.002	0.053	0.178	0.091	0.070	0.020	0.013	0.004	0.007	0.008	0.006	0.009	0.008	0.008	0.009	0.003	0.061
1987	0.000	0.004	0.014	0.095	0.224	0.057	0.037	0.026	0.009	0.007	0.004	0.002	0.007	0.008	0.005	0.008	0.004	0.035
1988	0.000	0.002	0.007	0.056	0.151	0.206	0.035	0.017	0.012	0.008	0.003	0.000	0.003	0.001	0.000	0.001	0.000	0.007
1989	0.000	0.003	0.007	0.076	0.093	0.184	0.104	0.009	0.010	0.006	0.001	0.001	0.001	0.002	0.000	0.001	0.004	0.020
1990	0.000	0.001	0.028	0.062	0.116	0.078	0.119	0.059	0.012	0.006	0.003	0.003	0.000	0.001	0.002	0.001	0.001	0.029
1991	0.000	0.000	0.004	0.054	0.084	0.099	0.066	0.057	0.054	0.011	0.009	0.005	0.004	0.002	0.001	0.003	0.002	0.040
1992	0.000	0.003	0.023	0.025	0.055	0.091	0.082	0.057	0.069	0.046	0.030	0.012	0.008	0.004	0.001	0.004	0.002	0.024
1993	0.000	0.001	0.008	0.059	0.038	0.068	0.070	0.055	0.050	0.084	0.048	0.029	0.015	0.009	0.003	0.004	0.002	0.029
1994	0.004	0.003	0.013	0.047	0.074	0.068	0.044	0.054	0.041	0.043	0.052	0.035	0.025	0.016	0.013	0.008	0.004	0.031
1995	0.001	0.009	0.032	0.050	0.078	0.082	0.055	0.037	0.023	0.027	0.017	0.021	0.010	0.007	0.011	0.005	0.002	0.014
1996	0.000	0.002	0.067	0.108	0.105	0.063	0.054	0.024	0.016	0.019	0.015	0.013	0.019	0.005	0.004	0.002	0.002	0.020
1997	0.000	0.001	0.029	0.167	0.142	0.053	0.033	0.024	0.017	0.018	0.017	0.010	0.007	0.011	0.005	0.002	0.003	0.029
1998	0.000	0.001	0.012	0.048	0.165	0.153	0.047	0.020	0.023	0.023	0.020	0.021	0.014	0.004	0.011	0.005	0.002	0.017
1999	0.000	0.001	0.012	0.046	0.067	0.127	0.105	0.053	0.033	0.023	0.015	0.013	0.014	0.009	0.006	0.011	0.005	0.018
2000	0.000	0.000	0.002	0.053	0.088	0.097	0.077	0.069	0.046	0.021	0.010	0.009	0.006	0.006	0.006	0.009	0.002	0.007
2001	0.000	0.000	0.002	0.025	0.053	0.090	0.058	0.014	0.031	0.025	0.048	0.035	0.017	0.019	0.004	0.006	0.008	0.023
2002	0.000	0.002	0.023	0.025	0.027	0.102	0.097	0.042	0.044	0.033	0.028	0.025	0.022	0.009	0.002	0.011	0.005	0.020

Table 5a. Propotional age composition of males for the Oregon midwater trawl fishery with the sum across sexes equal to 1. Data are from 1984 to 2002.

	Age																
Year	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20+
1984	0.000	0.001	0.017	0.188	0.114	0.008	0.018	0.006	0.008	0.007	0.015	0.021	0.002	0.007	0.003	0.002	0.001	0.011
1985	0.000	0.002	0.062	0.067	0.225	0.060	0.008	0.006	0.003	0.000	0.002	0.005	0.014	0.003	0.002	0.000	0.000	0.010
1986	0.000	0.000	0.005	0.104	0.074	0.195	0.060	0.005	0.005	0.004	0.000	0.000	0.001	0.013	0.004	0.003	0.001	0.008
1987	0.000	0.000	0.017	0.126	0.222	0.071	0.037	0.019	0.002	0.003	0.003	0.000	0.000	0.002	0.003	0.000	0.001	0.003
1988	0.000	0.001	0.014	0.076	0.239	0.132	0.032	0.021	0.008	0.000	0.000	0.000	0.001	0.000	0.003	0.002	0.000	0.004
1989	0.000	0.004	0.016	0.047	0.116	0.189	0.071	0.013	0.014	0.002	0.000	0.000	0.000	0.001	0.002	0.002	0.003	0.006
1990	0.000	0.003	0.028	0.030	0.058	0.100	0.133	0.068	0.033	0.016	0.008	0.004	0.000	0.001	0.000	0.002	0.000	0.004
1991	0.000	0.000	0.008	0.066	0.100	0.106	0.065	0.088	0.039	0.010	0.011	0.003	0.002	0.002	0.001	0.000	0.001	0.010
1992	0.000	0.000	0.036	0.040	0.087	0.083	0.080	0.041	0.086	0.030	0.022	0.014	0.002	0.004	0.000	0.000	0.001	0.013
1993	0.000	0.000	0.016	0.071	0.055	0.081	0.049	0.039	0.034	0.060	0.026	0.018	0.015	0.006	0.000	0.003	0.001	0.010
1994	0.000	0.002	0.009	0.076	0.156	0.080	0.047	0.041	0.012	0.020	0.031	0.000	0.002	0.005	0.000	0.000	0.000	0.009
1995	0.000	0.004	0.017	0.025	0.131	0.095	0.048	0.043	0.032	0.023	0.030	0.007	0.001	0.001	0.000	0.005	0.000	0.001
1996	0.000	0.008	0.073	0.093	0.071	0.065	0.049	0.034	0.014	0.008	0.024	0.009	0.017	0.008	0.003	0.000	0.005	0.005
1997	0.000	0.002	0.031	0.240	0.116	0.043	0.026	0.027	0.016	0.013	0.009	0.003	0.014	0.013	0.000	0.000	0.001	0.002
1998	0.000	0.000	0.012	0.081	0.194	0.112	0.054	0.015	0.025	0.015	0.003	0.007	0.001	0.001	0.009	0.002	0.001	0.004
1999	0.000	0.001	0.026	0.039	0.110	0.180	0.087	0.022	0.005	0.005	0.000	0.001	0.001	0.000	0.001	0.001	0.000	0.002
2000	0.000	0.000	0.005	0.032	0.072	0.085	0.107	0.083	0.045	0.030	0.004	0.007	0.009	0.003	0.000	0.000	0.000	0.000
2001	0.000	0.000	0.001	0.018	0.098	0.099	0.120	0.062	0.050	0.042	0.017	0.006	0.002	0.003	0.002	0.002	0.004	0.004
2002	0.000	0.005	0.010	0.045	0.075	0.187	0.173	0.053	0.006	0.010	0.011	0.006	0.000	0.015	0.003	0.000	0.007	0.003

Table 5b. Propotional age composition of females for the Oregon midwater trawl fishery with the sum across sexes equal to 1. Data are from 1984 to 2002.

	Age																
Year	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20+
1984	0.000	0.001	0.019	0.169	0.181	0.014	0.028	0.006	0.006	0.004	0.027	0.058	0.016	0.008	0.006	0.005	0.006	0.017
1985	0.000	0.000	0.046	0.066	0.254	0.091	0.009	0.013	0.010	0.000	0.001	0.007	0.019	0.003	0.002	0.001	0.002	0.007
1986	0.000	0.000	0.010	0.137	0.082	0.168	0.067	0.004	0.011	0.004	0.000	0.000	0.004	0.016	0.001	0.002	0.002	0.009
1987	0.000	0.001	0.015	0.115	0.203	0.080	0.041	0.022	0.001	0.004	0.002	0.000	0.001	0.001	0.002	0.001	0.000	0.002
1988	0.001	0.005	0.014	0.076	0.192	0.102	0.027	0.018	0.009	0.004	0.005	0.000	0.001	0.000	0.001	0.004	0.003	0.005
1989	0.000	0.003	0.023	0.034	0.076	0.195	0.087	0.032	0.016	0.015	0.009	0.002	0.000	0.001	0.000	0.002	0.006	0.012
1990	0.000	0.000	0.018	0.033	0.054	0.077	0.147	0.106	0.038	0.021	0.009	0.002	0.002	0.001	0.001	0.000	0.000	0.004
1991	0.000	0.000	0.011	0.063	0.096	0.061	0.068	0.098	0.043	0.013	0.010	0.004	0.003	0.001	0.000	0.000	0.002	0.015
1992	0.000	0.000	0.023	0.030	0.070	0.075	0.042	0.064	0.089	0.031	0.015	0.006	0.001	0.002	0.002	0.002	0.000	0.008
1993	0.000	0.001	0.010	0.068	0.036	0.080	0.065	0.036	0.046	0.067	0.034	0.024	0.020	0.010	0.004	0.005	0.002	0.007
1994	0.000	0.000	0.008	0.049	0.158	0.064	0.056	0.041	0.035	0.025	0.029	0.015	0.021	0.005	0.000	0.000	0.002	0.003
1995	0.000	0.005	0.005	0.031	0.059	0.088	0.089	0.057	0.043	0.039	0.032	0.046	0.013	0.007	0.014	0.001	0.000	0.009
1996	0.000	0.007	0.067	0.059	0.077	0.080	0.049	0.024	0.039	0.016	0.018	0.023	0.018	0.006	0.001	0.001	0.001	0.027
1997	0.000	0.003	0.012	0.170	0.082	0.038	0.038	0.017	0.014	0.012	0.013	0.013	0.007	0.017	0.001	0.002	0.000	0.005
1998	0.000	0.000	0.004	0.037	0.158	0.092	0.048	0.031	0.032	0.015	0.015	0.012	0.004	0.002	0.007	0.001	0.003	0.005
1999	0.000	0.000	0.024	0.038	0.082	0.184	0.092	0.040	0.020	0.008	0.011	0.007	0.001	0.007	0.004	0.001	0.000	0.001
2000	0.000	0.000	0.009	0.031	0.071	0.098	0.079	0.091	0.060	0.027	0.016	0.007	0.009	0.004	0.003	0.001	0.006	0.005
2001	0.000	0.000	0.000	0.013	0.067	0.067	0.071	0.069	0.049	0.060	0.016	0.010	0.008	0.008	0.014	0.008	0.006	0.004
2002	0.000	0.005	0.005	0.015	0.031	0.087	0.093	0.101	0.030	0.004	0.009	0.003	0.000	0.000	0.003	0.000	0.003	0.003

Table 6a. Propotional age composition of males for the Oregon bottom trawl fishery with the sum across sexes equal to 1. Data are from 1984 to 1999.

	Age																
Year	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20+
1984	0.000	0.002	0.034	0.158	0.115	0.018	0.017	0.004	0.004	0.002	0.021	0.015	0.011	0.009	0.007	0.003	0.001	0.010
1985	0.000	0.003	0.049	0.097	0.195	0.049	0.003	0.005	0.002	0.000	0.001	0.004	0.026	0.000	0.007	0.001	0.000	0.007
1986	0.000	0.002	0.014	0.200	0.081	0.085	0.058	0.003	0.018	0.005	0.002	0.000	0.001	0.018	0.002	0.001	0.003	0.016
1987	0.000	0.000	0.011	0.111	0.204	0.072	0.040	0.016	0.003	0.002	0.007	0.000	0.000	0.006	0.005	0.002	0.000	0.008
1988	0.002	0.011	0.017	0.080	0.208	0.102	0.022	0.011	0.007	0.003	0.000	0.000	0.001	0.000	0.002	0.004	0.001	0.006
1989	0.000	0.009	0.025	0.051	0.094	0.176	0.064	0.027	0.014	0.008	0.000	0.005	0.000	0.000	0.001	0.001	0.006	0.007
1990	0.000	0.004	0.047	0.045	0.056	0.068	0.116	0.058	0.021	0.020	0.010	0.004	0.001	0.003	0.000	0.000	0.000	0.012
1991	0.000	0.000	0.004	0.066	0.100	0.072	0.042	0.078	0.037	0.010	0.012	0.003	0.001	0.004	0.000	0.000	0.001	0.011
1992	0.000	0.000	0.017	0.022	0.084	0.073	0.059	0.034	0.048	0.018	0.029	0.016	0.004	0.004	0.006	0.002	0.003	0.017
1993	0.000	0.000	0.006	0.035	0.035	0.088	0.091	0.047	0.033	0.054	0.035	0.023	0.014	0.004	0.002	0.004	0.000	0.017
1994	0.000	0.003	0.014	0.057	0.107	0.069	0.042	0.017	0.021	0.029	0.024	0.008	0.006	0.005	0.009	0.002	0.000	0.011
1995	0.000	0.003	0.034	0.109	0.074	0.135	0.039	0.044	0.021	0.018	0.007	0.012	0.005	0.005	0.005	0.000	0.000	0.002
1996	0.000	0.002	0.079	0.082	0.059	0.058	0.022	0.017	0.017	0.020	0.016	0.002	0.017	0.005	0.002	0.011	0.001	0.007
1997	0.000	0.006	0.044	0.230	0.118	0.047	0.031	0.021	0.009	0.018	0.007	0.006	0.001	0.006	0.002	0.000	0.000	0.004
1998	0.000	0.000	0.008	0.051	0.183	0.116	0.035	0.022	0.017	0.020	0.006	0.009	0.000	0.002	0.007	0.000	0.003	0.008
1999	0.000	0.004	0.028	0.066	0.118	0.177	0.072	0.027	0.009	0.000	0.000	0.007	0.001	0.000	0.000	0.000	0.007	0.003

Table 6b. Propotional age composition of females for the Oregon bottom trawl fishery with the sum across sexes equal to 1. Data are from 1984 to 1999.

	Age																
Year	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20+
1984	0.000	0.000	0.033	0.135	0.188	0.031	0.018	0.013	0.008	0.005	0.014	0.034	0.017	0.009	0.005	0.006	0.003	0.049
1985	0.001	0.000	0.023	0.062	0.199	0.121	0.016	0.007	0.007	0.000	0.001	0.026	0.038	0.006	0.006	0.004	0.004	0.030
1986	0.000	0.001	0.025	0.106	0.062	0.096	0.068	0.007	0.018	0.013	0.000	0.000	0.004	0.044	0.010	0.007	0.005	0.025
1987	0.000	0.002	0.010	0.119	0.167	0.060	0.051	0.030	0.004	0.004	0.002	0.003	0.000	0.005	0.017	0.014	0.003	0.023
1988	0.010	0.014	0.009	0.077	0.172	0.103	0.041	0.027	0.015	0.010	0.005	0.006	0.001	0.002	0.006	0.010	0.003	0.010
1989	0.000	0.001	0.027	0.028	0.068	0.146	0.090	0.038	0.041	0.016	0.006	0.004	0.004	0.004	0.006	0.004	0.010	0.018
1990	0.000	0.000	0.046	0.036	0.037	0.068	0.137	0.107	0.036	0.017	0.009	0.005	0.007	0.002	0.002	0.001	0.001	0.024
1991	0.000	0.000	0.007	0.055	0.060	0.065	0.074	0.109	0.058	0.034	0.034	0.007	0.005	0.005	0.002	0.001	0.003	0.037
1992	0.000	0.000	0.010	0.008	0.082	0.089	0.069	0.058	0.090	0.048	0.032	0.020	0.014	0.005	0.006	0.001	0.003	0.031
1993	0.000	0.000	0.000	0.025	0.025	0.076	0.073	0.044	0.040	0.066	0.043	0.029	0.017	0.021	0.006	0.009	0.006	0.032
1994	0.000	0.002	0.009	0.043	0.100	0.063	0.057	0.063	0.046	0.026	0.065	0.029	0.020	0.012	0.012	0.007	0.006	0.016
1995	0.000	0.005	0.013	0.037	0.109	0.084	0.051	0.039	0.045	0.026	0.017	0.025	0.004	0.002	0.013	0.002	0.000	0.015
1996	0.000	0.007	0.076	0.102	0.082	0.086	0.051	0.028	0.041	0.032	0.008	0.004	0.040	0.000	0.002	0.010	0.003	0.011
1997	0.000	0.008	0.031	0.104	0.094	0.030	0.047	0.031	0.019	0.015	0.008	0.013	0.010	0.016	0.005	0.001	0.005	0.014
1998	0.000	0.000	0.012	0.047	0.141	0.110	0.054	0.024	0.030	0.017	0.026	0.013	0.016	0.003	0.008	0.002	0.001	0.009
1999	0.000	0.000	0.023	0.058	0.068	0.147	0.063	0.042	0.039	0.009	0.012	0.006	0.008	0.002	0.000	0.001	0.001	0.001

Table 7a. Propotional age composition of males for the Eureka-Conception fishery with the sum across sexes equal to 1. Data are from 1980 to 2002.

	Age																
Year	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20+
1980	0.000	0.000	0.001	0.020	0.012	0.007	0.056	0.041	0.069	0.040	0.060	0.011	0.037	0.016	0.003	0.003	0.006	0.012
1981	0.000	0.008	0.003	0.027	0.027	0.023	0.018	0.063	0.086	0.060	0.032	0.012	0.009	0.015	0.002	0.003	0.009	0.001
1982	0.000	0.000	0.036	0.005	0.035	0.037	0.031	0.015	0.044	0.109	0.034	0.040	0.024	0.010	0.013	0.013	0.006	0.025
1983	0.000	0.000	0.020	0.134	0.027	0.032	0.014	0.006	0.007	0.007	0.015	0.017	0.011	0.011	0.004	0.025	0.002	0.042
1984	0.000	0.000	0.022	0.137	0.145	0.028	0.036	0.014	0.014	0.002	0.010	0.030	0.014	0.004	0.005	0.004	0.004	0.030
1985	0.000	0.000	0.009	0.062	0.163	0.145	0.013	0.025	0.011	0.002	0.003	0.010	0.022	0.002	0.005	0.003	0.003	0.027
1986	0.000	0.003	0.042	0.046	0.082	0.124	0.129	0.014	0.022	0.017	0.001	0.001	0.008	0.029	0.006	0.009	0.004	0.038
1987	0.001	0.000	0.055	0.114	0.044	0.060	0.091	0.112	0.020	0.030	0.021	0.003	0.000	0.019	0.015	0.003	0.011	0.026
1988	0.000	0.035	0.000	0.066	0.061	0.090	0.061	0.051	0.034	0.014	0.009	0.008	0.003	0.004	0.006	0.016	0.002	0.016
1989	0.000	0.005	0.109	0.073	0.078	0.119	0.046	0.050	0.020	0.012	0.020	0.016	0.008	0.000	0.000	0.007	0.006	0.009
1990	0.000	0.000	0.045	0.116	0.029	0.047	0.038	0.056	0.030	0.025	0.016	0.023	0.019	0.014	0.004	0.002	0.008	0.006
1991	0.000	0.002	0.015	0.119	0.120	0.049	0.038	0.065	0.022	0.016	0.020	0.012	0.002	0.004	0.004	0.003	0.003	0.017
1992	0.000	0.001	0.011	0.019	0.138	0.095	0.038	0.017	0.044	0.028	0.021	0.019	0.011	0.005	0.016	0.001	0.002	0.023
1993	0.000	0.000	0.085	0.163	0.096	0.078	0.010	0.002	0.009	0.007	0.011	0.001	0.021	0.005	0.002	0.004	0.001	0.033
1994	0.002	0.004	0.007	0.070	0.148	0.110	0.065	0.021	0.024	0.007	0.008	0.005	0.006	0.009	0.001	0.005	0.000	0.005
1995	0.000	0.033	0.039	0.034	0.056	0.197	0.045	0.066	0.058	0.003	0.028	0.007	0.021	0.001	0.004	0.008	0.000	0.003
1996	0.004	0.006	0.046	0.045	0.067	0.114	0.118	0.033	0.027	0.018	0.015	0.003	0.025	0.007	0.002	0.002	0.009	0.013
1997	0.000	0.002	0.008	0.108	0.041	0.051	0.052	0.048	0.050	0.036	0.027	0.023	0.013	0.005	0.004	0.012	0.006	0.012
1998	0.000	0.008	0.082	0.061	0.093	0.069	0.054	0.021	0.045	0.025	0.018	0.018	0.005	0.007	0.009	0.000	0.000	0.013
1999	0.001	0.001	0.019	0.072	0.059	0.101	0.069	0.051	0.027	0.022	0.030	0.016	0.006	0.006	0.006	0.012	0.005	0.031
2000	0.000	0.000	0.004	0.044	0.061	0.116	0.055	0.044	0.027	0.028	0.009	0.000	0.003	0.003	0.008	0.002	0.002	0.002
2001	0.000	0.000	0.000	0.010	0.073	0.012	0.064	0.092	0.035	0.040	0.032	0.030	0.042	0.021	0.004	0.003	0.000	0.007
2002	0.000	0.010	0.002	0.001	0.014	0.031	0.042	0.101	0.028	0.020	0.101	0.030	0.059	0.000	0.030	0.000	0.035	0.040

Table 7b. Propotional age composition of females for the Eureka-Conception fishery with the sum across sexes equal to 1. Data are from 1980 to 2002.

Year	Age 3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20+
1980	0.000	0.000	0.002	0.005	0.003	0.002	0.091	0.162	0.075	0.070	0.076	0.044	0.012	0.005	0.023	0.007	0.003	0.026
1981	0.000	0.006	0.001	0.019	0.027	0.014	0.006	0.049	0.131	0.095	0.045	0.059	0.044	0.042	0.019	0.008	0.011	0.025
1982	0.000	0.000	0.020	0.011	0.026	0.022	0.026	0.010	0.028	0.093	0.052	0.042	0.037	0.030	0.027	0.036	0.017	0.044
1983	0.000	0.009	0.067	0.183	0.045	0.047	0.014	0.010	0.003	0.007	0.032	0.022	0.014	0.026	0.018	0.014	0.023	0.092
1984	0.000	0.000	0.025	0.124	0.113	0.027	0.029	0.012	0.007	0.003	0.020	0.045	0.010	0.011	0.007	0.007	0.010	0.050
1985	0.000	0.000	0.002	0.039	0.153	0.144	0.020	0.039	0.006	0.002	0.003	0.010	0.023	0.002	0.006	0.007	0.009	0.031
1986	0.000	0.001	0.032	0.027	0.073	0.082	0.100	0.007	0.021	0.009	0.005	0.002	0.002	0.028	0.003	0.004	0.004	0.026
1987	0.001	0.000	0.047	0.095	0.021	0.051	0.051	0.055	0.011	0.010	0.004	0.002	0.001	0.004	0.003	0.006	0.001	0.011
1988	0.000	0.086	0.037	0.076	0.072	0.055	0.033	0.037	0.021	0.004	0.014	0.020	0.004	0.007	0.004	0.006	0.009	0.039
1989	0.000	0.003	0.082	0.043	0.042	0.081	0.054	0.038	0.021	0.010	0.008	0.004	0.006	0.006	0.000	0.001	0.001	0.022
1990	0.000	0.003	0.051	0.109	0.056	0.037	0.089	0.071	0.037	0.024	0.010	0.008	0.006	0.001	0.003	0.001	0.002	0.012
1991	0.000	0.007	0.008	0.113	0.128	0.061	0.030	0.033	0.023	0.017	0.013	0.011	0.008	0.008	0.007	0.001	0.002	0.018
1992	0.000	0.000	0.015	0.031	0.108	0.086	0.039	0.030	0.037	0.026	0.026	0.044	0.015	0.000	0.001	0.001	0.006	0.042
1993	0.000	0.004	0.033	0.135	0.124	0.097	0.037	0.004	0.001	0.010	0.008	0.001	0.001	0.001	0.001	0.005	0.005	0.007
1994	0.002	0.002	0.022	0.067	0.161	0.066	0.051	0.020	0.026	0.017	0.015	0.007	0.009	0.008	0.006	0.000	0.002	0.023
1995	0.000	0.008	0.009	0.015	0.050	0.137	0.050	0.068	0.023	0.005	0.008	0.002	0.005	0.008	0.000	0.008	0.000	0.001
1996	0.005	0.007	0.040	0.043	0.042	0.081	0.058	0.050	0.038	0.030	0.011	0.010	0.012	0.003	0.001	0.007	0.005	0.004
1997	0.000	0.001	0.007	0.083	0.038	0.056	0.053	0.042	0.065	0.048	0.030	0.020	0.005	0.021	0.006	0.007	0.005	0.014
1998	0.000	0.002	0.054	0.029	0.076	0.030	0.046	0.045	0.053	0.060	0.028	0.008	0.010	0.006	0.007	0.002	0.003	0.013
1999	0.000	0.002	0.010	0.074	0.046	0.094	0.042	0.047	0.038	0.022	0.021	0.015	0.014	0.014	0.004	0.009	0.002	0.013
2000	0.000	0.000	0.007	0.033	0.099	0.073	0.075	0.057	0.039	0.027	0.059	0.033	0.033	0.021	0.002	0.001	0.024	0.007
2001	0.000	0.000	0.000	0.008	0.060	0.099	0.037	0.065	0.064	0.032	0.038	0.023	0.021	0.001	0.013	0.023	0.034	0.018
2002	0.000	0.010	0.002	0.001	0.030	0.013	0.041	0.112	0.053	0.072	0.001	0.034	0.032	0.035	0.006	0.006	0.000	0.012

Table 8. Number of fish and samples collected for each year and fishery of age composition data used in the widow rockfish assessment.

	Vancouver-Columbia		Oregon midwater trawl		Oregon bottom trawl		Eureka-Conception	
Year	Fish	Sample	Fish	Sample	Fish	Sample	Fish	Sample
1980	1775	18					644	70
1981	3050	31					1618	100
1982	3944	40					3145	126
1983	2480	25					2584	167
1984	2193	22	990	33	778	26	2873	137
1985	1591	16	1444	51	606	21	2850	118
1986	2592	27	1974	56	828	22	2568	102
1987	1939	36	1836	62	776	26	2642	101
1988	993	20	1089	38	945	32	1771	74
1989	1494	30	1640	61	963	43	2185	72
1990	2047	41	1410	60	1131	49	2411	85
1991	1739	35	1348	60	1600	77	2024	54
1992	1547	31	654	29	1582	82	736	33
1993	1797	36	1169	50	1201	61	491	20
1994	1398	28	576	22	1379	63	558	25
1995	1650	33	232	12	932	43	235	11
1996	1347	27	338	14	681	27	1008	33
1997	1497	30	523	21	966	40	1097	52
1998	1099	22	239	9	686	30	1180	31
1999	1448	29	254	11	668	26	1158	31
2000	1047	21	465	34			540	14
2001	485	10	543	23			211	7
2002	587	12	183	15			201	10

Table 9. Yearly index estimates from the Santa Cruz/Tiburon Laboratory midwater trawl pelagic juvenile survey from 1984 to 2002.

Year	Index Estimate	CV
1984	5.633	0.4346
1985	14.888	0.4897
1986	0.217	0.5020
1987	4.906	0.2485
1988	3.429	0.2869
1989	0.142	0.4164
1990	0.178	0.4297
1991	1.178	0.3197
1992	0.061	2.0000
1993	0.822	0.2849
1994	0.122	0.4880
1995	0.165	0.4941
1996	0.061	2.0000
1997	0.177	0.4214
1998	0.061	2.0000
1999	0.191	0.5001
2000	0.220	0.3657
2001	0.890	0.2721
2002	6.779	0.3156

Table 10. Oregon bottom trawl logbook catch-per-unit-effort index from 1984 to 1999.

Year	CPUE (lbs./hr.)	CV
1984	331.47	0.2121
1985	100.88	0.1875
1986	227.08	0.2928
1987	169.08	0.2730
1988	93.97	0.2897
1989	164.10	0.1749
1990	78.49	0.1348
1991	73.59	0.1275
1992	83.16	0.1179
1993	53.58	0.1314
1994	100.34	0.1128
1995	109.96	0.1387
1996	94.81	0.1357
1997	97.23	0.1502
1998	56.56	0.1718
1999	84.46	0.1684

Table 11. Indices of widow rockfish catches derived from bycatch in three sectors of the Pacific whiting fisheries. Note that index values after 1998 were not used in this assessment.

Year	Index	CV
Foreign (FOR)		
1976	4.2561	0.1889
1977	3.5294	0.0972
1978	3.8534	0.0718
1979	2.8001	0.0785
1980	6.2652	0.0754
1981	3.2341	0.0795
1982	1.1476	0.2310
1984	9.4606	0.0761
1985	1.3972	0.0817
1986	3.8934	0.0752
1987	2.1810	0.0652
1988	2.4261	0.0940
Joint venture (JV)		
1983	10.5908	0.1113
1985	4.7064	0.1401
1986	4.2898	0.0822
1987	1.0555	0.1028
1988	2.0725	0.0868
1989	4.6436	0.0586
1990	3.1349	0.0703
Domestic (DOM)		
1991	0.5121	0.1137
1992	0.2133	0.0985
1993	0.3035	0.0867
1994	0.5860	0.0570
1995	0.1616	0.0872
1996	0.3362	0.0688
1997	0.3099	0.0619
1998	0.4385	0.0653
1999	0.1769	0.0656
2000	0.1450	0.0695
2001	0.1075	0.0757

Table 12. Model runs with various likelihood components de-emphasized (indicated by bold-italic) and corresponding changes of log-likelihood values in each component. De-emphases were done by multiplying weighting factor for each component by 0.1.

Component de-emphasized	Age composition	Landing	Recruitment Residual	Midwater juvenile survy	Oregon bottom trawl Index	Whiting bycatch - foreign	Whiting bycatch – joint venture	Whiting bycatch - domestic
None (base run)	-457.25	341.49	18.32	-9.80	6.20	0.70	-1.97	3.21
Age composition	***-477.56***	341.51	18.51	-3.96	7.51	0.92	-1.63	2.96
Landing	-456.98	***339.68***	18.33	-9.78	6.24	0.69	-1.95	3.21
Recruitment residual	-456.10	341.50	***8.04***	-9.91	6.17	0.69	-1.98	3.22
Midwater juvenile survey	-456.44	341.50	18.29	***-13.27***	6.08	0.73	-1.98	3.35
Oregon bottom trawl logbook	-457.02	341.50	18.31	-10.05	***5.91***	0.72	-2.01	3.28
Whiting bycatch – foreign	-457.25	341.49	18.32	-9.75	6.21	***0.66***	-1.96	3.20
Whiting bycatch – joint venture	-457.20	341.50	18.32	-9.82	6.16	0.70	***-1.99***	3.22
Whiting bycatch – domestic	-457.38	341.49	18.32	-9.55	6.24	0.69	-1.95	***3.15***

Table 13. Estimated parameter values and their standard deviation (SD) for the base model.

Parameter description	Parameter	Estimate	SD
Mean recruitment	R	10.551000	0.148580
Recruitment steepness	h	0.217140	0.058856
Recruitment deviation in 1958	R_1^δ	0.104720	0.642680
Recruitment deviation in 1959	R_2^δ	0.114950	0.645180
Recruitment deviation in 1960	R_3^δ	0.125360	0.647280
Recruitment deviation in 1961	R_4^δ	0.128560	0.646680
Recruitment deviation in 1962	R_5^δ	0.129320	0.644140
Recruitment deviation in 1963	R_6^δ	0.131250	0.640190
Recruitment deviation in 1964	R_7^δ	0.013240	0.606230
Recruitment deviation in 1965	R_8^δ	-0.038203	0.562450
Recruitment deviation in 1966	R_9^δ	-0.070130	0.500510
Recruitment deviation in 1967	R_{10}^δ	0.069377	0.420870
Recruitment deviation in 1968	R_{11}^δ	0.365340	0.317400
Recruitment deviation in 1969	R_{12}^δ	-0.035161	0.346750
Recruitment deviation in 1970	R_{13}^δ	0.372800	0.261920
Recruitment deviation in 1971	R_{14}^δ	0.233010	0.262250
Recruitment deviation in 1972	R_{15}^δ	0.184440	0.263770
Recruitment deviation in 1973	R_{16}^δ	1.093900	0.166130
Recruitment deviation in 1974	R_{17}^δ	-0.175890	0.240320
Recruitment deviation in 1975	R_{18}^δ	-1.327500	0.279930
Recruitment deviation in 1976	R_{19}^δ	-1.077300	0.255780
Recruitment deviation in 1977	R_{20}^δ	-0.777960	0.222260
Recruitment deviation in 1978	R_{21}^δ	-0.395040	0.176160
Recruitment deviation in 1979	R_{22}^δ	-1.522100	0.232880
Recruitment deviation in 1980	R_{23}^δ	0.331310	0.133140
Recruitment deviation in 1981	R_{24}^δ	0.347740	0.130420
Recruitment deviation in 1982	R_{25}^δ	-0.512030	0.172020
Recruitment deviation in 1983	R_{26}^δ	0.256680	0.122990
Recruitment deviation in 1984	R_{27}^δ	0.784080	0.092010
Recruitment deviation in 1985	R_{28}^δ	0.001073	0.156710
Recruitment deviation in 1986	R_{29}^δ	0.228740	0.174090

Table 13. (continued) Estimated parameter values and their standard deviation (SD) for the base model.

Parameter description	Parameter	Estimate	SD
Recruitment deviation in 1987	R_{30}^{δ}	0.545860	0.163040
Recruitment deviation in 1988	R_{31}^{δ}	0.337950	0.170280
Recruitment deviation in 1989	R_{32}^{δ}	-0.443770	0.223280
Recruitment deviation in 1990	R_{33}^{δ}	0.426010	0.169890
Recruitment deviation in 1991	R_{34}^{δ}	0.031233	0.194390
Recruitment deviation in 1992	R_{35}^{δ}	-0.108580	0.213980
Recruitment deviation in 1993	R_{36}^{δ}	0.345900	0.203060
Recruitment deviation in 1994	R_{37}^{δ}	0.915800	0.185160
Recruitment deviation in 1995	R_{38}^{δ}	-0.175660	0.262270
Recruitment deviation in 1996	R_{39}^{δ}	0.215940	0.238260
Recruitment deviation in 1997	R_{40}^{δ}	-0.214240	0.283310
Recruitment deviation in 1998	R_{41}^{δ}	-0.477730	0.313300
Recruitment deviation in 1999	R_{42}^{δ}	-0.463610	0.343260
Recruitment deviation in 2000	R_{43}^{δ}	0.026063	0.378740
Recruitment deviation in 2001	R_{44}^{δ}	-0.144860	0.398790
Recruitment deviation in 2002	R_{45}^{δ}	0.099135	0.400010
Selectivity parameter 1 for fishery 1	$\eta_{1,1}$	2.508400	0.371340
Selectivity parameter 2 for fishery 1	$\eta_{2,1}$	5.836200	0.183620
Selectivity parameter 3 for fishery 1	$\eta_{3,1}$	0.147270	0.098170
Selectivity parameter 4 for fishery 1	$\eta_{4,1}$	9.872600	14.303000
Selectivity parameter 1 for fishery 2	$\eta_{1,2}$	2.683900	0.383700
Selectivity parameter 2 for fishery 2	$\eta_{2,2}$	6.155100	0.151870
Selectivity parameter 3 for fishery 2	$\eta_{3,2}$	0.236040	0.073958
Selectivity parameter 4 for fishery 2	$\eta_{4,2}$	8.713800	5.565300
Selectivity parameter 1 for fishery 3	$\eta_{1,3}$	2.392700	0.344100
Selectivity parameter 2 for fishery 3	$\eta_{2,3}$	5.994300	0.159700
Selectivity parameter 3 for fishery 3	$\eta_{3,3}$	0.209330	0.128850
Selectivity parameter 4 for fishery 3	$\eta_{4,3}$	15.639000	4.640200

Table 13. (continued) Estimated parameter values and their standard deviation (SD) for the base model.

Parameter description	Parameter	Estimate	SD
Selectivity parameter 1 for fishery 4	$\eta_{1,4}$	2.220100	0.226800
Selectivity parameter 2 for fishery 4	$\eta_{2,4}$	5.838900	0.105580
Selectivity parameter 3 for fishery 4	$\eta_{3,4}$	0.406790	0.140380
Selectivity parameter 4 for fishery 4	$\eta_{4,4}$	19.379000	0.908250
Catchbility for midwater juvenile survey	$\log(q_1)$	-31.356000	0.611190
Catchbility for Oregon bottom trawl logbook	$\log(q_2)$	-6.375600	0.161830
Catchbility for whiting bycatch (foreign)	$\log(q_3)$	-10.177000	0.183660
Catchbility for whiting bycatch (joint venture)	$\log(q_4)$	-9.777400	0.311620
Catchbility for whiting bycatch (domestic)	$\log(q_5)$	-11.790000	0.211780
Average fishing mortality for Fishery 1	$\log(FF_1)$	-4.010600	0.106790
Average fishing mortality for Fishery 2	$\log(FF_2)$	-2.921200	0.144870
Average fishing mortality for Fishery 3	$\log(FF_3)$	-3.958700	0.148400
Average fishing mortality for Fishery 4	$\log(FF_4)$	-4.752700	0.113500
Deviation of fishing mortality for Fishery 1 in 1966	$\log(FF^{\delta}_{1,1966})$	0.503830	0.149280
Deviation of fishing mortality for Fishery 1 in 1967	$\log(FF^{\delta}_{1,1967})$	0.588560	0.142860
Deviation of fishing mortality for Fishery 1 in 1968	$\log(FF^{\delta}_{1,1968})$	-0.220110	0.135430
Deviation of fishing mortality for Fishery 1 in 1969	$\log(FF^{\delta}_{1,1969})$	-1.765900	0.126620
Deviation of fishing mortality for Fishery 1 in 1970	$\log(FF^{\delta}_{1,1970})$	-1.330200	0.116780
Deviation of fishing mortality for Fishery 1 in 1971	$\log(FF^{\delta}_{1,1971})$	-1.126900	0.106260
Deviation of fishing mortality for Fishery 1 in 1972	$\log(FF^{\delta}_{1,1972})$	-1.685900	0.099091
Deviation of fishing mortality for Fishery 1 in 1973	$\log(FF^{\delta}_{1,1973})$	-1.306300	0.093194
Deviation of fishing mortality for Fishery 1 in 1974	$\log(FF^{\delta}_{1,1974})$	-2.081300	0.088991
Deviation of fishing mortality for Fishery 1 in 1975	$\log(FF^{\delta}_{1,1975})$	-1.678100	0.086701
Deviation of fishing mortality for Fishery 1 in 1976	$\log(FF^{\delta}_{1,1976})$	-1.039200	0.084570
Deviation of fishing mortality for Fishery 1 in 1977	$\log(FF^{\delta}_{1,1977})$	-0.734730	0.084946
Deviation of fishing mortality for Fishery 1 in 1978	$\log(FF^{\delta}_{1,1978})$	-1.434400	0.089091

Table 13. (continued) Estimated parameter values and their standard deviation (SD) for the base model.

Parameter description	Parameter	Estimate	SD
Deviation of fishing mortality for Fishery 1 in 1979	$\log(FF^{\delta}_{1,1979})$	-0.852490	0.093661
Deviation of fishing mortality for Fishery 1 in 1980	$\log(FF^{\delta}_{1,1980})$	2.144100	0.095214
Deviation of fishing mortality for Fishery 1 in 1981	$\log(FF^{\delta}_{1,1981})$	2.697600	0.090513
Deviation of fishing mortality for Fishery 1 in 1982	$\log(FF^{\delta}_{1,1982})$	2.616300	0.082482
Deviation of fishing mortality for Fishery 1 in 1983	$\log(FF^{\delta}_{1,1983})$	1.275500	0.078493
Deviation of fishing mortality for Fishery 1 in 1984	$\log(FF^{\delta}_{1,1984})$	0.377370	0.073821
Deviation of fishing mortality for Fishery 1 in 1985	$\log(FF^{\delta}_{1,1985})$	0.420270	0.072976
Deviation of fishing mortality for Fishery 1 in 1986	$\log(FF^{\delta}_{1,1986})$	0.883230	0.070268
Deviation of fishing mortality for Fishery 1 in 1987	$\log(FF^{\delta}_{1,1987})$	1.157400	0.070356
Deviation of fishing mortality for Fishery 1 in 1988	$\log(FF^{\delta}_{1,1988})$	0.982890	0.070775
Deviation of fishing mortality for Fishery 1 in 1989	$\log(FF^{\delta}_{1,1989})$	1.177200	0.067586
Deviation of fishing mortality for Fishery 1 in 1990	$\log(FF^{\delta}_{1,1990})$	0.855390	0.067060
Deviation of fishing mortality for Fishery 1 in 1991	$\log(FF^{\delta}_{1,1991})$	0.249670	0.068806
Deviation of fishing mortality for Fishery 1 in 1992	$\log(FF^{\delta}_{1,1992})$	0.125560	0.070416
Deviation of fishing mortality for Fishery 1 in 1993	$\log(FF^{\delta}_{1,1993})$	0.798190	0.073786
Deviation of fishing mortality for Fishery 1 in 1994	$\log(FF^{\delta}_{1,1994})$	0.399990	0.081713
Deviation of fishing mortality for Fishery 1 in 1995	$\log(FF^{\delta}_{1,1995})$	0.502920	0.092474
Deviation of fishing mortality for Fishery 1 in 1996	$\log(FF^{\delta}_{1,1996})$	0.423150	0.107670
Deviation of fishing mortality for Fishery 1 in 1997	$\log(FF^{\delta}_{1,1997})$	0.426940	0.127720
Deviation of fishing mortality for Fishery 1 in 1998	$\log(FF^{\delta}_{1,1998})$	-0.179580	0.146940
Deviation of fishing mortality for Fishery 1 in 1999	$\log(FF^{\delta}_{1,1999})$	-0.173910	0.163120
Deviation of fishing mortality for Fishery 1 in 2000	$\log(FF^{\delta}_{1,2000})$	-0.379140	0.183640
Deviation of fishing mortality for Fishery 1 in 2001	$\log(FF^{\delta}_{1,2001})$	-0.546310	0.197970
Deviation of fishing mortality for Fishery 1 in 2002	$\log(FF^{\delta}_{1,2002})$	-2.071400	0.199410
Deviation of fishing mortality for Fishery 2 in 1983	$\log(FF^{\delta}_{2,1983})$	-0.233850	0.116520
Deviation of fishing mortality for Fishery 2 in 1984	$\log(FF^{\delta}_{2,1984})$	0.466440	0.107060
Deviation of fishing mortality for Fishery 2 in 1985	$\log(FF^{\delta}_{2,1985})$	0.271110	0.102800
Deviation of fishing mortality for Fishery 2 in 1986	$\log(FF^{\delta}_{2,1986})$	0.173270	0.097853

Table 13. (continued) Estimated parameter values and their standard deviation (SD) for the base model.

Parameter description	Parameter	Estimate	SD
Deviation of fishing mortality for Fishery 2 in 1987	$\log(FF^{\delta}_{2,1987})$	0.561470	0.092900
Deviation of fishing mortality for Fishery 2 in 1988	$\log(FF^{\delta}_{2,1988})$	0.321030	0.088694
Deviation of fishing mortality for Fishery 2 in 1989	$\log(FF^{\delta}_{2,1989})$	0.607250	0.081619
Deviation of fishing mortality for Fishery 2 in 1990	$\log(FF^{\delta}_{2,1990})$	0.312920	0.074025
Deviation of fishing mortality for Fishery 2 in 1991	$\log(FF^{\delta}_{2,1991})$	-0.194320	0.068843
Deviation of fishing mortality for Fishery 2 in 1992	$\log(FF^{\delta}_{2,1992})$	-0.585160	0.065952
Deviation of fishing mortality for Fishery 2 in 1993	$\log(FF^{\delta}_{2,1993})$	-0.055828	0.062398
Deviation of fishing mortality for Fishery 2 in 1994	$\log(FF^{\delta}_{2,1994})$	-0.035984	0.059635
Deviation of fishing mortality for Fishery 2 in 1995	$\log(FF^{\delta}_{2,1995})$	0.002514	0.061534
Deviation of fishing mortality for Fishery 2 in 1996	$\log(FF^{\delta}_{2,1996})$	0.219960	0.068594
Deviation of fishing mortality for Fishery 2 in 1997	$\log(FF^{\delta}_{2,1997})$	0.256190	0.082663
Deviation of fishing mortality for Fishery 2 in 1998	$\log(FF^{\delta}_{2,1998})$	-0.571830	0.100750
Deviation of fishing mortality for Fishery 2 in 1999	$\log(FF^{\delta}_{2,1999})$	0.369820	0.116330
Deviation of fishing mortality for Fishery 2 in 2000	$\log(FF^{\delta}_{2,2000})$	0.474840	0.138120
Deviation of fishing mortality for Fishery 2 in 2001	$\log(FF^{\delta}_{2,2001})$	-0.286130	0.154620
Deviation of fishing mortality for Fishery 2 in 2002	$\log(FF^{\delta}_{2,2002})$	-2.073700	0.158510
Deviation of fishing mortality for Fishery 3 in 1983	$\log(FF^{\delta}_{3,1983})$	0.446210	0.117390
Deviation of fishing mortality for Fishery 3 in 1984	$\log(FF^{\delta}_{3,1984})$	0.255570	0.105650
Deviation of fishing mortality for Fishery 3 in 1985	$\log(FF^{\delta}_{3,1985})$	-0.196430	0.099582
Deviation of fishing mortality for Fishery 3 in 1986	$\log(FF^{\delta}_{3,1986})$	0.070451	0.095572
Deviation of fishing mortality for Fishery 3 in 1987	$\log(FF^{\delta}_{3,1987})$	-0.021600	0.091146
Deviation of fishing mortality for Fishery 3 in 1988	$\log(FF^{\delta}_{3,1988})$	-0.071484	0.086793
Deviation of fishing mortality for Fishery 3 in 1989	$\log(FF^{\delta}_{3,1989})$	0.577380	0.080468
Deviation of fishing mortality for Fishery 3 in 1990	$\log(FF^{\delta}_{3,1990})$	0.764400	0.072530
Deviation of fishing mortality for Fishery 3 in 1991	$\log(FF^{\delta}_{3,1991})$	0.704600	0.067141
Deviation of fishing mortality for Fishery 3 in 1992	$\log(FF^{\delta}_{3,1992})$	1.075200	0.063646
Deviation of fishing mortality for Fishery 3 in 1993	$\log(FF^{\delta}_{3,1993})$	1.410800	0.059516

Table 13. (continued) Estimated parameter values and their standard deviation (SD) for the base model.

Parameter description	Parameter	Estimate	SD
Deviation of fishing mortality for Fishery 3 in 1994	$\log(FF^{\delta}_{3,1994})$	1.131000	0.057035
Deviation of fishing mortality for Fishery 3 in 1995	$\log(FF^{\delta}_{3,1995})$	1.174000	0.058622
Deviation of fishing mortality for Fishery 3 in 1996	$\log(FF^{\delta}_{3,1996})$	1.155300	0.065993
Deviation of fishing mortality for Fishery 3 in 1997	$\log(FF^{\delta}_{3,1997})$	1.205000	0.080426
Deviation of fishing mortality for Fishery 3 in 1998	$\log(FF^{\delta}_{3,1998})$	0.661440	0.097640
Deviation of fishing mortality for Fishery 3 in 1999	$\log(FF^{\delta}_{3,1999})$	0.191660	0.114280
Deviation of fishing mortality for Fishery 3 in 2000	$\log(FF^{\delta}_{3,2000})$	-3.503500	0.135150
Deviation of fishing mortality for Fishery 3 in 2001	$\log(FF^{\delta}_{3,2001})$	-2.537700	0.150670
Deviation of fishing mortality for Fishery 3 in 2002	$\log(FF^{\delta}_{3,2002})$	-4.492300	0.154170
Deviation of fishing mortality for Fishery 4 in 1966	$\log(FF^{\delta}_{4,1966})$	-2.463800	0.141320
Deviation of fishing mortality for Fishery 4 in 1967	$\log(FF^{\delta}_{4,1967})$	-1.490800	0.136330
Deviation of fishing mortality for Fishery 4 in 1968	$\log(FF^{\delta}_{4,1968})$	-1.170000	0.130540
Deviation of fishing mortality for Fishery 4 in 1969	$\log(FF^{\delta}_{4,1969})$	-3.932100	0.123480
Deviation of fishing mortality for Fishery 4 in 1970	$\log(FF^{\delta}_{4,1970})$	-6.980300	0.115400
Deviation of fishing mortality for Fishery 4 in 1971	$\log(FF^{\delta}_{4,1971})$	-7.001400	0.106780
Deviation of fishing mortality for Fishery 4 in 1972	$\log(FF^{\delta}_{4,1972})$	-4.456500	0.100510
Deviation of fishing mortality for Fishery 4 in 1973	$\log(FF^{\delta}_{4,1973})$	-1.712200	0.094788
Deviation of fishing mortality for Fishery 4 in 1974	$\log(FF^{\delta}_{4,1974})$	-1.437000	0.090702
Deviation of fishing mortality for Fishery 4 in 1975	$\log(FF^{\delta}_{4,1975})$	-1.223400	0.087874
Deviation of fishing mortality for Fishery 4 in 1976	$\log(FF^{\delta}_{4,1976})$	-1.155400	0.085021
Deviation of fishing mortality for Fishery 4 in 1977	$\log(FF^{\delta}_{4,1977})$	-0.427510	0.086073
Deviation of fishing mortality for Fishery 4 in 1978	$\log(FF^{\delta}_{4,1978})$	-0.950500	0.088328
Deviation of fishing mortality for Fishery 4 in 1979	$\log(FF^{\delta}_{4,1979})$	0.661010	0.089668
Deviation of fishing mortality for Fishery 4 in 1980	$\log(FF^{\delta}_{4,1980})$	1.703200	0.088566
Deviation of fishing mortality for Fishery 4 in 1981	$\log(FF^{\delta}_{4,1981})$	1.856700	0.084318
Deviation of fishing mortality for Fishery 4 in 1982	$\log(FF^{\delta}_{4,1982})$	2.939500	0.078086

Table 13. (continued) Estimated parameter values and their standard deviation (SD) for the base model.

Parameter description	Parameter	Estimate	SD
Deviation of fishing mortality for Fishery 4 in 1983	$\log(FF^{\delta}_{4,1983})$	2.206200	0.075402
Deviation of fishing mortality for Fishery 4 in 1984	$\log(FF^{\delta}_{4,1984})$	1.990100	0.073149
Deviation of fishing mortality for Fishery 4 in 1985	$\log(FF^{\delta}_{4,1985})$	2.013200	0.070136
Deviation of fishing mortality for Fishery 4 in 1986	$\log(FF^{\delta}_{4,1986})$	1.722400	0.068621
Deviation of fishing mortality for Fishery 4 in 1987	$\log(FF^{\delta}_{4,1987})$	1.646700	0.067129
Deviation of fishing mortality for Fishery 4 in 1988	$\log(FF^{\delta}_{4,1988})$	1.409900	0.065153
Deviation of fishing mortality for Fishery 4 in 1989	$\log(FF^{\delta}_{4,1989})$	1.535800	0.064997
Deviation of fishing mortality for Fishery 4 in 1990	$\log(FF^{\delta}_{4,1990})$	1.708200	0.066883
Deviation of fishing mortality for Fishery 4 in 1991	$\log(FF^{\delta}_{4,1991})$	1.152100	0.068975
Deviation of fishing mortality for Fishery 4 in 1992	$\log(FF^{\delta}_{4,1992})$	1.187100	0.070837
Deviation of fishing mortality for Fishery 4 in 1993	$\log(FF^{\delta}_{4,1993})$	1.272200	0.075741
Deviation of fishing mortality for Fishery 4 in 1994	$\log(FF^{\delta}_{4,1994})$	1.265100	0.083361
Deviation of fishing mortality for Fishery 4 in 1995	$\log(FF^{\delta}_{4,1995})$	1.828600	0.093823
Deviation of fishing mortality for Fishery 4 in 1996	$\log(FF^{\delta}_{4,1996})$	1.627100	0.109190
Deviation of fishing mortality for Fishery 4 in 1997	$\log(FF^{\delta}_{4,1997})$	1.690900	0.127850
Deviation of fishing mortality for Fishery 4 in 1998	$\log(FF^{\delta}_{4,1998})$	1.445300	0.144900
Deviation of fishing mortality for Fishery 4 in 1999	$\log(FF^{\delta}_{4,1999})$	1.118700	0.162560
Deviation of fishing mortality for Fishery 4 in 2000	$\log(FF^{\delta}_{4,2000})$	1.402500	0.183640
Deviation of fishing mortality for Fishery 4 in 2001	$\log(FF^{\delta}_{4,2001})$	0.656630	0.199280
Deviation of fishing mortality for Fishery 4 in 2002	$\log(FF^{\delta}_{4,2002})$	-1.638200	0.202160

Table 14. Estimated age 3 recruits, age 3+ biomass, spawning biomass, spawning outputs, and annual fishing mortality of widow rockfish from 1958 to 2003 from the base model.

Year	Age 3 Recruits (10^3)	Age 3+ Biomass (mt)	Spawning Biomass (mt)	Spawning Output (10^6 eggs)	Fishing Mortality
1958	42425	220466	102199	39568	0.0000
1959	42862	221913	102256	39569	0.0000
1960	43310	223699	102502	39589	0.0000
1961	43450	225686	103008	39675	0.0000
1962	43484	227766	103779	39870	0.0000
1963	43588	229879	104767	40171	0.0000
1964	38812	230739	105804	40532	0.0000
1965	37029	230746	106795	40920	0.0000
1966	36109	230055	107526	41294	0.0007
1967	41850	226533	105758	40763	0.0019
1968	56748	226743	103517	39987	0.0027
1969	38332	225878	102483	39553	0.0002
1970	56976	231209	103219	39558	0.0000
1971	48694	235105	104283	39775	0.0000
1972	45931	238175	105953	40223	0.0001
1973	114065	258422	108494	40903	0.0016
1974	32197	261645	110677	41586	0.0021
1975	10281	257183	115070	42616	0.0025
1976	13405	249546	119094	44140	0.0027
1977	18353	240538	120479	45821	0.0056
1978	27513	231691	118712	46409	0.0033
1979	9198	218269	113852	45497	0.0167
1980	60680	215045	106614	43132	0.0474
1981	62387	196624	88927	36181	0.0552
1982	25945	168282	70995	28394	0.1631
1983	53363	150954	56512	21674	0.2157
1984	77180	157269	53990	19954	0.2001
1985	28235	153457	53514	19304	0.1785
1986	27537	150183	53840	19015	0.1767
1987	34969	147181	54543	19188	0.2156
1988	27526	137756	53297	19056	0.1758
1989	12418	126337	51429	18741	0.2318
1990	29889	116427	46808	17297	0.2049

Table 14 (continued). Estimated age 3 recruits, age 3+ biomass, spawning biomass, spawning outputs, and annual fishing mortality of widow rockfish from 1958 to 2002 from the base model.

Year	Age 3 Recruits (10^3)	Age 3+ Biomass (mt)	Spawning Biomass (mt)	Spawning Output (10^6 eggs)	Fishing Mortality
1991	20008	106788	43036	16076	0.1335
1992	17124	100875	41335	15525	0.1348
1993	24993	97515	39290	14779	0.2002
1994	41204	96923	35993	13536	0.1687
1995	13379	91781	34015	12701	0.1994
1996	18878	87232	32090	11757	0.1993
1997	11283	80813	31178	11258	0.2079
1998	8153	72565	30036	10898	0.1191
1999	7673	67531	29594	10928	0.1427
2000	12005	62878	27999	10558	0.1347
2001	9806	58524	26086	10027	0.0691
2002	12548	57481	25125	9755	0.0109

Table 15. Estimated numbers of fish (thousands) by age and year for widow rockfish aged 3 to 20+ from 1958 to 2002 from the base model.

	Age																
Year	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20+
1958	42425	32885	28305	24362	20969	18048	15534	13370	11508	9905	8525	7338	6316	5436	4679	4027	3466	21418
1959	42862	36516	28305	24362	20969	18048	15534	13370	11508	9905	8525	7338	6316	5436	4679	4027	3466	21418
1960	43310	36892	31429	24362	20969	18048	15534	13370	11508	9905	8525	7338	6316	5436	4679	4027	3466	21418
1961	43450	37277	31753	27052	20969	18048	15534	13370	11508	9905	8525	7338	6316	5436	4679	4027	3466	21418
1962	43484	37397	32085	27330	23284	18048	15534	13370	11508	9905	8525	7338	6316	5436	4679	4027	3466	21418
1963	43588	37427	32188	27616	23523	20040	15534	13370	11508	9905	8525	7338	6316	5436	4679	4027	3466	21418
1964	38812	37517	32214	27705	23769	20246	17249	13370	11508	9905	8525	7338	6316	5436	4679	4027	3466	21418
1965	37029	33405	32291	27727	23846	20458	17426	14846	11508	9905	8525	7338	6316	5436	4679	4027	3466	21418
1966	36109	31871	28752	27793	23865	20524	17609	14999	12778	9905	8525	7338	6316	5436	4679	4027	3466	21418
1967	41850	31078	27421	24650	23436	19920	17137	14729	12570	10730	8333	7186	6196	5342	4606	3971	3423	21202
1968	56748	36020	26738	23497	20733	19488	16569	14282	12301	10520	8999	7003	6051	5228	4516	3901	3368	20952
1969	38332	48842	30996	22962	19996	17544	16490	14032	12107	10438	8935	7650	5959	5154	4457	3854	3332	20808
1970	56976	32993	42037	26667	19721	17155	15051	14150	12044	10393	8962	7673	6571	5120	4429	3831	3313	20755
1971	48694	49039	28396	36160	22879	16893	14695	12897	12129	10326	8914	7689	6585	5641	4396	3804	3291	20682
1972	45931	41911	42206	24422	31000	19576	14455	12580	11044	10390	8849	7642	6594	5649	4841	3774	3266	20594
1973	114065	39533	36072	36311	20972	26590	16792	12402	10795	9480	8920	7599	6563	5664	4854	4160	3243	20513
1974	32197	98176	34024	31021	31121	17936	22741	14365	10613	9241	8117	7641	6511	5626	4857	4164	3570	20400
1975	10281	27712	84496	29268	26627	26675	15372	19492	12315	9100	7925	6963	6555	5587	4829	4170	3576	20596
1976	13405	8849	23850	72670	25096	22787	22825	13156	16686	10545	7794	6789	5966	5619	4791	4142	3578	20758
1977	18353	11538	7615	20503	62179	21408	19436	19476	11230	14250	9009	6662	5806	5105	4810	4104	3550	20876
1978	27513	15797	9929	6542	17486	52775	18166	16501	16545	9546	12121	7668	5674	4949	4355	4107	3507	20910
1979	9198	23680	13595	8537	5604	14939	45081	15521	14103	14145	8164	10369	6563	4858	4239	3732	3521	20954
1980	60680	7916	20374	11663	7238	4712	12549	37886	13052	11867	11911	6881	8748	5543	4109	3591	3168	20852

Table 15 (continued). Estimated numbers of fish (thousand) by age and year for widow rockfish aged 3 to 20+ from 1958 to 2002 from the base model.

	Age																	
Year	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20+
1981	62387	52214	6795	17081	8799	5105	3320	8924	27218	9475	8706	8832	5157	6629	4247	3185	2816	19237
1982	25945	53677	44753	5608	11880	5495	3188	2107	5763	17892	6341	5931	6125	3641	4765	3108	2372	16956
1983	53363	22318	45935	36495	3710	6847	3146	1852	1245	3465	10956	3957	3776	3984	2424	3251	2177	14245
1984	77180	45919	19160	38594	27677	2590	4757	2205	1312	891	2509	8022	2931	2831	3025	1864	2536	13142
1985	28235	66417	39444	16180	29767	19600	1827	3393	1593	959	660	1880	6083	2249	2199	2378	1483	12744
1986	27537	24297	57059	33353	12611	21534	14129	1329	2494	1183	720	500	1441	4711	1760	1739	1902	11619
1987	34969	23697	20875	48250	25980	9132	15553	10303	980	1859	891	548	385	1120	3702	1398	1396	11052
1988	27526	30092	20355	17603	36812	18091	6347	10956	7367	711	1369	666	415	295	870	2911	1112	10116
1989	12418	23688	25857	17227	13728	26656	13079	4639	8105	5516	539	1049	516	325	234	696	2349	9220
1990	29889	10686	20345	21778	13034	9409	18230	9075	3271	5807	4015	398	787	392	251	183	551	9354
1991	20008	25721	9179	17167	16721	9184	6607	12945	6526	2383	4285	3000	301	603	304	197	145	8041
1992	17124	17219	22110	7800	13723	12636	6922	5015	9905	5035	1853	3361	2372	240	484	246	161	6780
1993	24993	14737	14800	18778	6228	10367	9510	5241	3824	7608	3897	1446	2642	1880	192	390	200	5726
1994	41204	21508	12660	12493	14452	4412	7311	6774	3776	2788	5616	2912	1094	2023	1457	150	310	4803
1995	13379	35459	18482	10723	9798	10556	3211	5367	5023	2829	2111	4295	2250	854	1595	1161	121	4188
1996	18878	11513	30456	15594	8258	6951	7450	2287	3863	3656	2082	1571	3235	1715	658	1246	917	3487
1997	11283	16245	9890	25723	12030	5855	4907	5314	1650	2822	2703	1559	1190	2480	1331	517	990	3571
1998	8153	9709	13954	8346	19753	8460	4099	3471	3805	1197	2072	2010	1174	908	1915	1040	409	3687
1999	7673	7016	8346	11867	6722	15151	6467	3149	2683	2960	937	1633	1595	938	730	1553	850	3393
2000	12005	6604	6032	7097	9469	5030	11318	4877	2400	2066	2303	736	1295	1276	757	594	1273	3525
2001	9806	10332	5678	5133	5690	7139	3788	8604	3746	1862	1619	1821	587	1042	1035	619	490	4001
2002	12548	8439	8888	4858	4257	4576	5737	3059	6984	3056	1527	1334	1507	488	870	867	520	3802

Table 16. Estimated numbers of fish caught (thousand) by age and year for widow rockfish aged 3 to 20+ from 1958 to 2002 from the base model.

Year	Age 3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20+
1958	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1959	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1960	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1961	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1962	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1963	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1964	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1965	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1966	1	11	105	525	670	570	461	366	290	207	164	129	101	79	61	47	36	197
1967	1	12	113	521	738	622	505	406	323	255	183	144	113	89	69	53	41	222
1968	1	7	55	246	326	306	247	200	162	129	103	74	58	46	36	27	21	113
1969	0	2	12	46	60	53	47	37	30	24	19	15	10	8	6	5	4	21
1970	0	2	24	80	88	75	62	54	43	34	27	21	16	11	9	7	5	30
1971	0	3	20	132	125	91	74	61	53	41	33	26	20	15	11	8	6	36
1972	0	2	17	52	99	62	43	35	29	25	19	15	12	9	7	5	4	21
1973	1	3	28	142	124	158	95	66	55	45	40	31	25	20	15	12	8	43
1974	0	6	18	79	121	71	87	53	38	31	26	23	18	15	11	9	6	31
1975	0	2	61	102	142	145	81	98	59	42	34	28	25	19	15	12	9	42
1976	0	1	26	398	208	190	183	100	120	72	50	40	33	28	22	17	13	63
1977	0	2	13	174	801	280	245	235	129	156	93	65	52	42	36	27	20	102
1978	0	2	9	30	120	371	123	108	103	57	68	40	28	22	18	15	11	56
1979	0	8	41	119	120	333	988	332	293	284	158	191	114	78	62	48	39	192
1980	14	20	491	1340	1216	795	2030	5829	1902	1631	1535	827	974	566	380	297	231	1321

Table 16 (continued). Estimated numbers of fish caught (thousand) by age and year for widow rockfish aged 3 to 20+ from 1958 to 2002 from the base model.

Year	Age 3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20+
1981	22	203	260	3053	2251	1306	813	2077	5991	1963	1690	1597	863	1017	592	399	313	1875
1982	13	286	2186	1209	3663	1717	967	617	1620	4815	1625	1439	1394	769	920	538	361	2223
1983	12	53	1018	4036	653	1230	544	305	195	512	1522	513	453	437	239	284	164	908
1984	14	84	336	3728	4566	435	758	330	184	116	302	887	296	257	244	131	152	658
1985	5	115	644	1421	4420	2964	263	461	203	114	73	192	567	190	165	156	83	594
1986	4	41	929	2946	1862	3224	2008	177	311	137	77	49	129	381	127	110	103	529
1987	6	45	394	5097	4620	1637	2628	1623	143	250	110	61	39	102	297	98	84	561
1988	4	46	315	1537	5437	2694	891	1433	892	79	140	62	35	22	58	169	55	425
1989	2	47	515	1938	2604	5100	2360	781	1264	792	71	125	56	31	20	52	151	501
1990	5	20	372	2187	2201	1613	2970	1389	468	772	493	45	81	36	21	13	34	489
1991	2	31	108	1136	1897	1062	726	1337	629	213	354	227	21	37	17	9	6	281
1992	2	22	272	524	1562	1476	775	532	990	471	161	270	174	16	29	13	7	260
1993	4	27	265	1848	1026	1743	1527	794	544	1008	478	163	272	174	16	28	13	309
1994	6	32	187	1032	2036	634	1001	873	456	313	582	277	95	157	101	9	16	213
1995	3	68	338	1049	1603	1768	516	817	721	381	265	499	240	82	138	88	8	232
1996	3	21	530	1503	1355	1163	1188	344	544	479	253	175	328	157	54	89	56	181
1997	2	30	180	2579	2049	1018	814	831	242	385	342	181	126	237	113	39	64	194
1998	1	11	155	498	1999	880	409	329	341	101	163	146	78	55	104	49	17	126
1999	1	8	93	804	817	1862	745	336	263	265	76	119	104	54	37	68	32	105
2000	1	7	63	452	1093	585	1228	488	220	172	173	50	78	68	35	24	43	97
2001	1	6	32	174	348	440	218	455	181	82	64	65	19	30	26	13	9	59
2002	0	1	8	26	43	46	53	26	53	21	9	7	7	2	3	3	1	8

Table 17. Sensitivity analysis showing changes in spawning outputs and total log-likelihood values in response to changes in natural mortality (M). Spawning outputs are for the first year (SO_{1958}=B_0), the last year (SO_{2002}), and percentage of SO_{2002}/ SO_{1958}.

Change in M	SO_{1968}	SO_{2002}	% SO_{2002}/ SO_{1968}	Likelihood
$M=0.09$	45637	10394	22.78	-98.88
$M=0.11$	43282	10256	23.70	-98.81
$M=0.13$	41499	9918	23.90	-100.27
Base run ($M=0.15$)	39566	9755	24.65	-103.35
$M=0.17$	37603	9950	26.46	-108.24
$M=0.19$	34552	11287	32.67	-115.57
$M=0.21$	35791	16714	46.70	-125.43

Table 18. Sensitivity analysis showing changes in spawning outputs and total log-likelihood values in response to changes in the power coefficient for the midwater juvenile survey index (p). Spawning outputs are for the first year (SO_{1958}=B_0), the last year (SO_{2002}), and percentage of SO_{2002}/ SO_{1958}.

Change in p	SO_{1968}	SO_{2002}	% SO_{2002}/ SO_{1968}	Likelihood
$p=1.0$	39591	8876	22.42	-105.80
$p=2.0$	39730	8895	22.39	-103.49
Base run ($p=3.0$)	39566	9755	24.65	-103.35
$p=4.0$	39519	10711	27.11	-104.48
$p=5.0$	39569	11538	29.16	-106.26

Figure 1. U.S. landings (mt) of widow rockfish by four fisheries from 1966 to 2002. Four fisheries are defined by area and gear type.

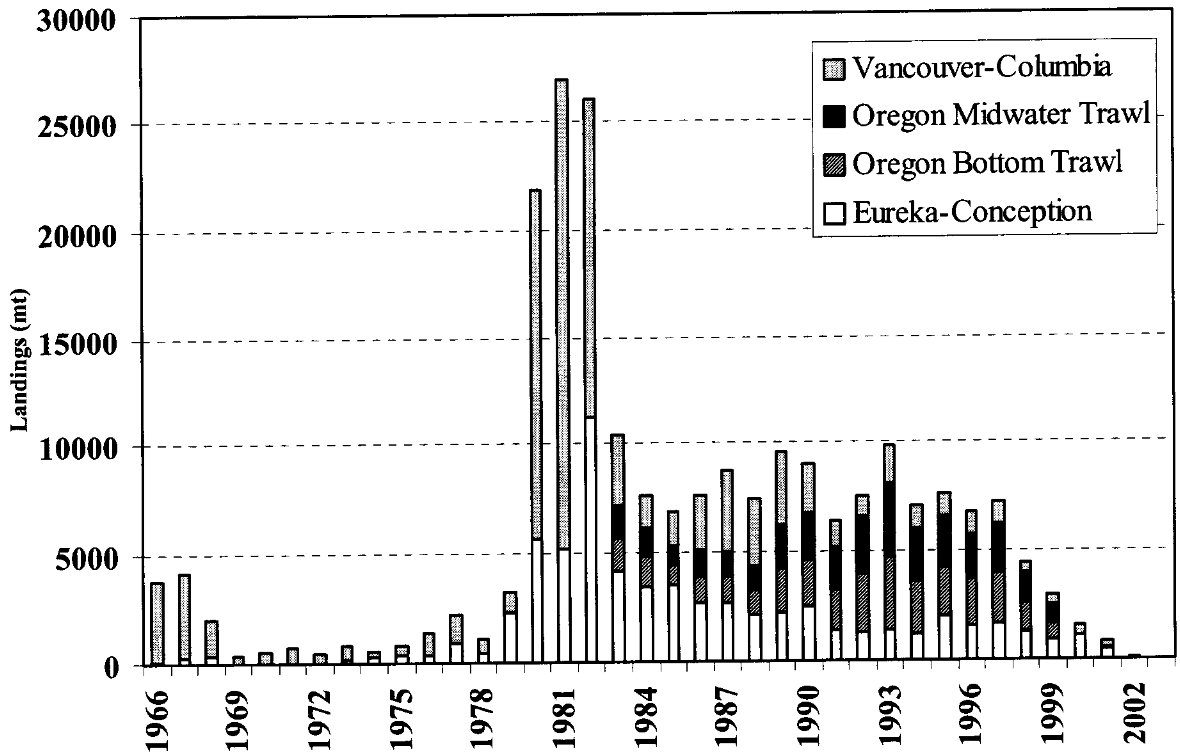
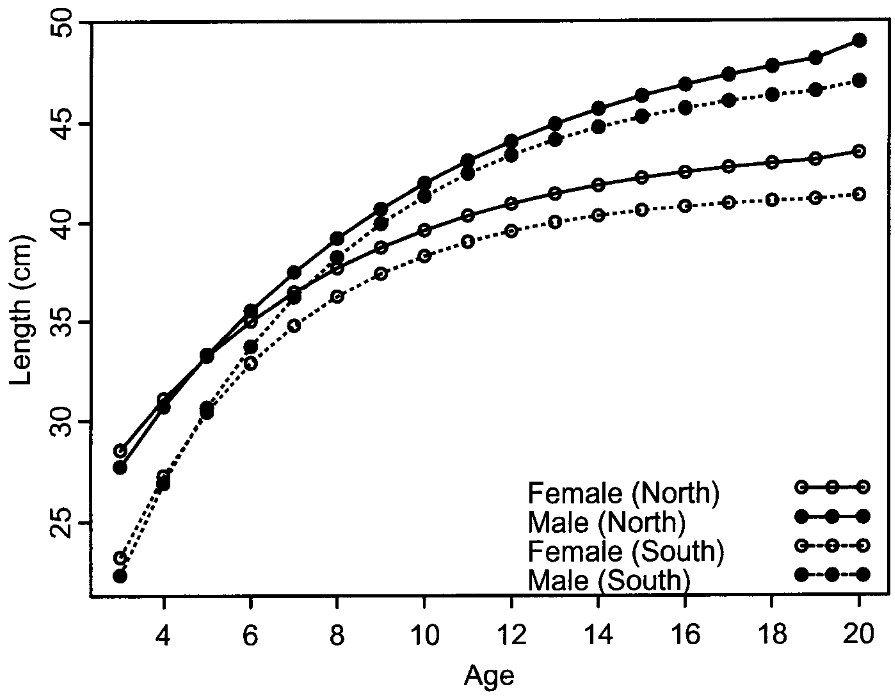


Figure 2. Growth functions for widow rockfish by sex from north and south of 43° latitude used in this assessment.



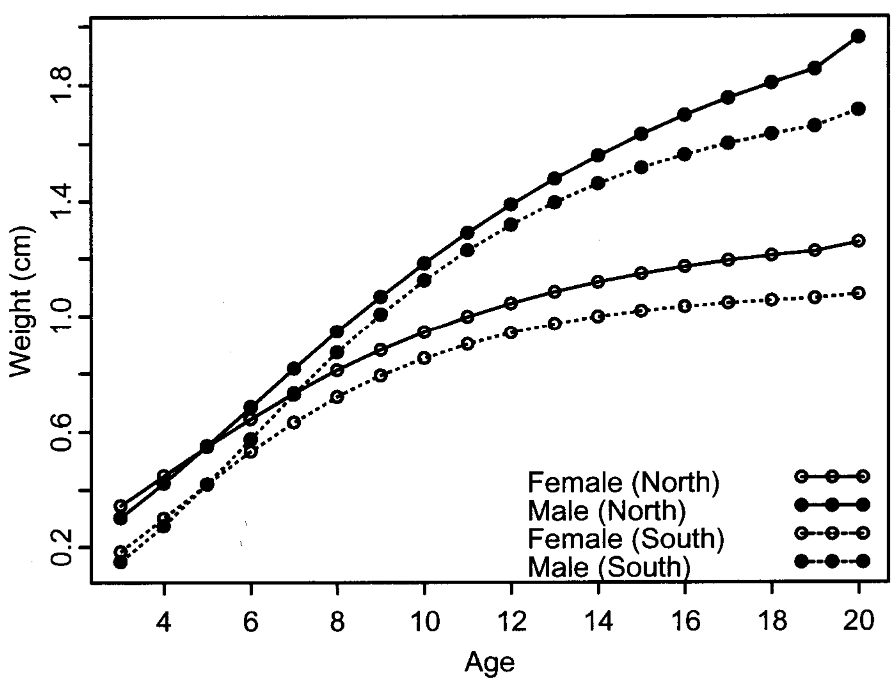
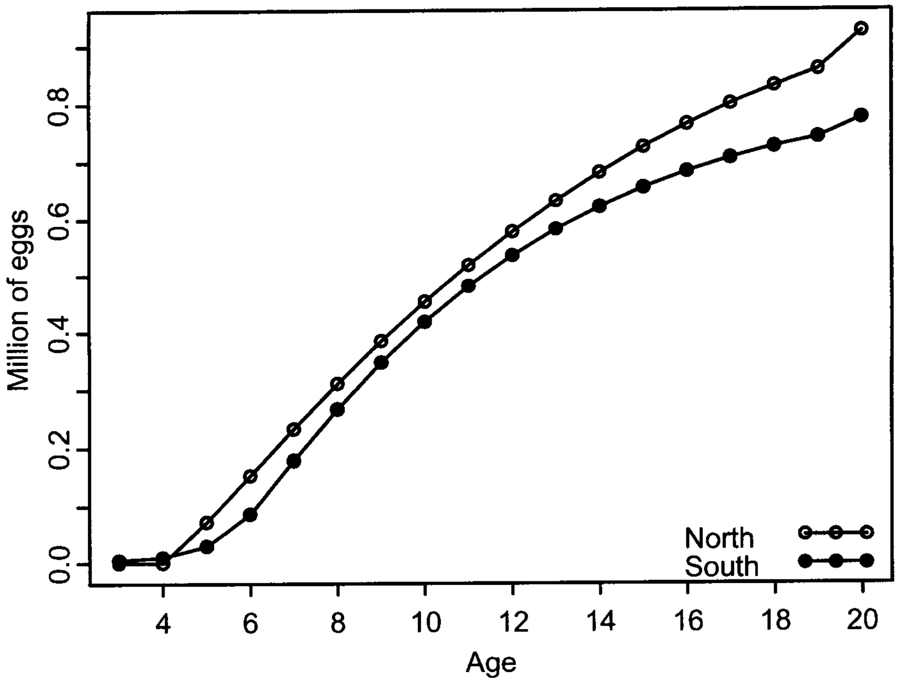


Figure 3. Fecundity and maturity for widow rockfish from north and south of 43° latitude used in this assessment.



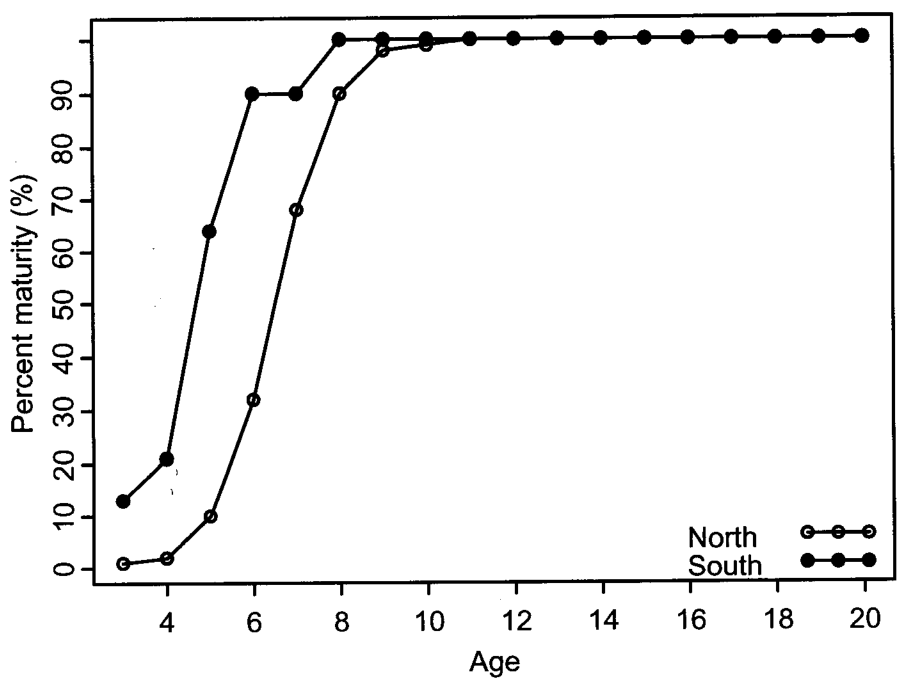


Figure 4. Proportional age composition data for the Vancouver-Columbia combined fishery, by sex and year with the sum across sexes equal to 1.

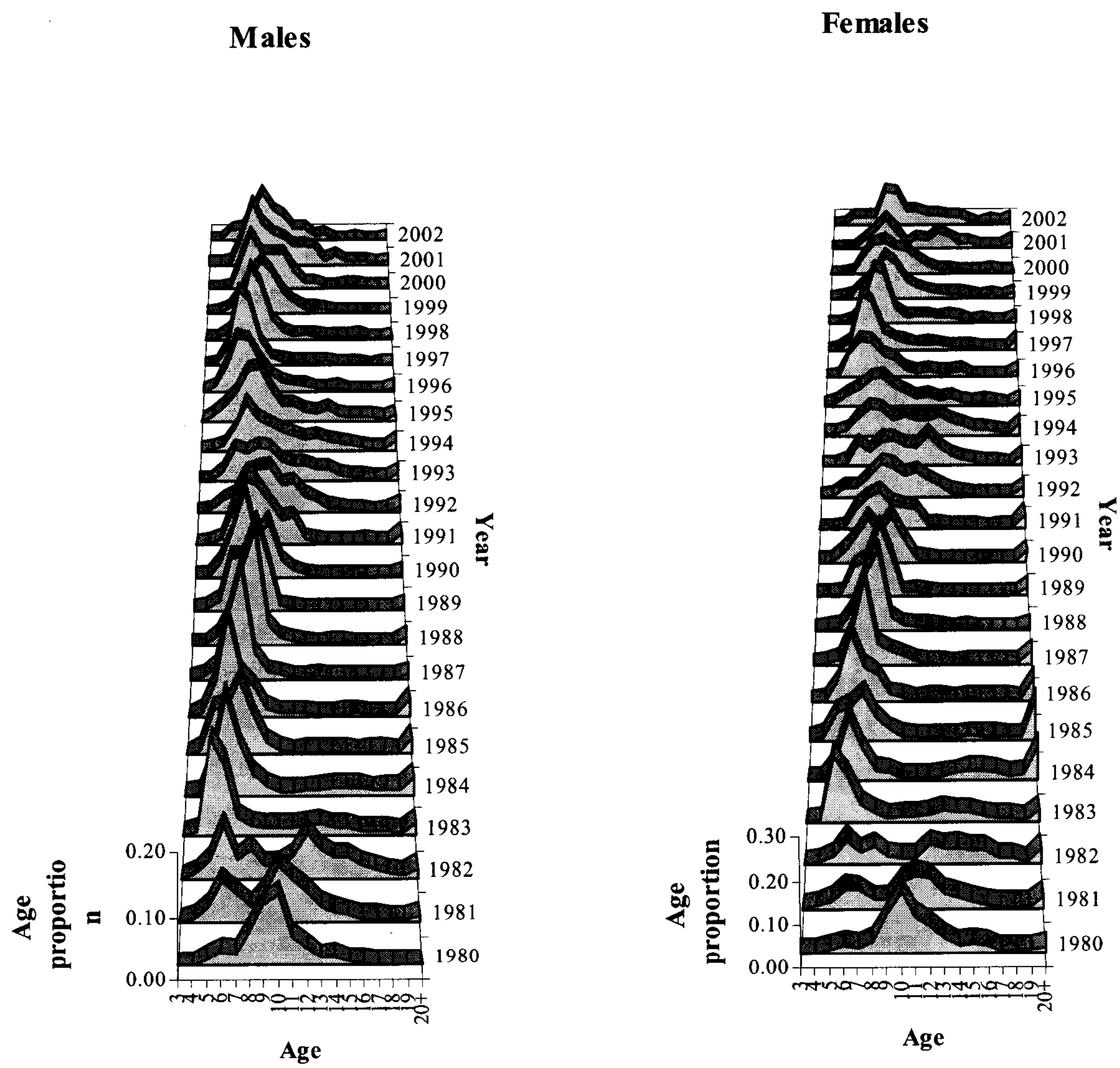
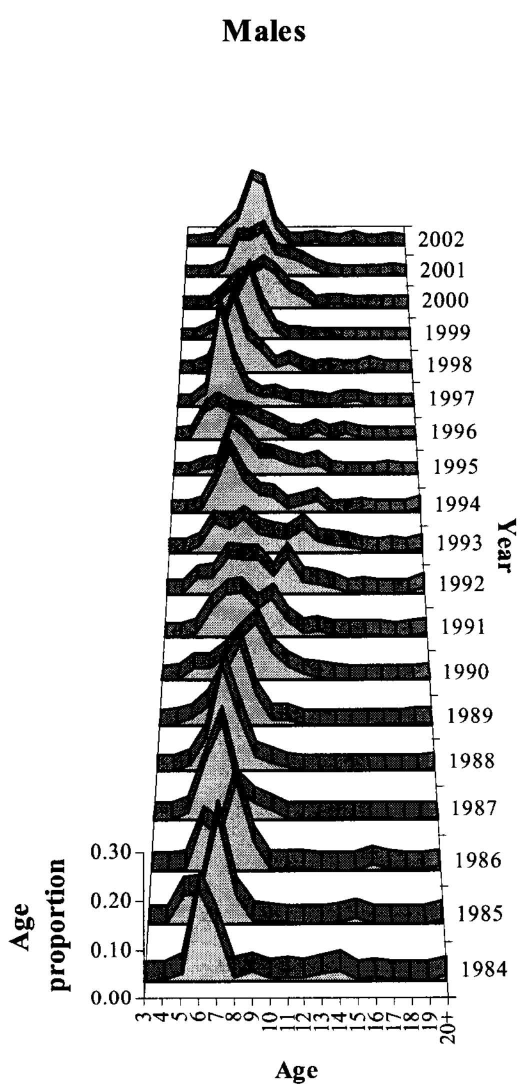


Figure 5. Proportional age composition data for the Oregon midwater trawl fishery, by sex and year with the sum across sexes equal to 1.



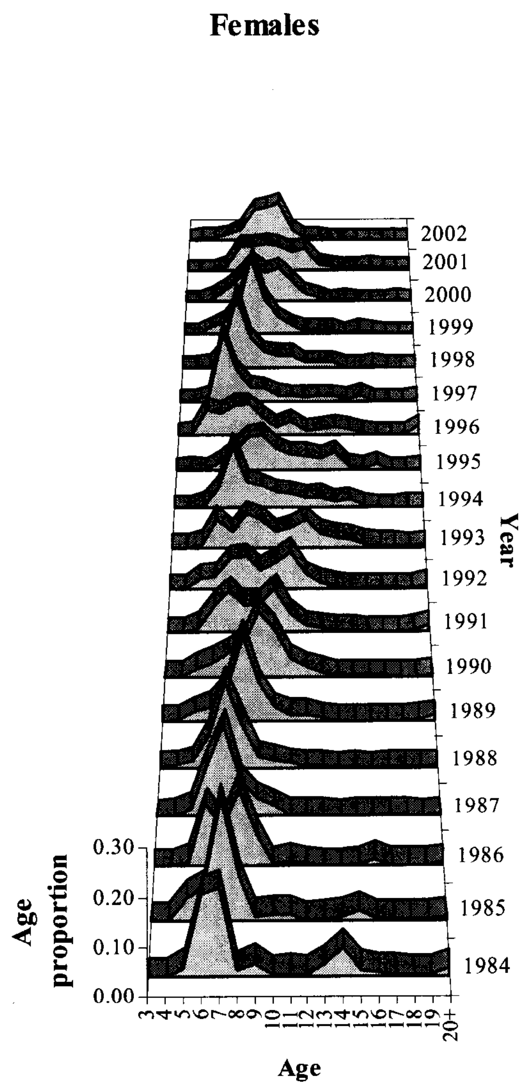


Figure 6. Proportional age composition data for the Oregon bottom trawl fishery, by sex and year with the sum across sexes equal to 1.

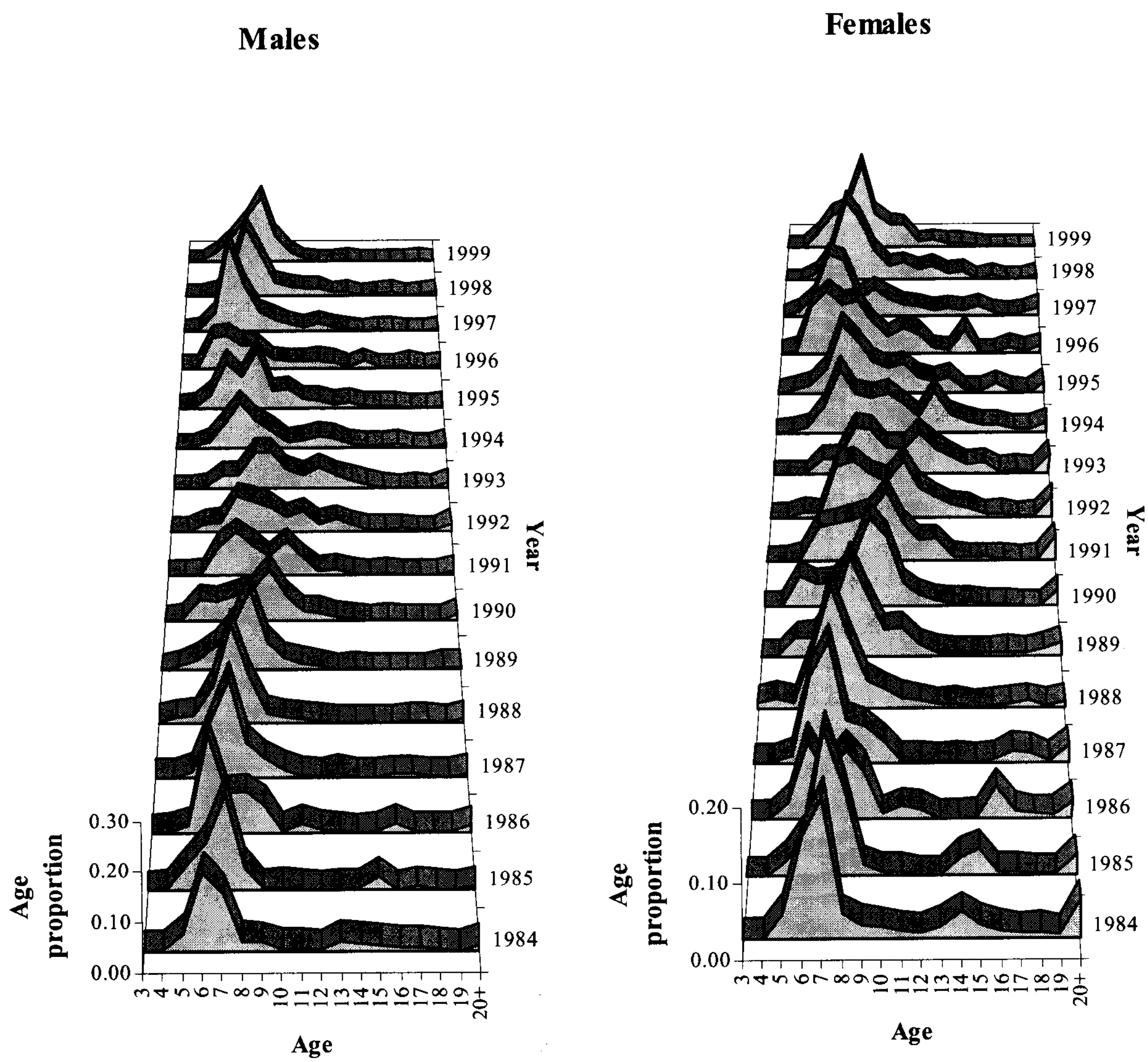
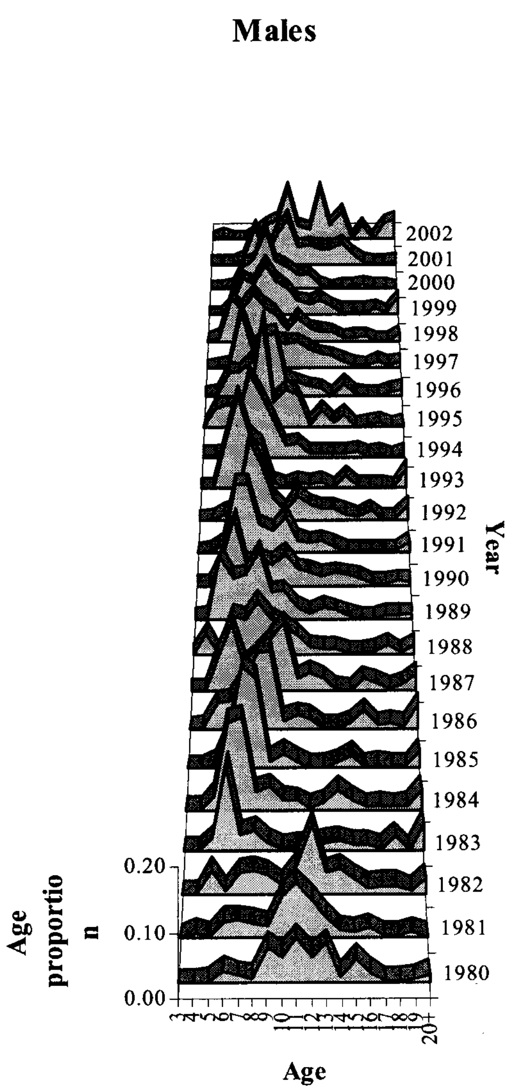


Figure 7. Proportional age composition data for the Eureka-Conception combined fishery, by sex and year with the sum across sexes equal to 1.



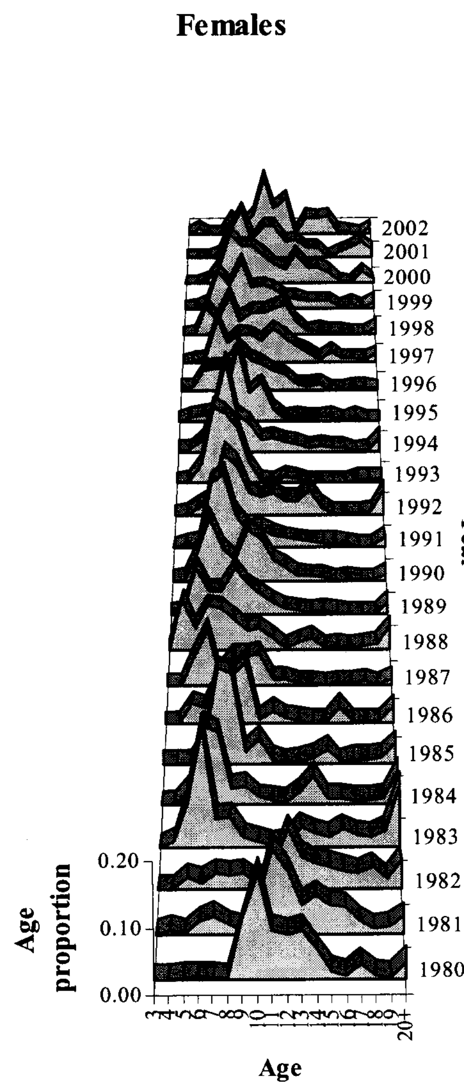
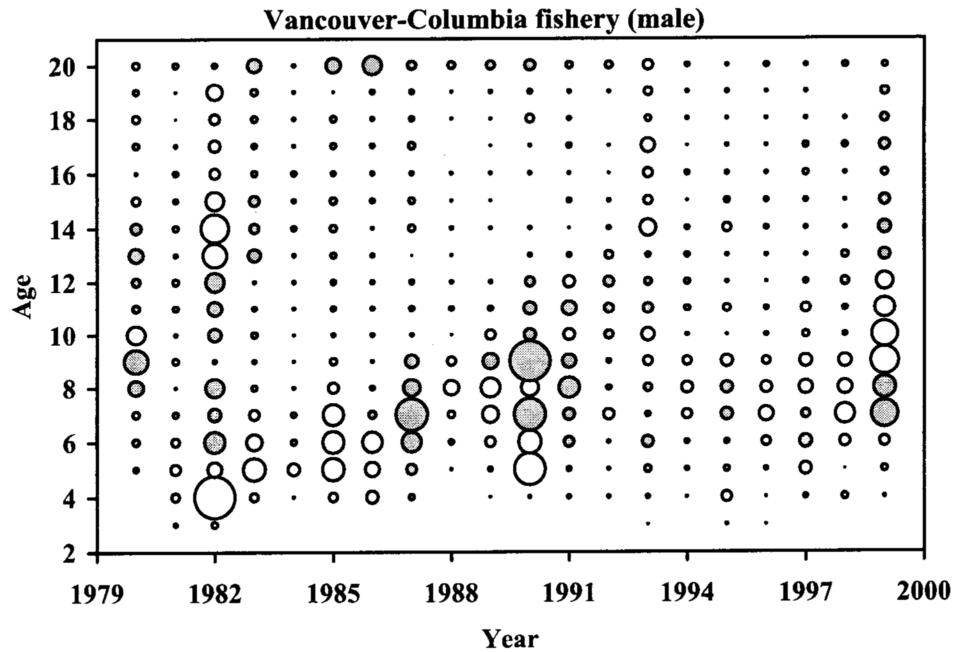


Figure 8. Differences in proportions between age composition data used in 2000 and this assessment (2000 estimate – this estimate) for the Vancouver-Columbia fishery. Dark circles represent positive differences and open circles represent negative differences. The largest circle represents approximately difference of 0.04.



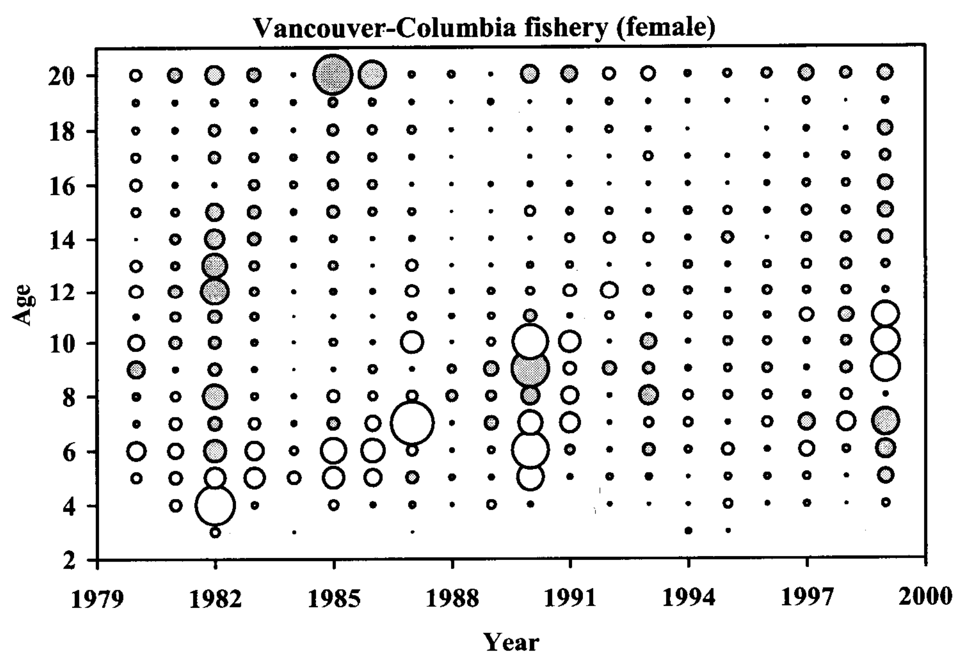
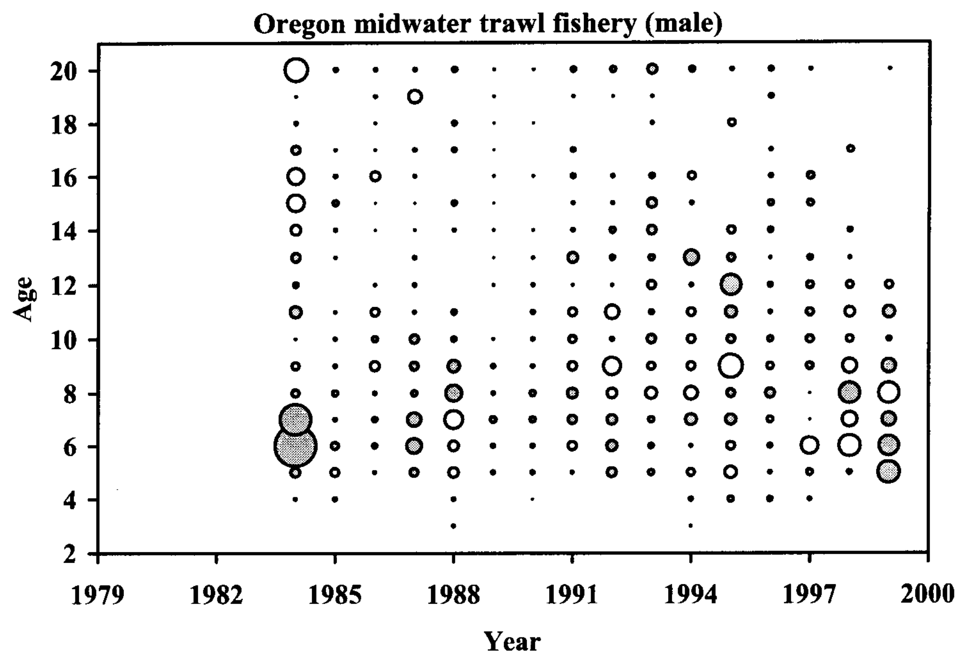


Figure 9. Differences in proportions between age composition data used in 2000 and this assessment (2000 estimate – this estimate) for the Oregon midwater trawl fishery. Dark circles represent positive differences and open circles represent negative differences. The largest circle represents approximately difference of 0.04.



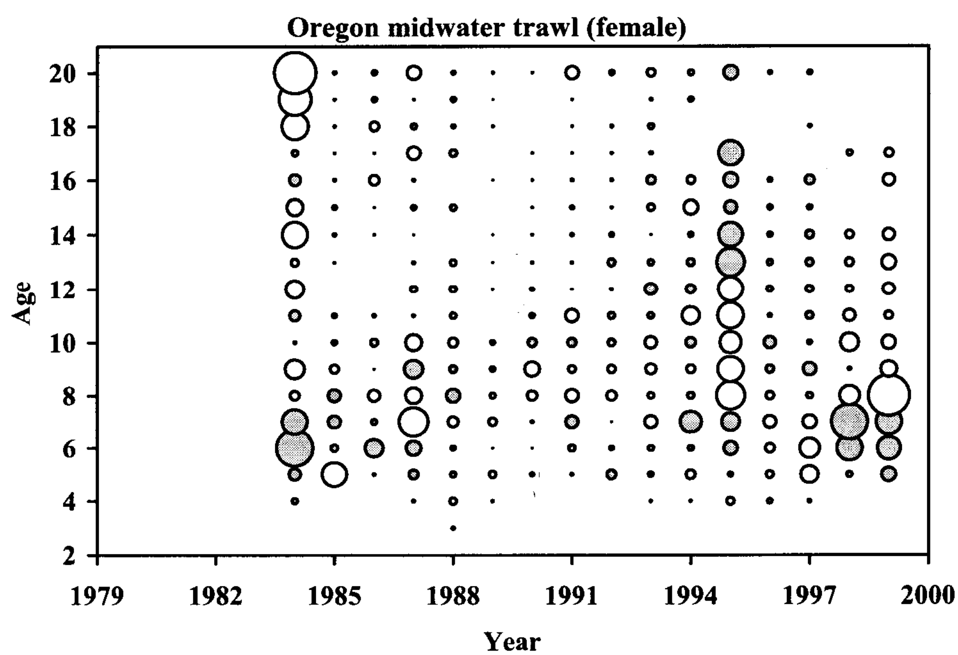
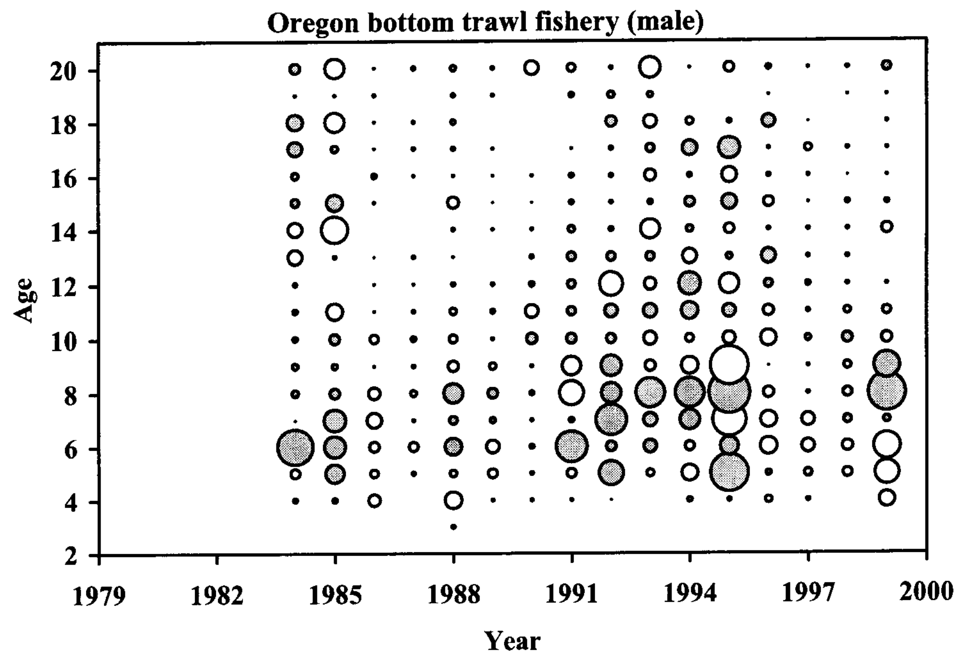


Figure 10. Differences in proportions between age composition data used in 2000 and this assessment (2000 estimate – this estimate) for the Oregon bottom trawl fishery. Dark circles represent positive differences and open circles represent negative differences. The largest circle represents approximately difference of 0.04.



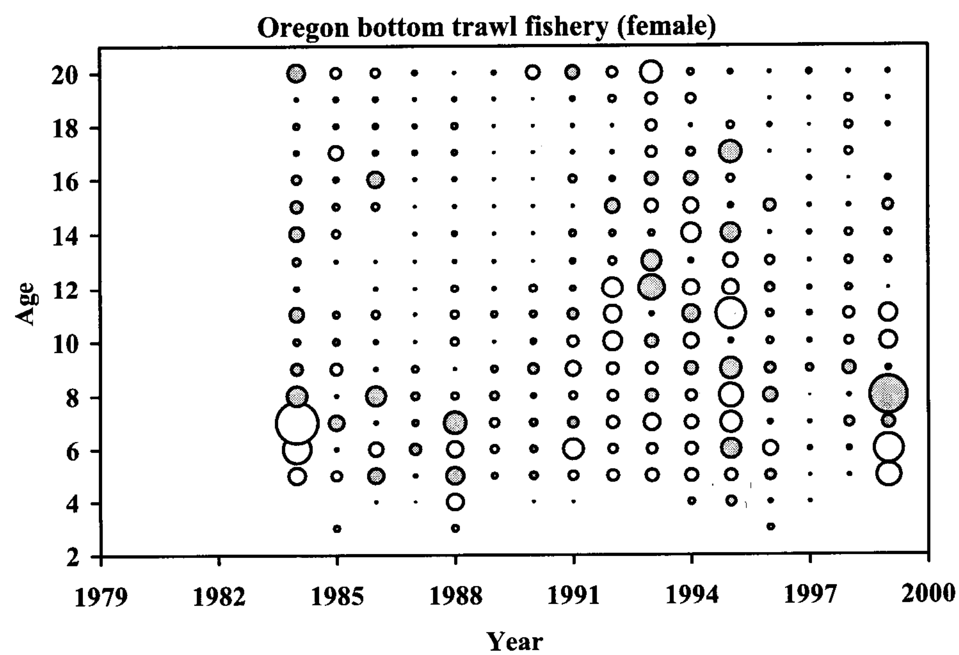
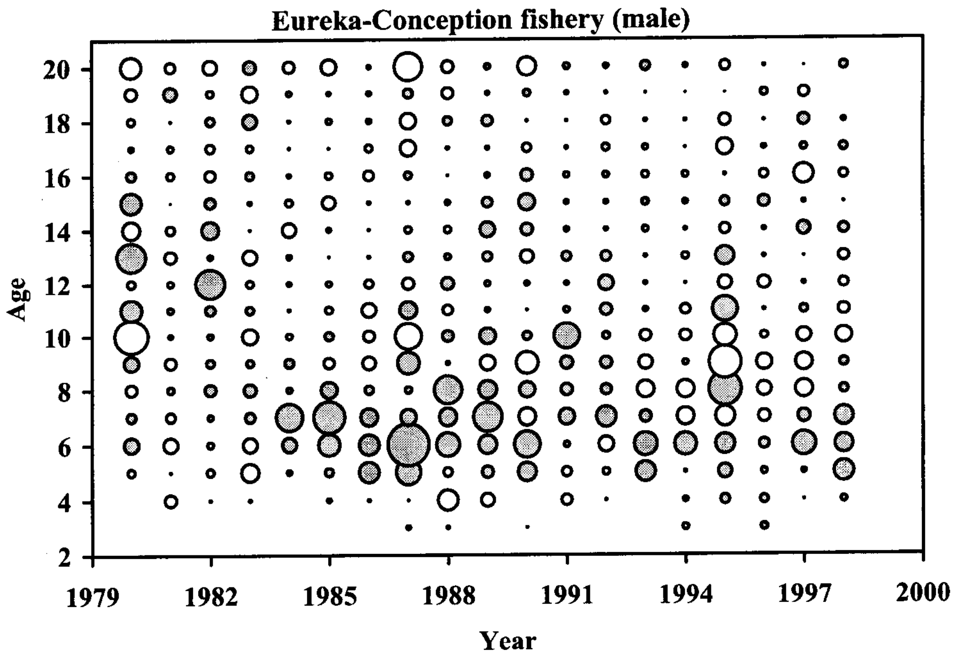


Figure 11. Differences in proportions between age composition data used in 2000 and this assessment (2000 estimate – this estimate) for the Eureka-Conception fishery. Dark circles represent positive differences and open circles represent negative differences. The largest circle represents approximately difference of 0.04.



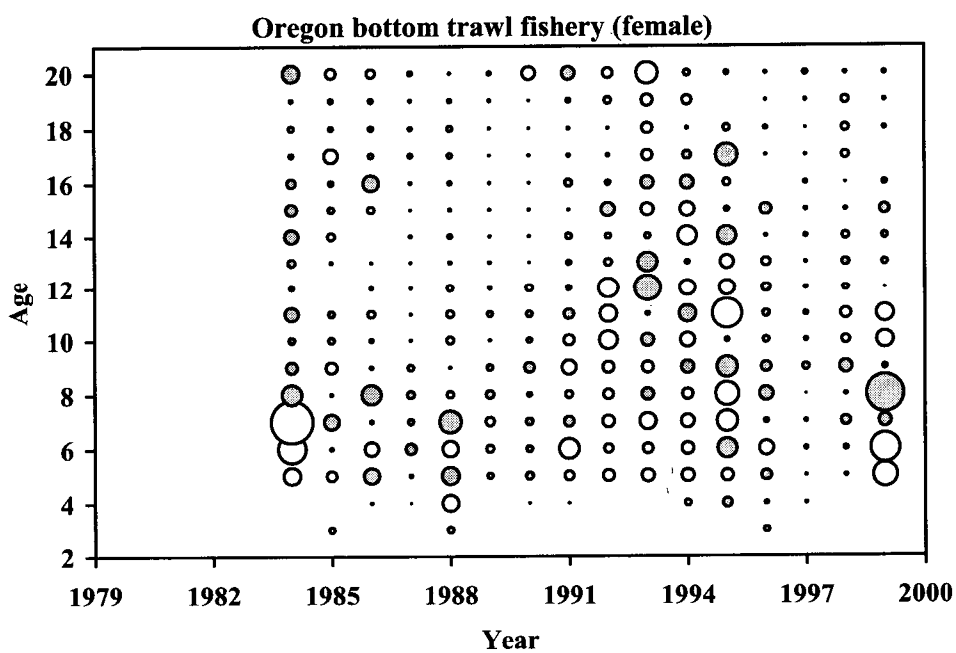


Figure 12. Yearly index estimates from the Santa Cruz/Tiburon Laboratory midwater juvenile trawl survey from 1984 to 2002.

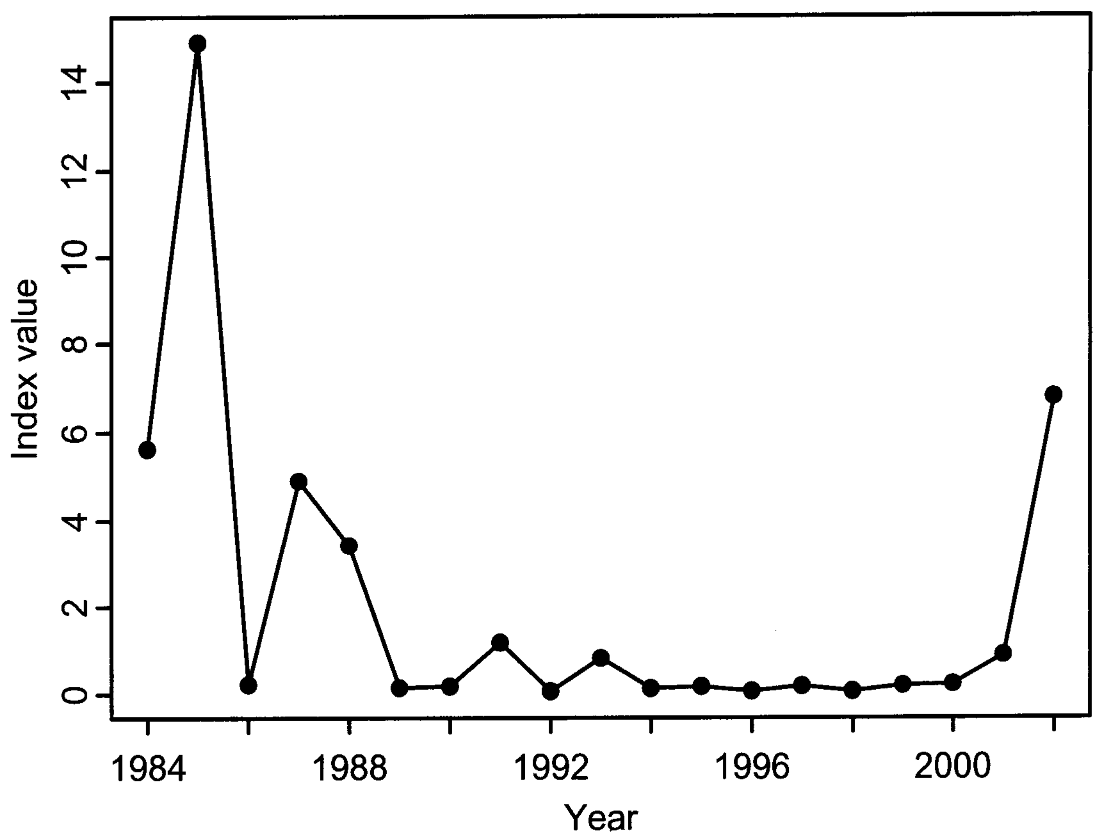


Figure 13. Catch per unit effort of widow rockfish from Oregon bottom trawl fishery from 1984 to 1999.

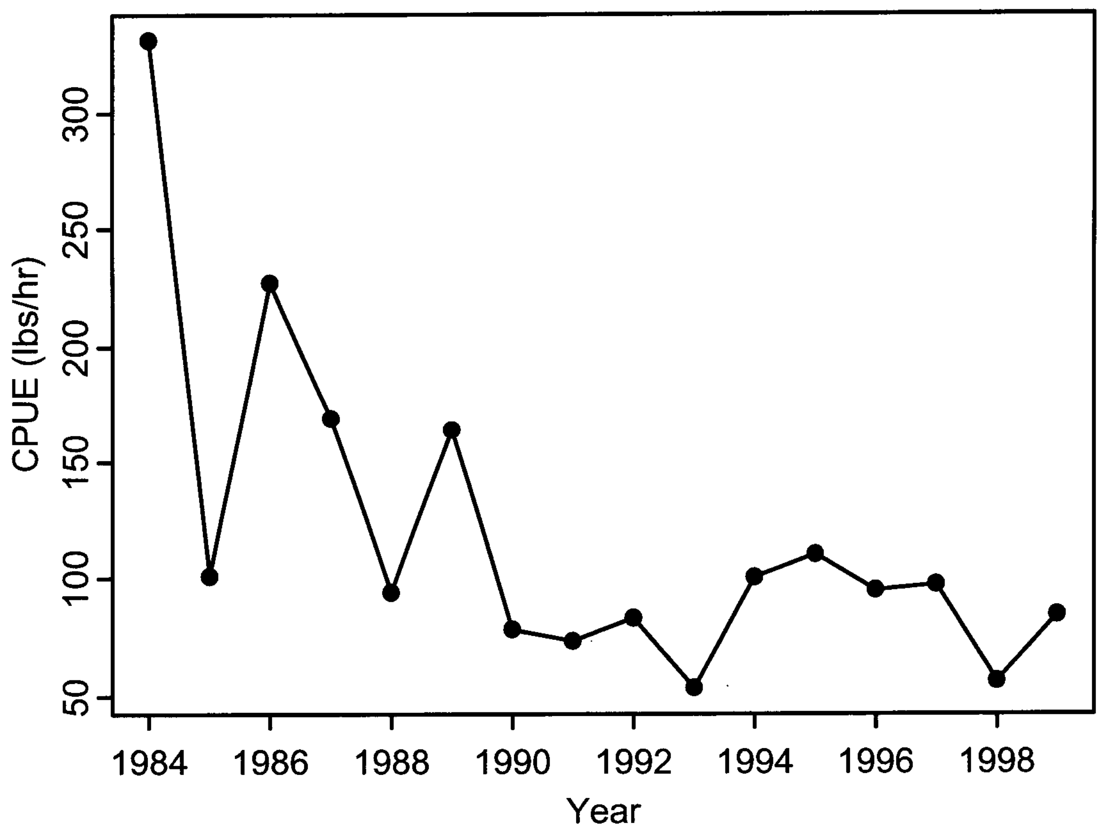


Figure 14. Catch per unit effort of widow rockfish abundance derived from bycatch in the Pacific whiting fisheries.

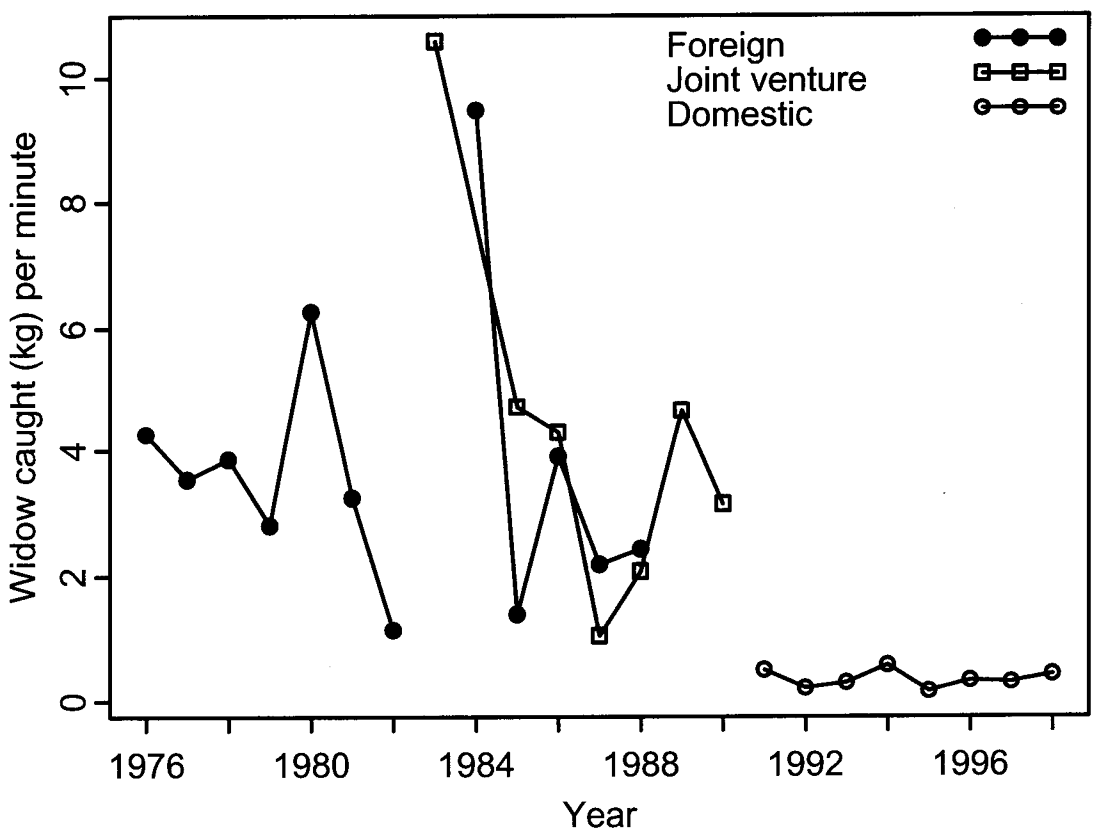


Figure 15. Fraction of landings in the north area, defined as the Vancouver-Columbia and Oregon trawl fisheries, with a 7-year moving average. Note that the fractions before 1977 were fixed at the value computed before the foreign landings (Rogers 2003) were added.

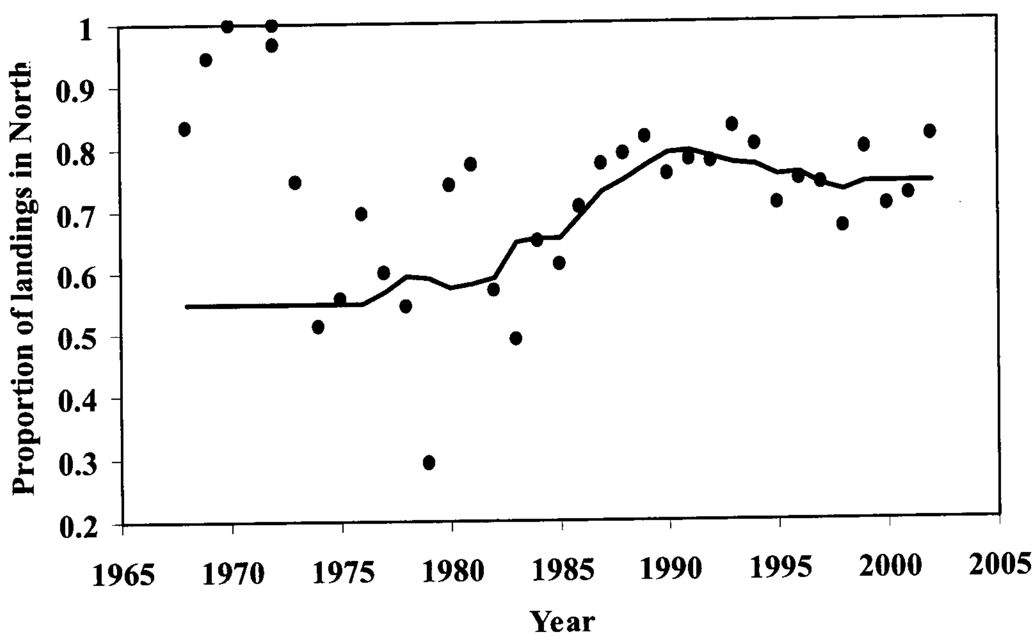
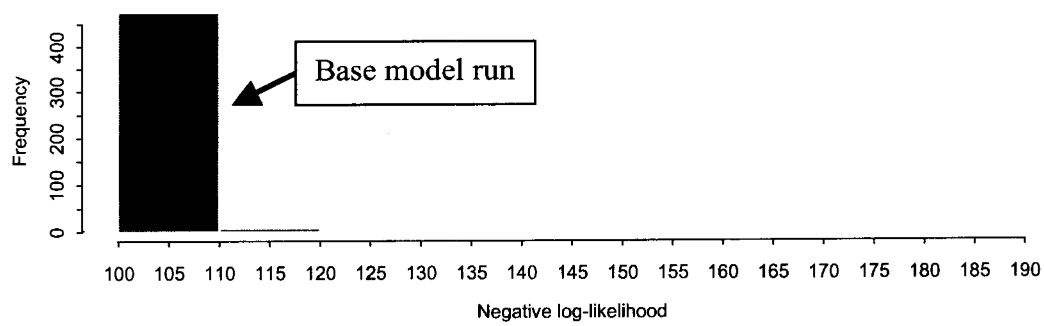


Figure 16. Negative log-likelihood values and percentages of B_{2002} (spawning output in 2002) over B_0 (spawning output in 1958) from 488 base model runs. These runs were from a total of 500 model runs, of which 12 runs resulted in poor fits of the model (extreme likelihood values or Hessian matrix not positive definite). In each of 500 runs, initial value of every parameter was randomly perturbed by 50% of the best fitted value in the base model.



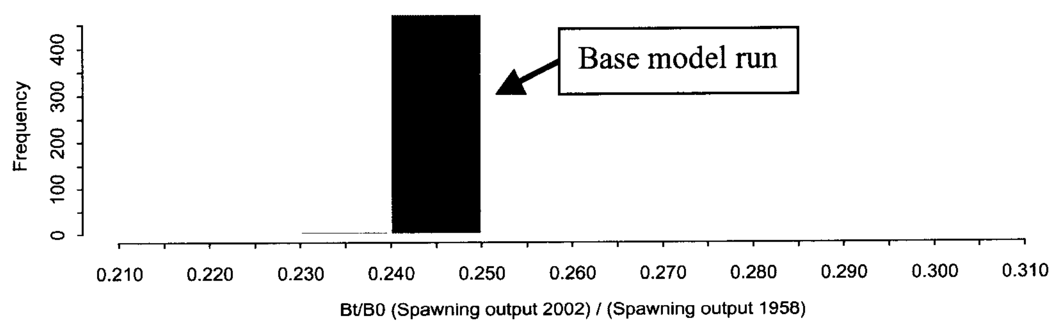


Figure 17. Age 3+ biomass (1000mt) and spawning biomass (1000mt) from 1958 to 2002 estimates from the base model.

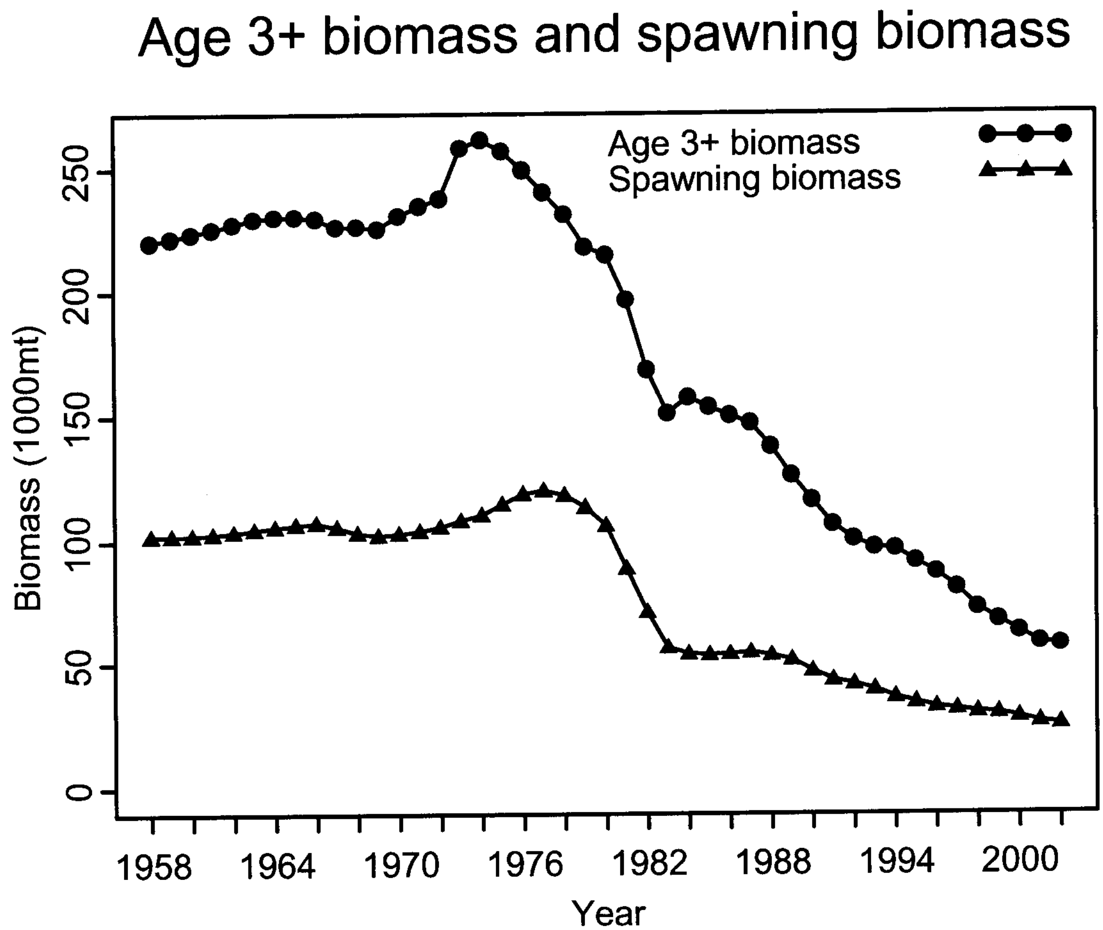


Figure 18. Spawning biomass (million of eggs) from 1958 to 2002, estimates from the base model.

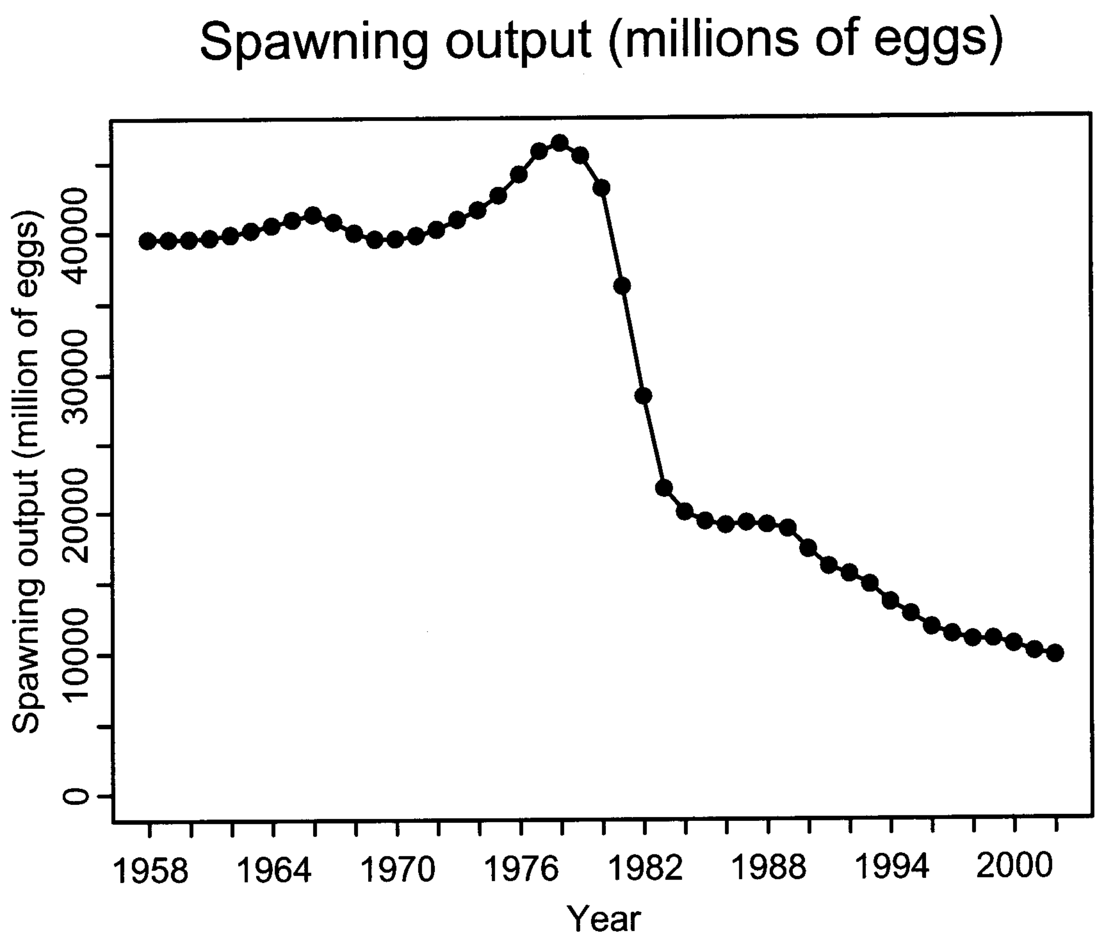


Figure 19. Age 3 recruits (*1000) from 1958 to 2002 estimates from the base model.

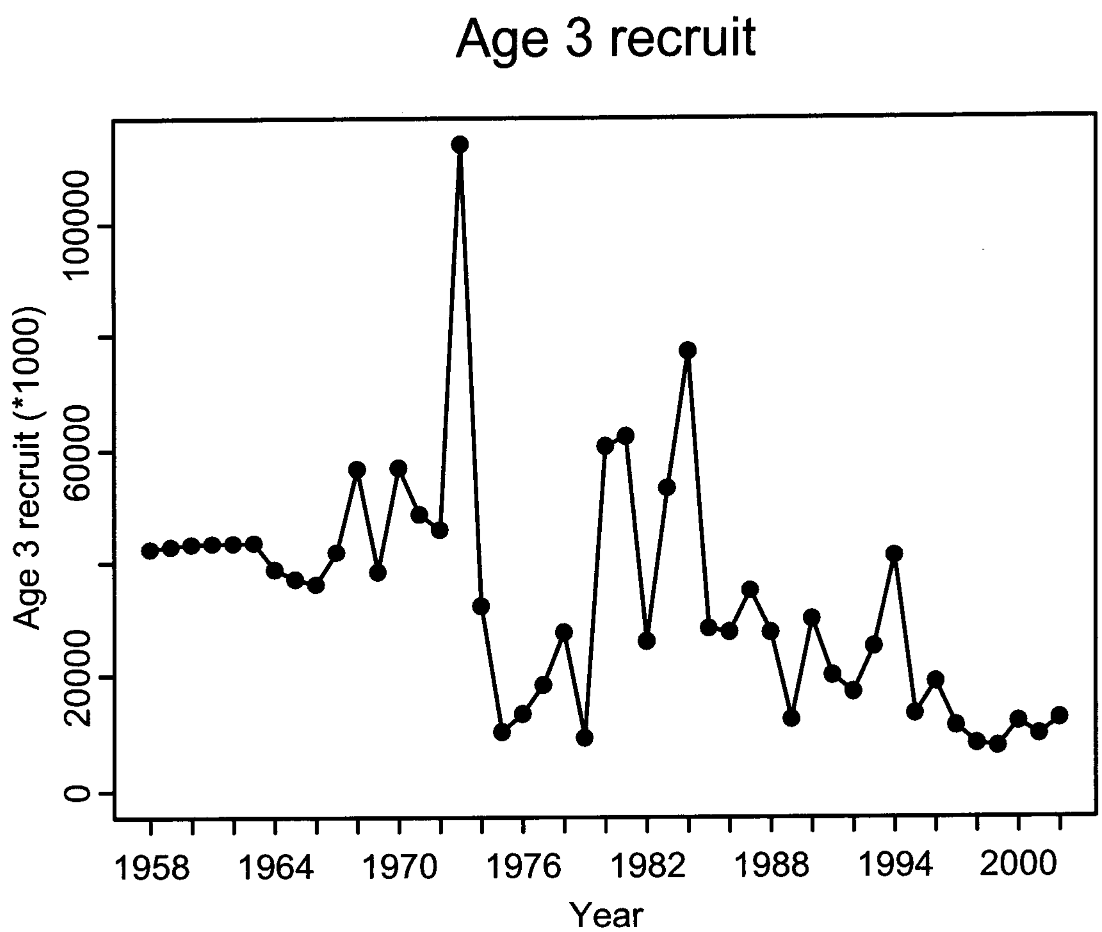


Figure 20. Fishing mortality by four fisheries from 1958 to 2002 estimates from the base model

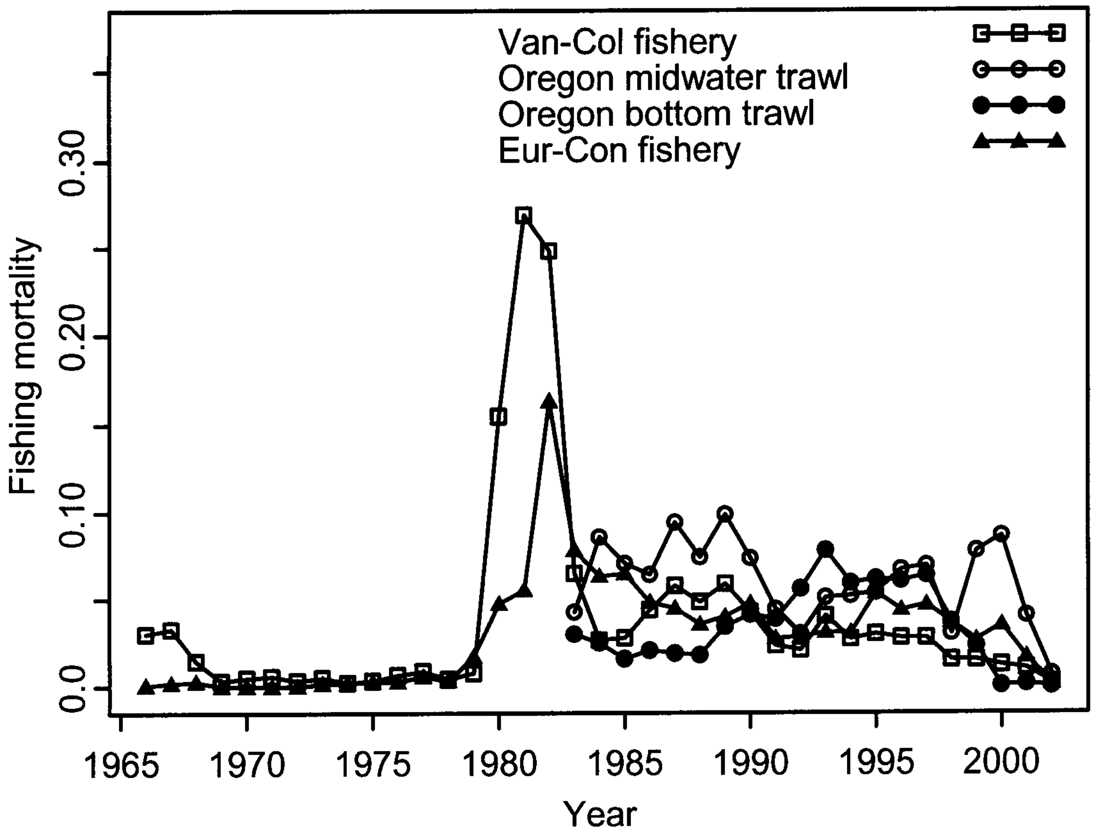


Figure 21. Fishery-specific selectivity estimates from the base model.

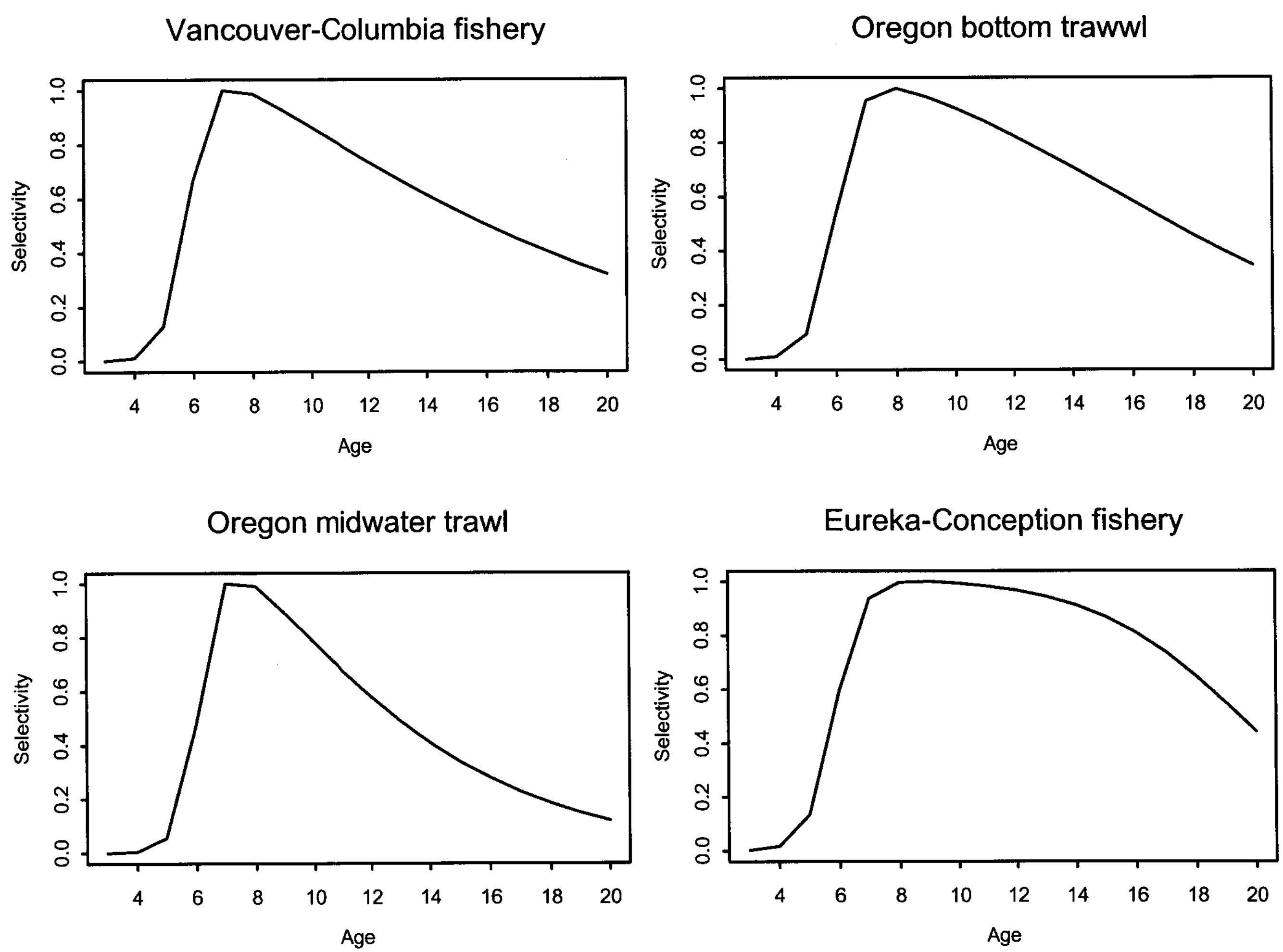


Figure 22. Stock-recruitment relationship from the base model. Est = estimated values from stock-recruitment relationship; Est+Res = predicted values plus annual recruitment residuals.

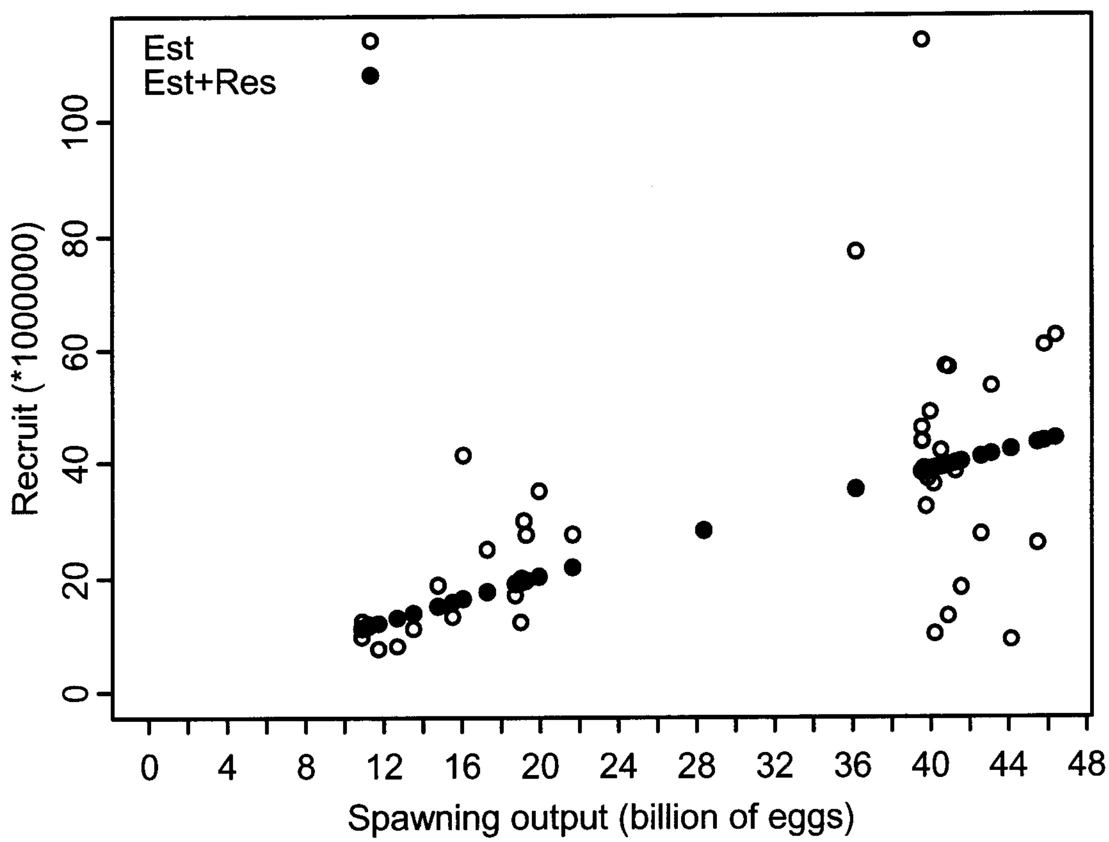
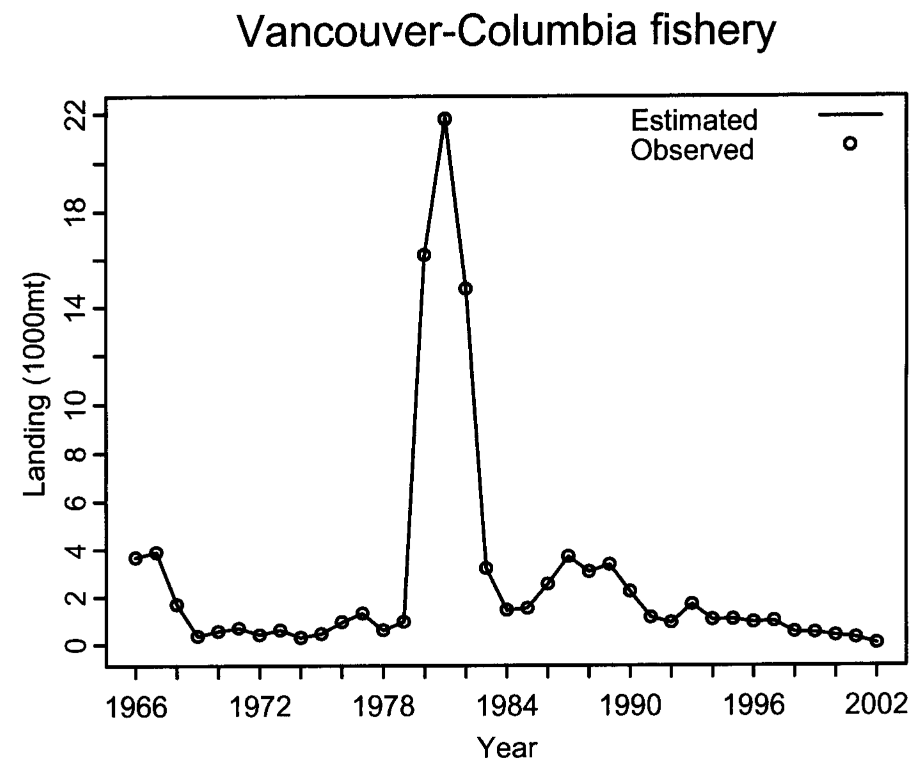


Figure 23. Model fits to the Vancouver-Columbia and Oregon midwater trawl fisheries landings data.



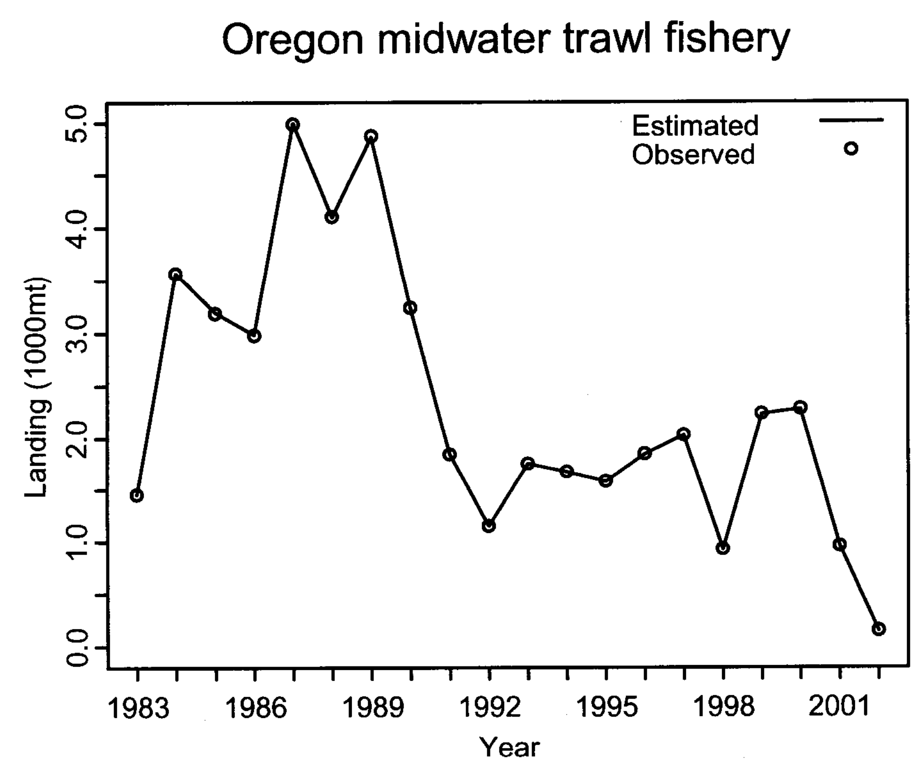
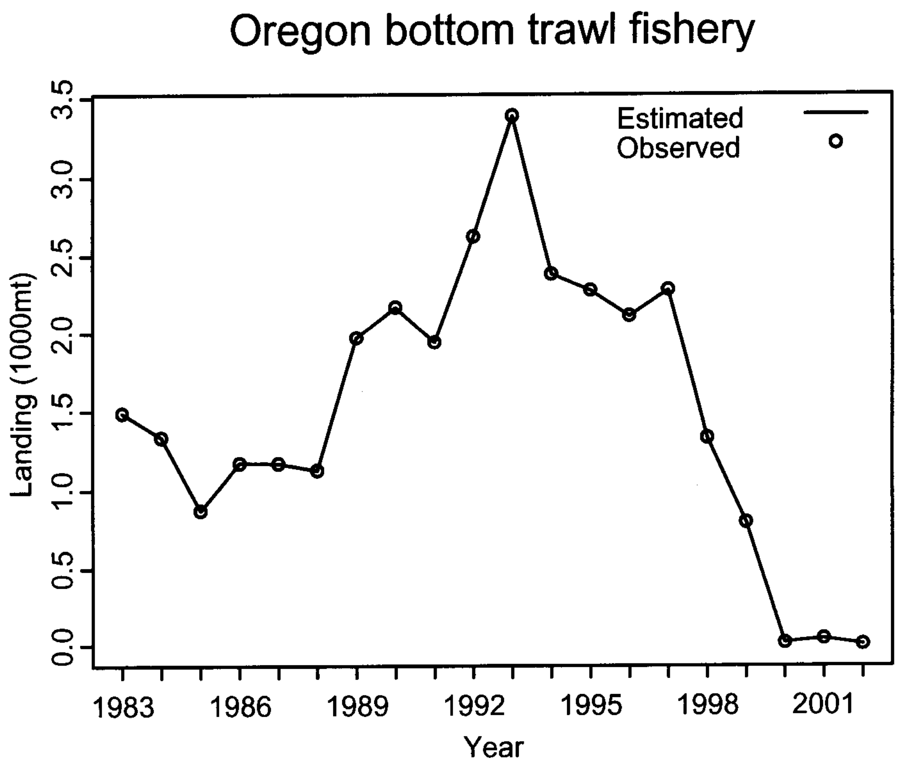


Figure 24. Model fits to the Oregon bottom trawl and Eureka-Conception fisheries landings data.



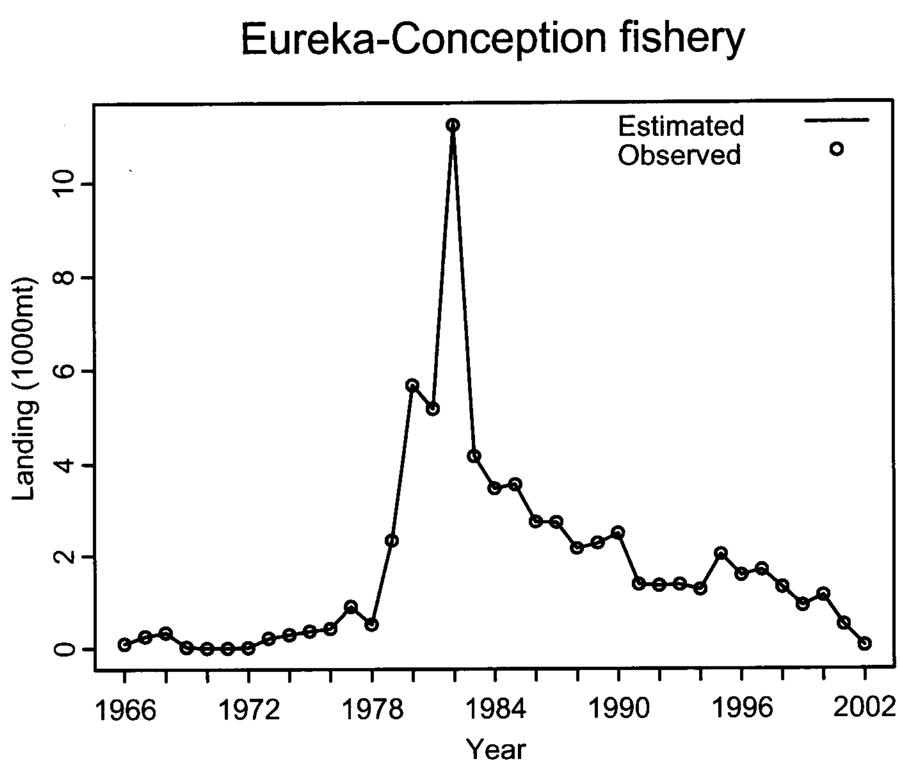


Figure 25. Model fits to the midwater trawl juvenile survey index.

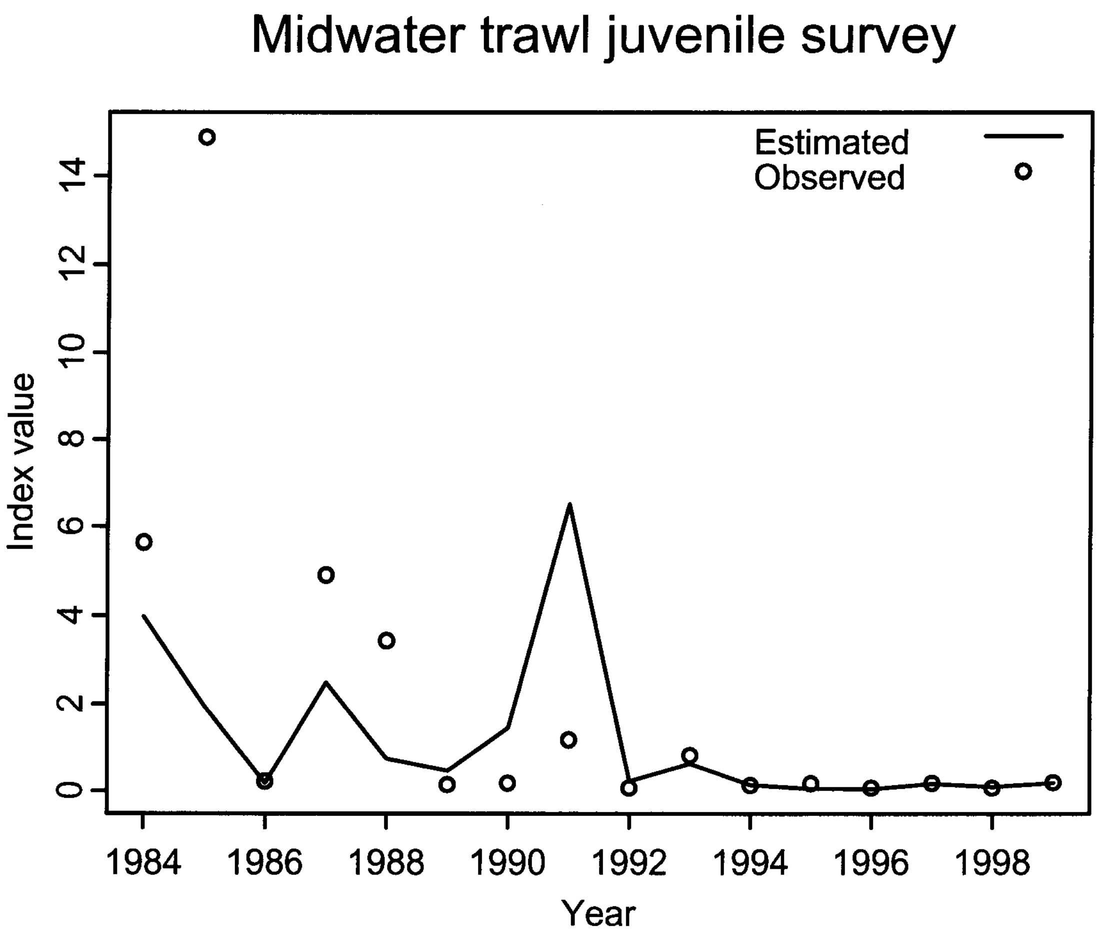


Figure 26. Model fits to the Oregon bottom trawl logbook index.

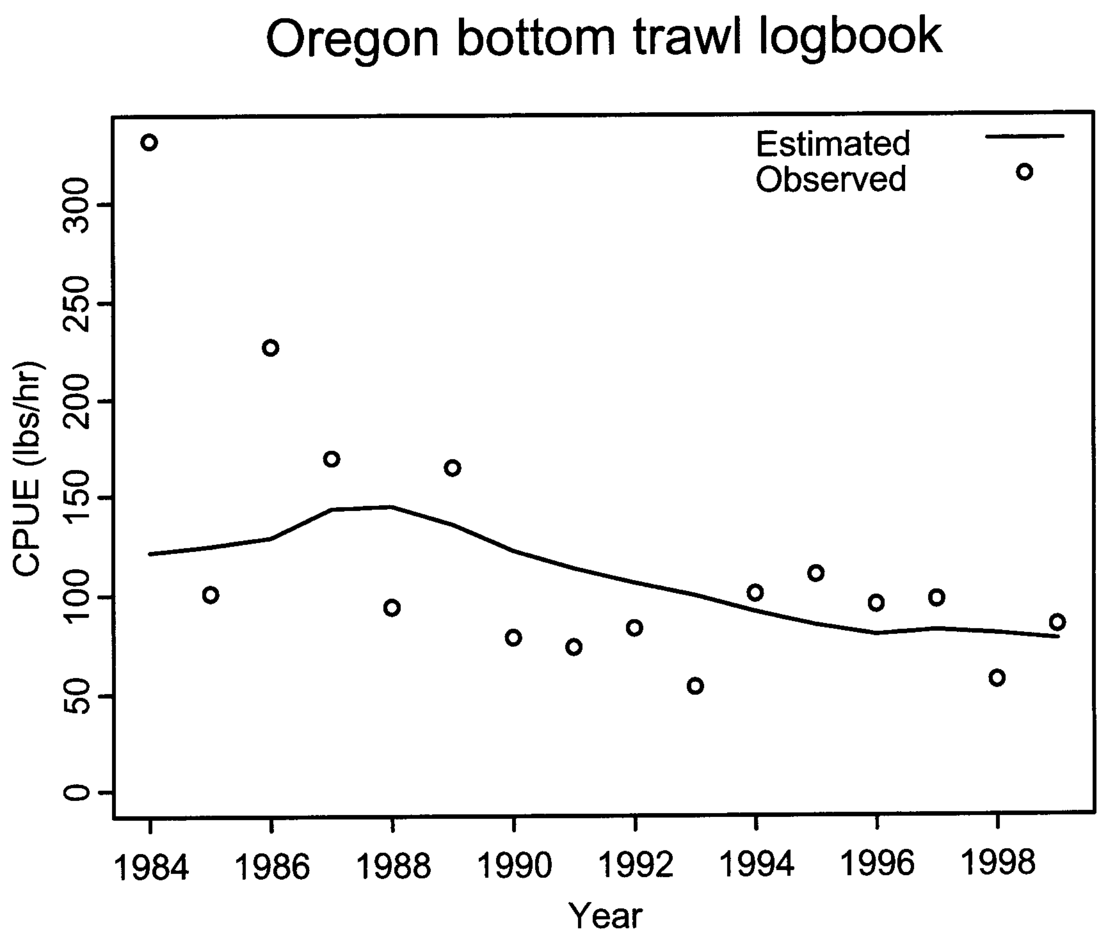


Figure 27. Model fits to the Pacific whiting foreign fishery bycatch index.

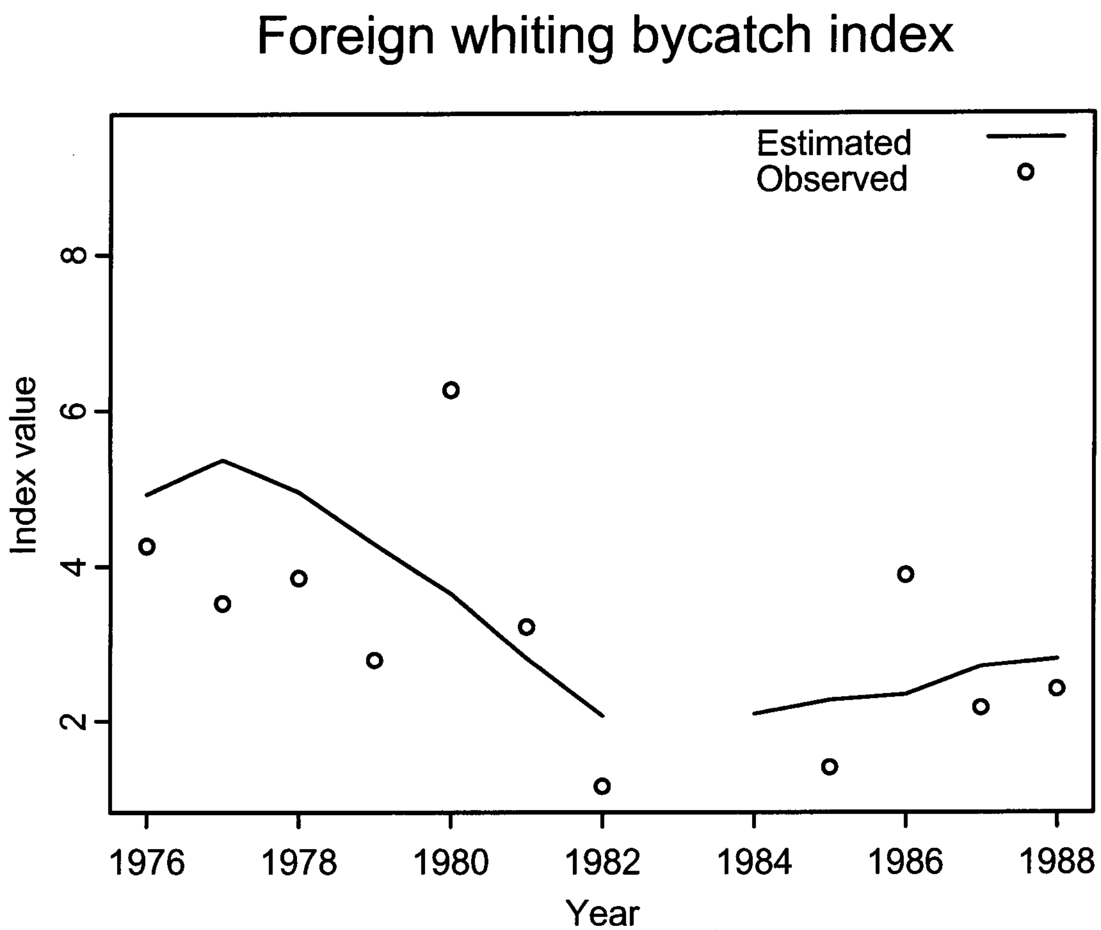


Figure 28. Model fits to the the Pacific whiting joint venture fishery bycatch index.

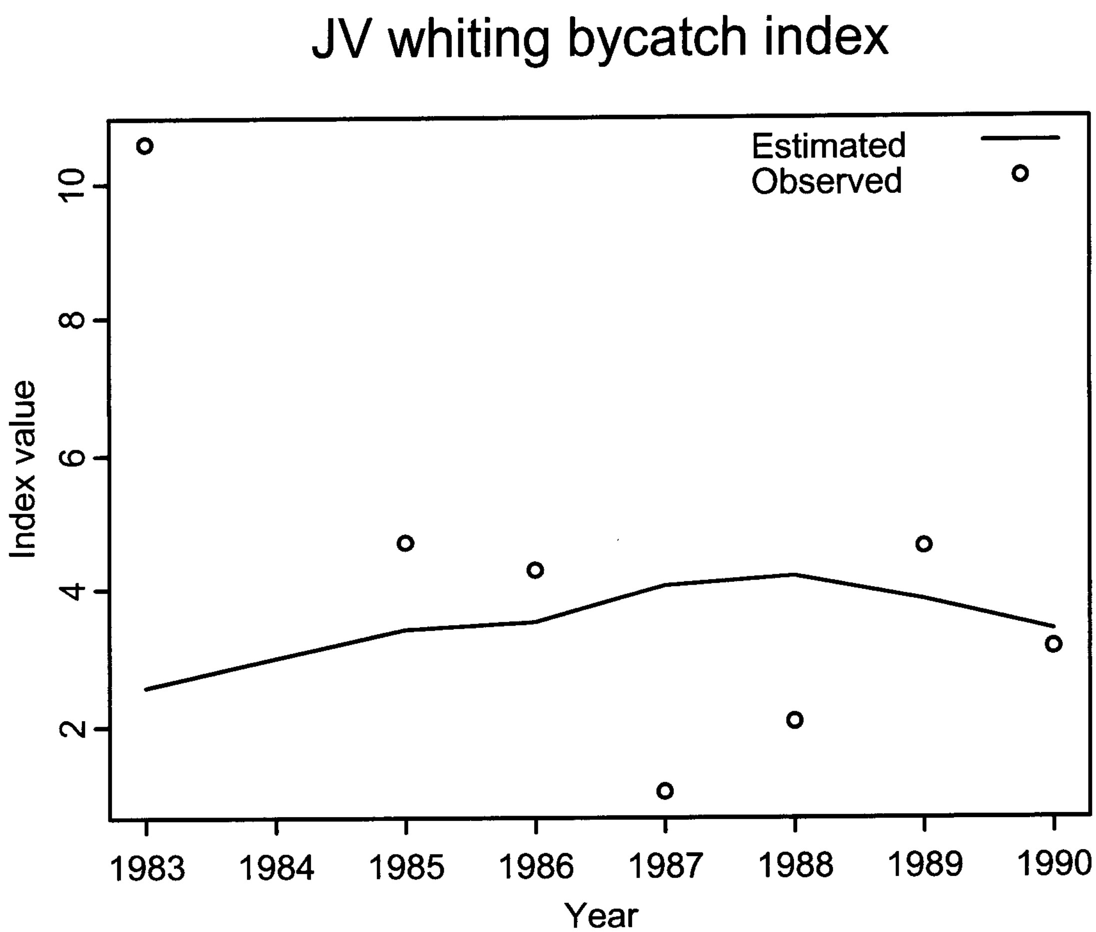


Figure 29. Model fits to the Pacific whiting domestic fishery index.

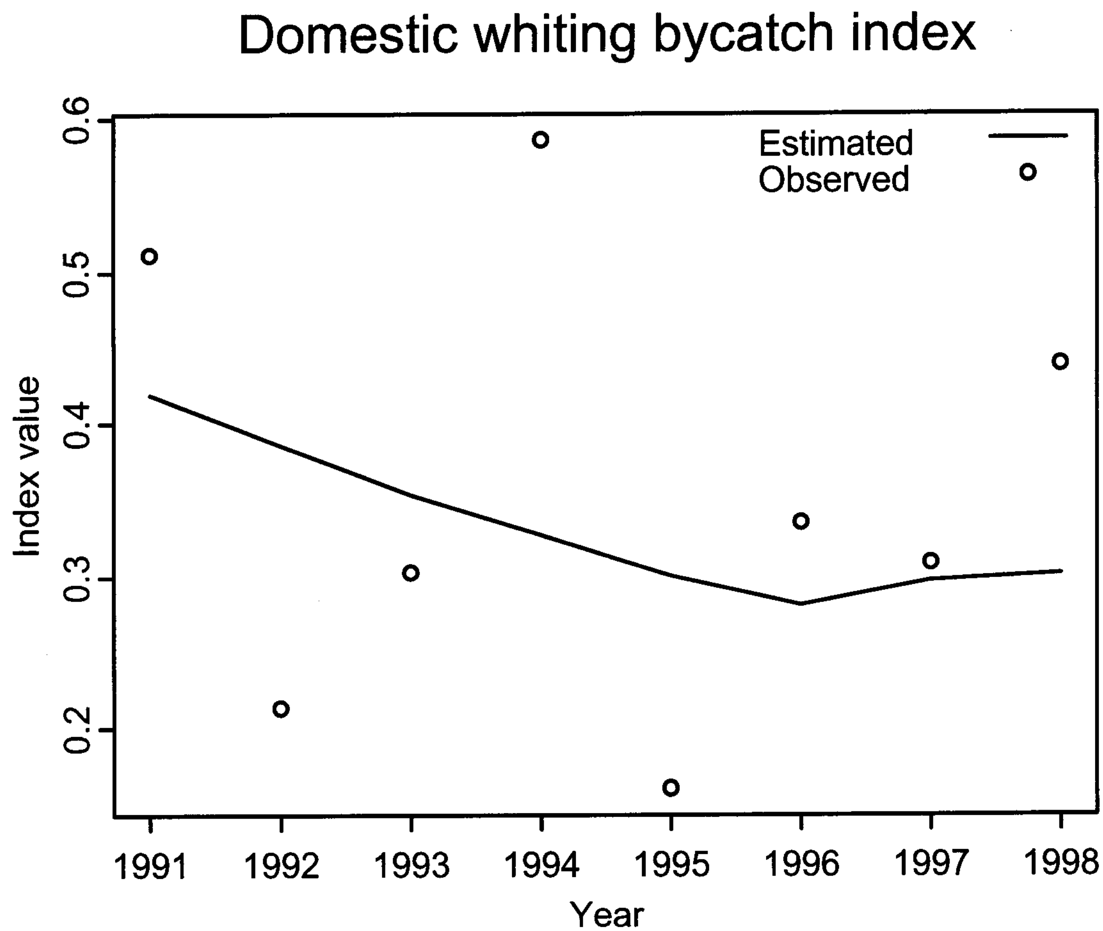
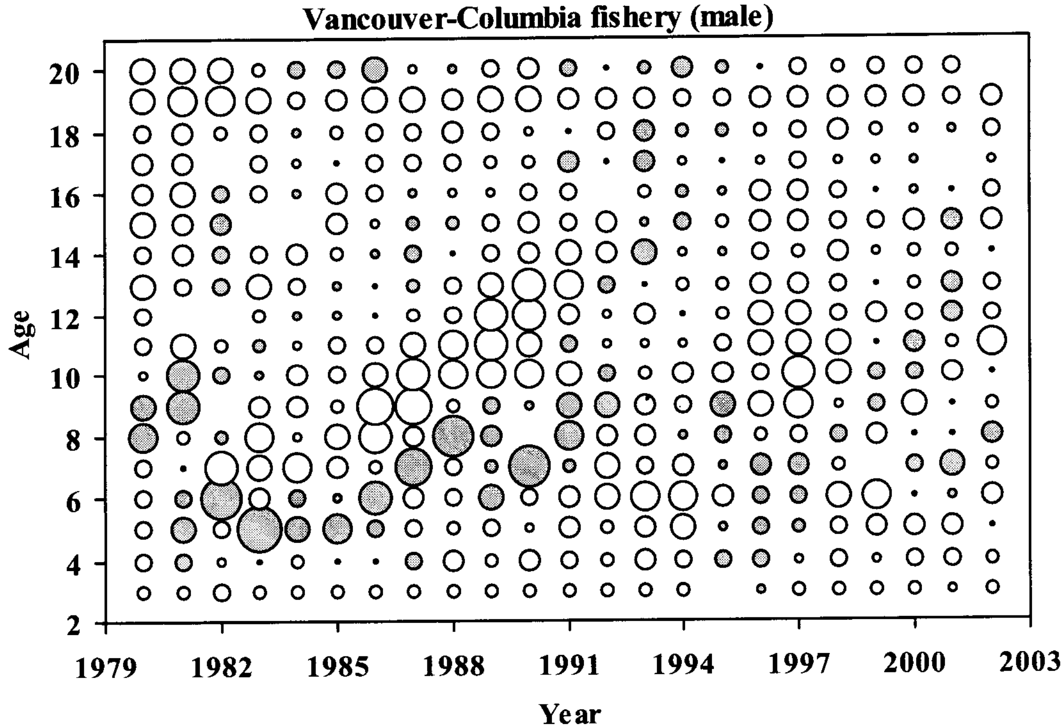


Figure 30a. Age composition residuals for the Vancouver-Columbia fishery from the base model. Residuals are standardized differences (observed – estimated). Dark circles are positive residuals and open circles are negative residuals.



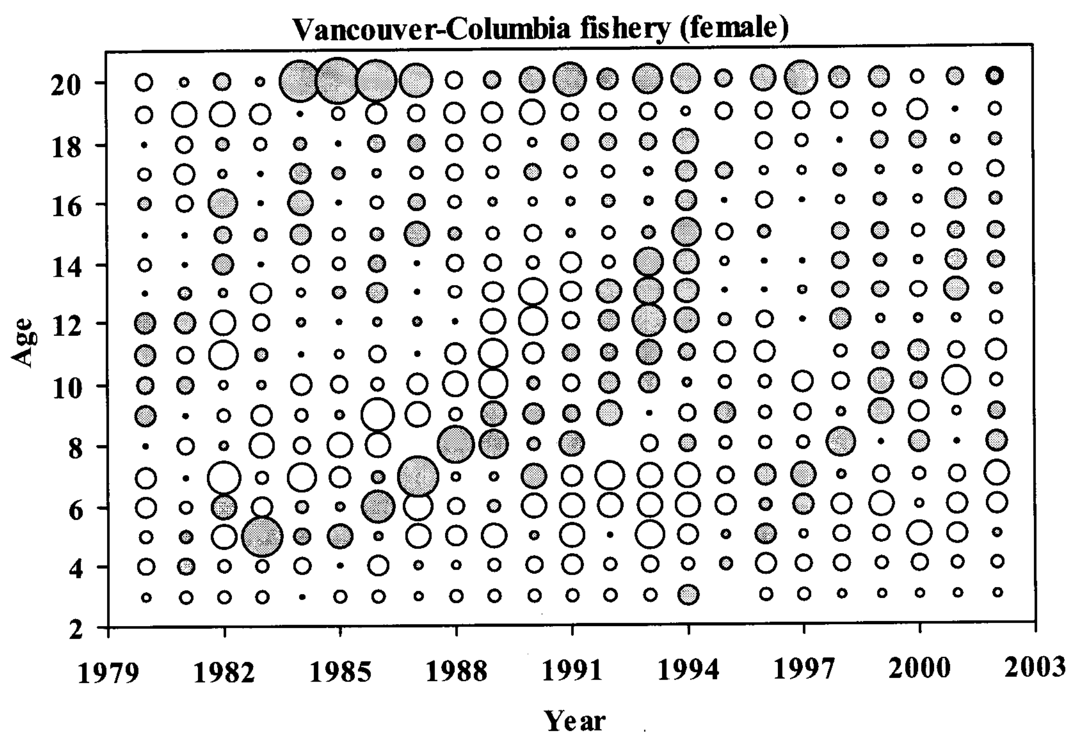
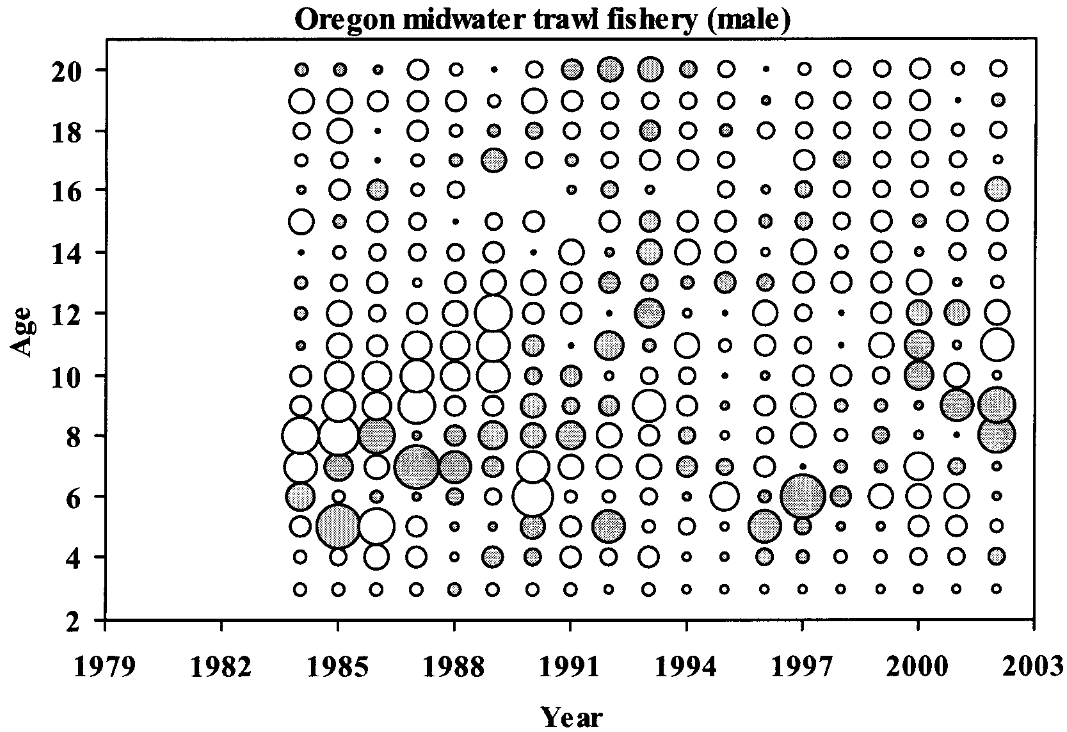


Figure 30b. Age composition residuals for the Oregon midwater trawl fishery from the base model. Residuals are standardized differences (observed – estimated). Dark circles are positive residuals and open circles are negative residuals.



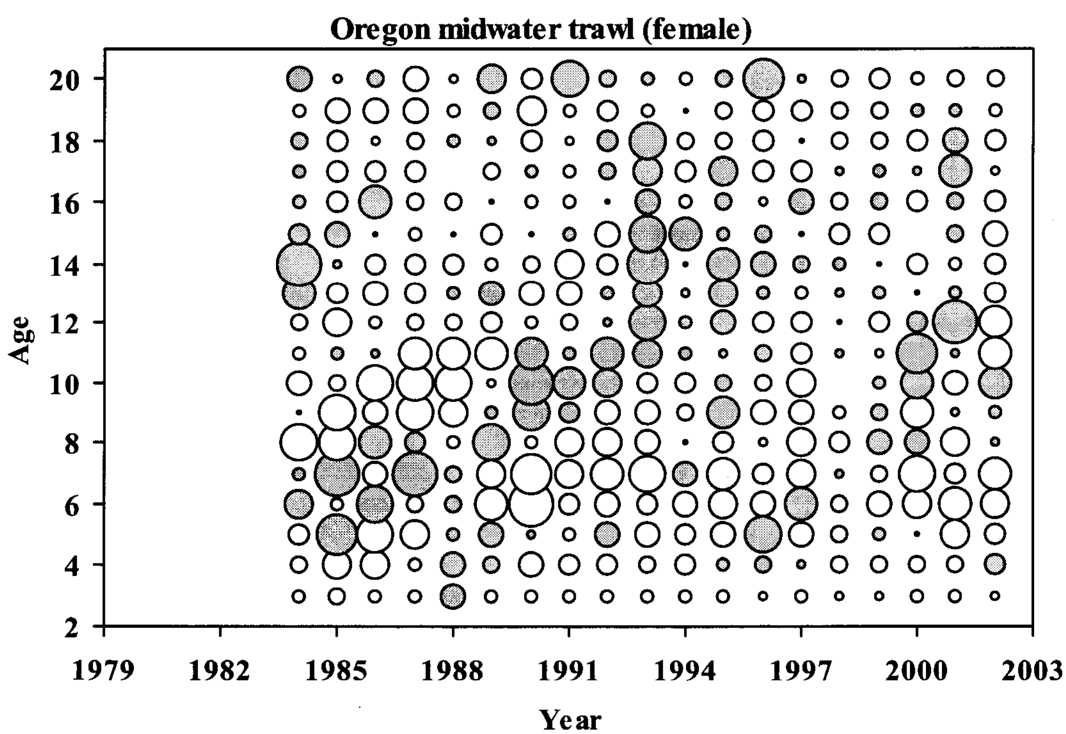
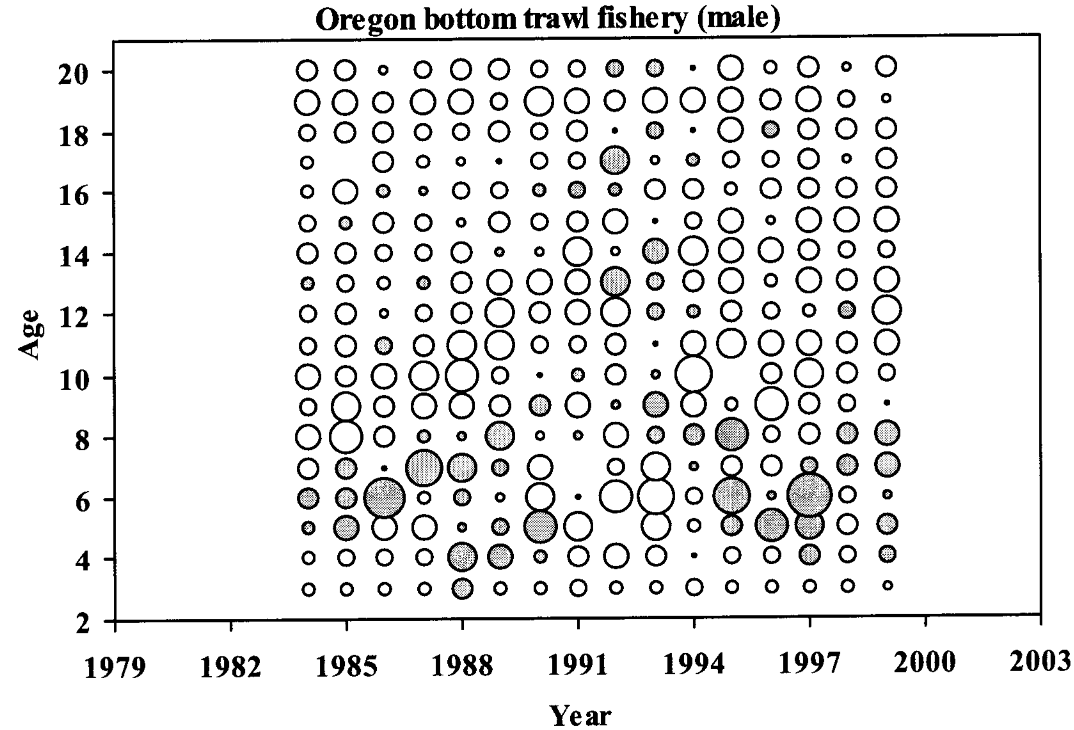


Figure 30c. Age composition residuals for the Oregon bottom trawl fishery from the base model. Residuals are standardized differences (observed – estimated). Dark circles are positive residuals and open circles are negative residuals.



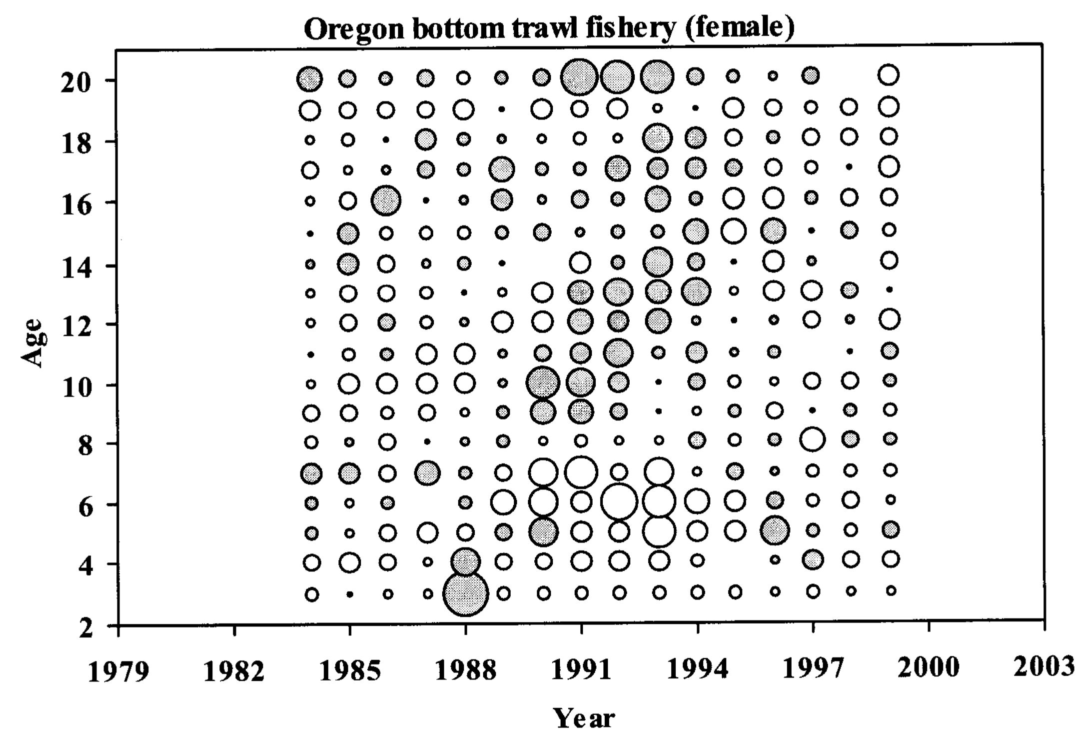
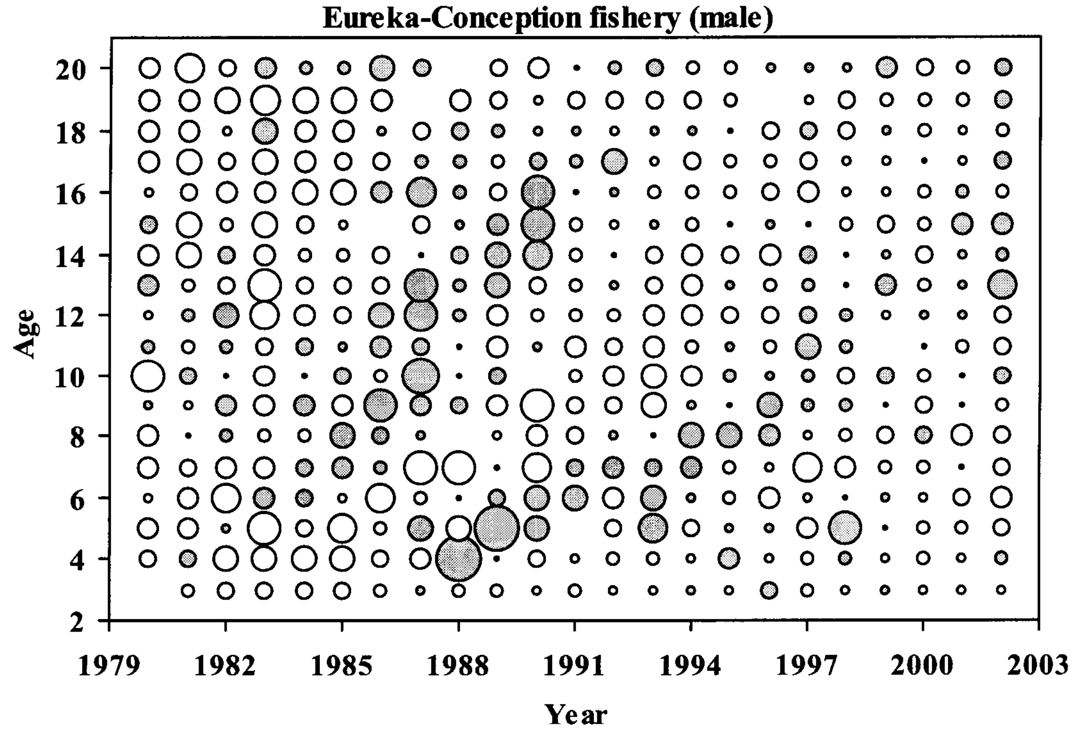


Figure 30d. Age composition residuals for the Eureka-Conception fishery from the base model. Residuals are standardized differences (observed – estimated). Dark circles are positive residuals and open circles are negative residuals.



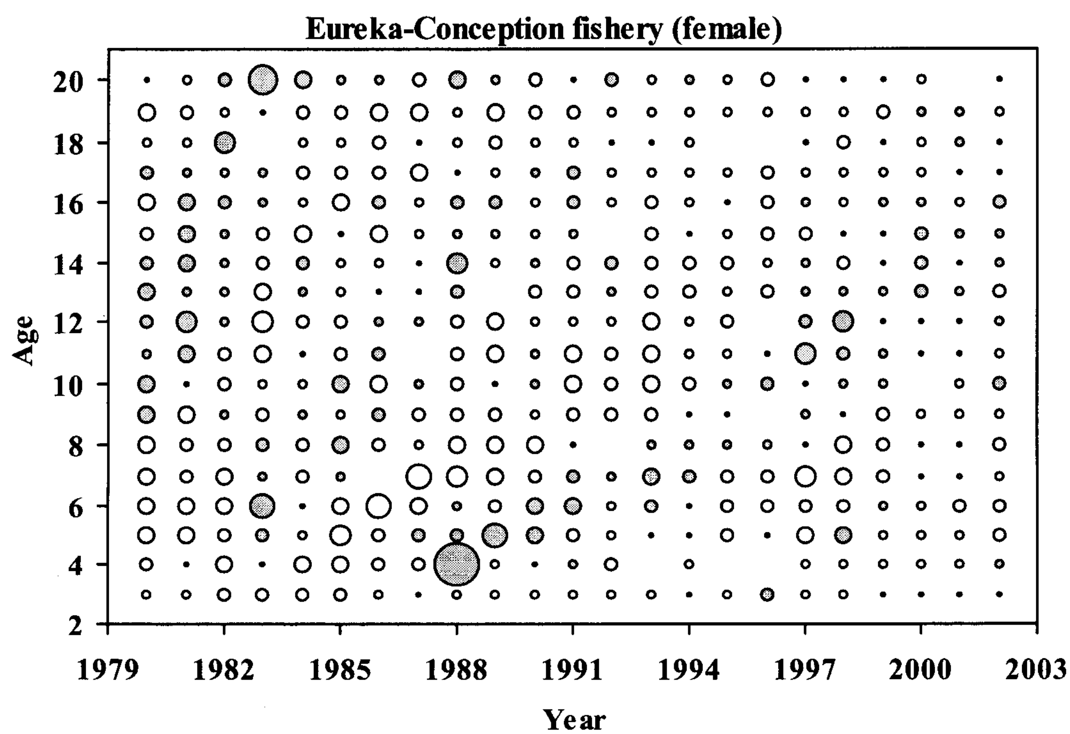


Figure 31. Retrospective analysis of the model showing spawning outputs from the model runs with the most recent data removed. Run to 2002 = no data removed; Run to 2001 = data from 2002 removed; Run to 1999 = data from 2000 to 2002 removed; and Run to 1997 = data from 1998 to 2002 removed.

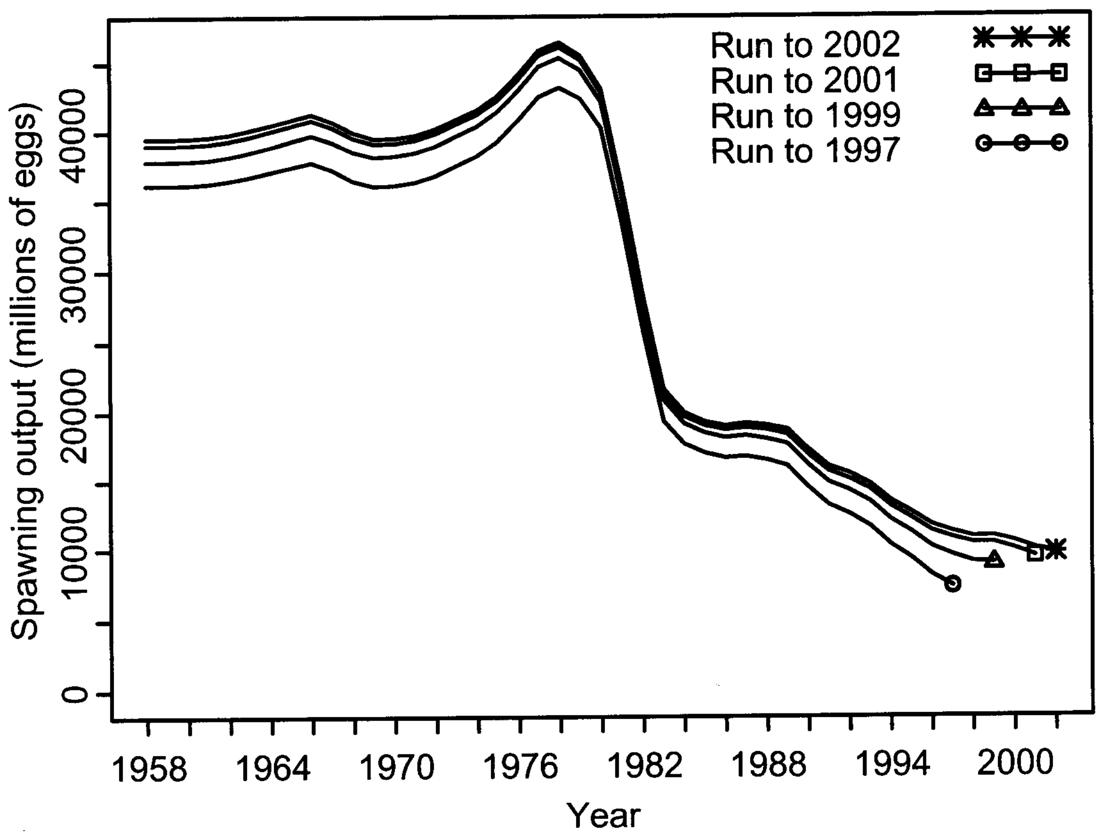


Figure 32. Frequency distribution on percentages of B_{2002} (spawning output in 2002) over B_0 (spawning output in 1958). Both $B_{2002}$and B_0 are outputs from the last 2 million runs of a total of 3 million MCMC runs.

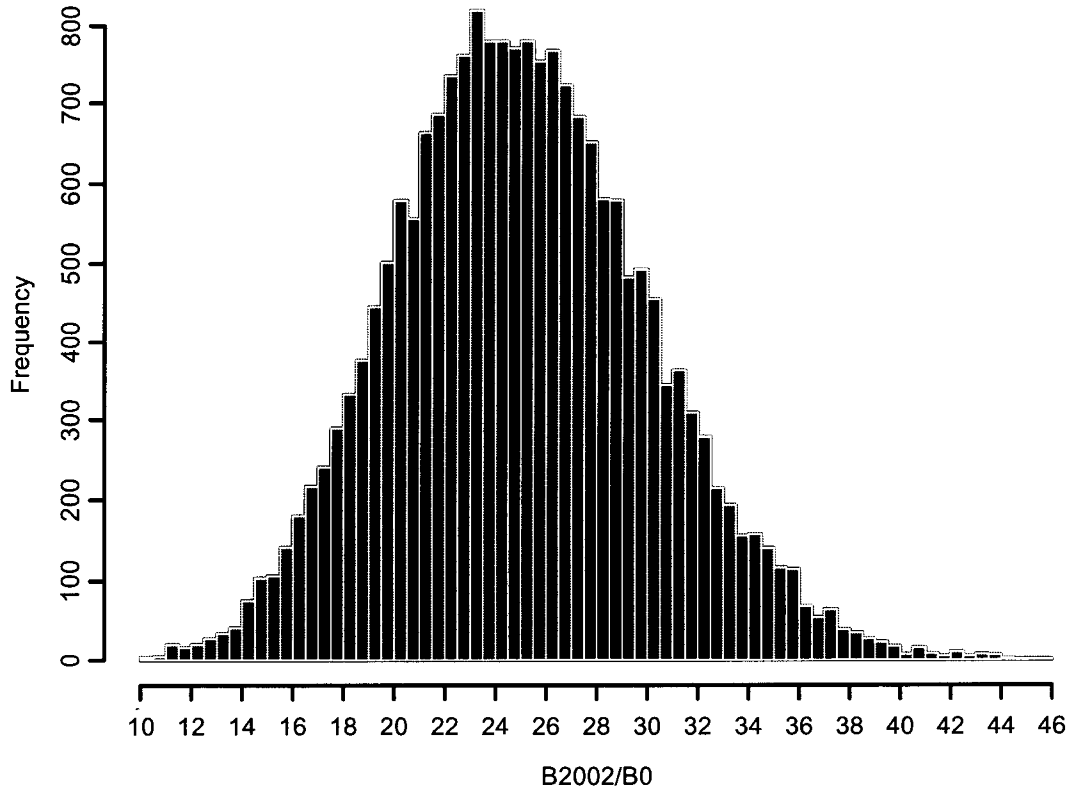


Figure 33. Median of spawning outputs (10^6 eggs) from 1958 to 2002 estimates from the widow rockfish model. Dotted lines indicate 95% confidence intervals. The medians and confidence intervals are computed from the last 2 million runs in a total of 3 million MCMC runs.

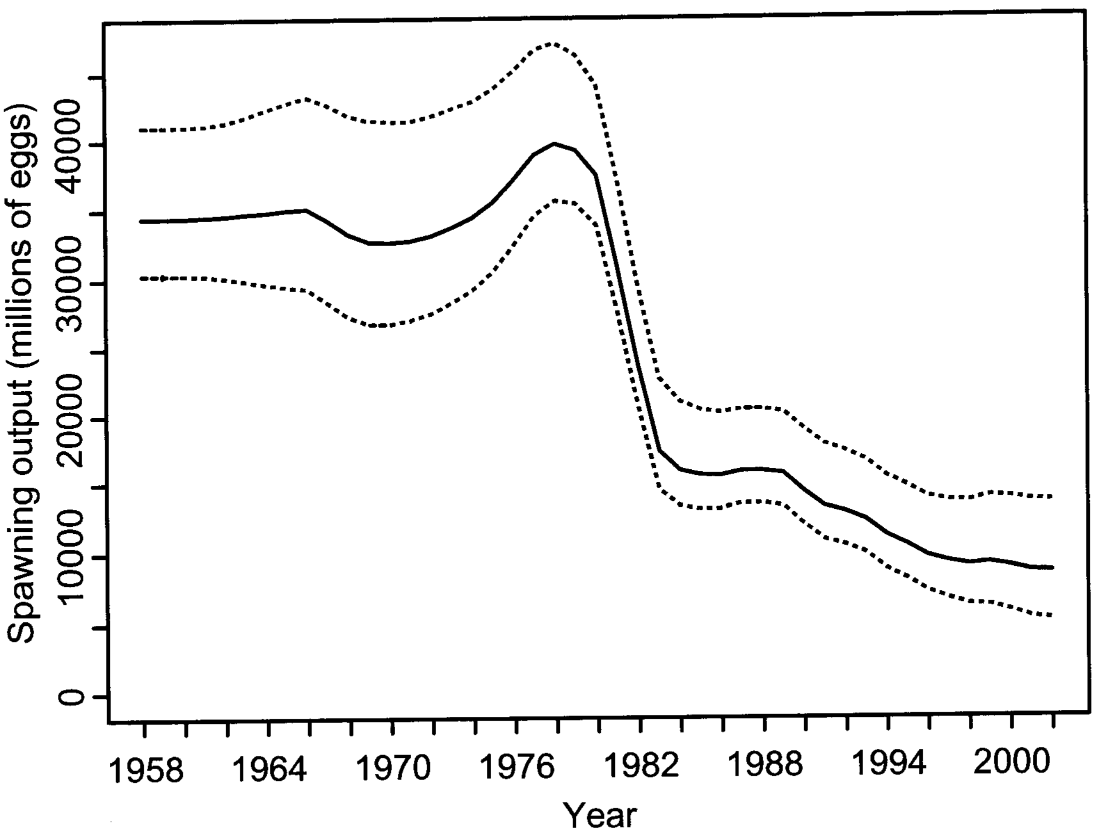
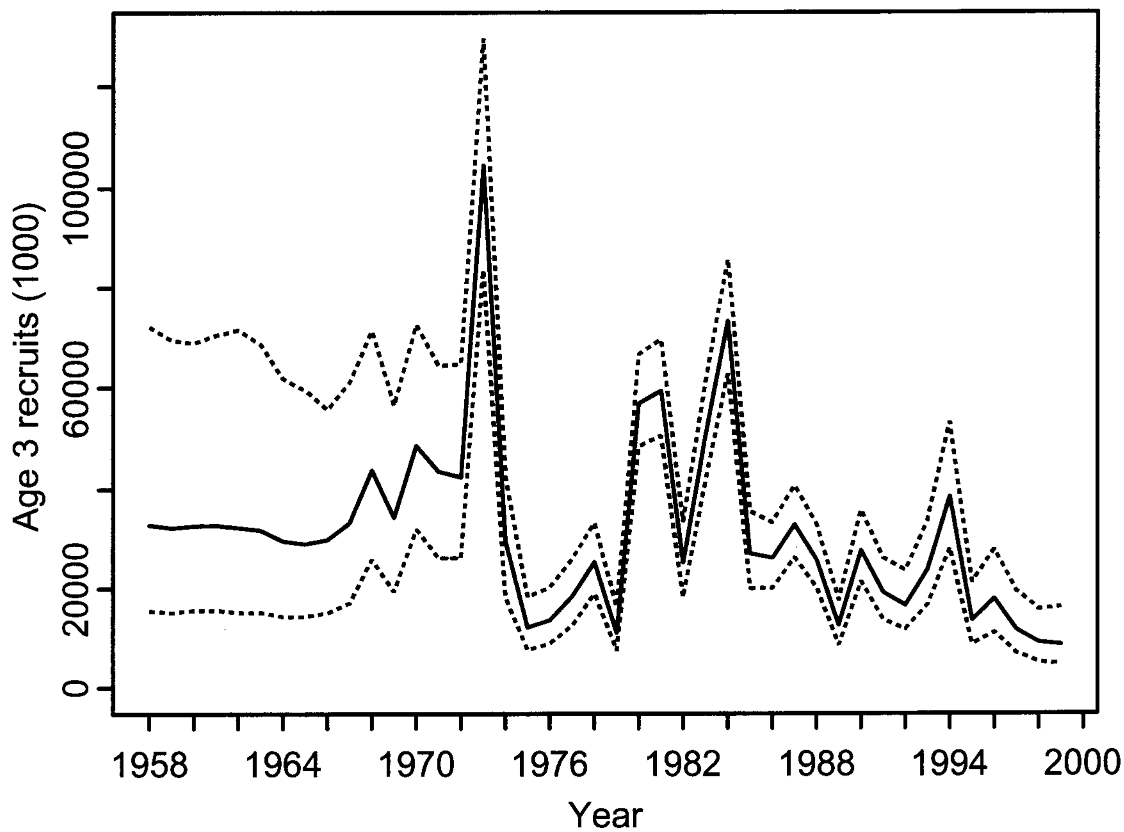


Figure 34. Recruitment estimates from 1958 to 2002 from the base model. Dotted lines indicate 95% confidence intervals. The confidence intervals are computed from the last 2 million runs in a total of 3 million MCMC runs.



Appendix A. Three widow bycatch indices computed from the Pacific Hake fisheries

E.J. Dick, Xi He, and Steve Ralston
NMFS, Southwest Fisheries Science Center, Santa Cruz Laboratory

We computed three abundance indices based on incidental catch of widow rockfish in the Pacific Hake fishery. As in the previous assessment (Williams et al., 2000), we recognized three periods of the fishery and treated them as independent indices in the model: 'foreign' (1976-88), 'joint-venture' (1983-90), and 'domestic' (1991-2001). Data for the domestic fishery were obtained from the NORPAC database, and Martin Dorn (AFSC) supplied data for the foreign and joint-venture fisheries.

We excluded records with extreme and/or missing values prior to calculating each index. Table A1 describes the final data sets for each fishery.

Table A1. Summary of three Pacific Hake fisheries' data used in computing bycatch CPUE of widow rockfish.

	FISHERY		
FIELD	**Foreign**	**Joint-Venture (JV)**	**Domestic**
Year	1976-82, 1984-88	1983, 1985-90	1991-2001
Tow duration	>15 min. & <500 min.	>15 min. & <500 min.	>15 min. & <500 min.
Latitude	43° – 46°, 47° – 48°	43° – 49°	43° – 49°
Hake catch	< 50 tons/tow	< 150 tons/tow	< 150 tons/tow
Widow catch	< 5 tons/tow	< 5 tons/tow	< 5 tons/tow
Gear type (NORPAC code)	Pair trawl (4)	Pair trawl (4) Non-pelagic trawl (1)	Pelagic trawl (2)
Standardized CPUE (see text)	<= 2 std. deviations	<= 2 std. deviations	<= 2 std. deviations
Distance from 200m isobath	<= 5 nautical miles	<= 5 nautical miles	<= 5 nautical miles

We calculated CPUE per tow (x_i) as the weight of widow rockfish divided by tow duration in minutes. We then calculated a standardized CPUE ('z-score') for each record by subtracting year-specific mean CPUE and dividing by the standard deviation in CPUE for that year. Records with z-scores >2 were excluded from the analyses.

$$Z_i = \frac{\left(x_i - \bar{x}_y\right)}{\sigma_y}$$

To examine the spatial distribution of hake effort and associated widow catch rates, we generated a 200-meter isobath using bathymetry grids and geographic information system software from ESRI (ArcView v. 3.2). For each tow, we calculated distance in nautical miles from the 200 m isobath, and binned tows into 0.5 nautical mile bands from the isobath. This analysis confirmed that hake effort is centered over the 200-meter depth contour. Mean z-scores for each distance category indicate that widow catch rates are highest near the 200 m isobath, largely tapering off within 5 nautical miles.

The first 'bycatch index' (I_y^1, Index 1) was calculated using a method identical to the previous three assessments (Rogers and Lenarz 1993, Ralston and Pearson 1997, Williams et al. 2000):

$$I_y^1 = \frac{C_y}{F_y} \cdot \frac{\sum_{i=1}^{n_y} w_{iy}}{\sum_{i=1}^{n_y} h_{iy}}$$

where n_y is the number of tows in year y. The first component of this index is a ratio of total hake catch by the U.S. fishery, C_y, in year y to annual exploitation rate F_y (Table A2, data from Helser et al. 2002). The second component is a within-year ratio of sums, widow bycatch (w) over targeted hake catch (h). Coefficients of variation for this index were derived from the delta method (Seber 1982) as described in Rogers and Lenarz, 1993.

No clear trend is apparent in the JV and foreign fisheries (Figure A1a), while the domestic fishery shows a declining trend in CPUE (Figure A1b). To illustrate the influence of declining Hake biomass on this index, we plotted Index 1 for the domestic fishery next to the second component of the index, the ratio of widow catch over hake catch (Figure A1b). The hake fishery's recent attempts (1999 to present) to reduce widow bycatch could potentially influence the index, so we plotted the annual proportion of tows with zero widow bycatch for all three fisheries (Figure A2).

Our second bycatch index (I_y^2, Index 2) is a direct estimate of catch per minute (Figure A3), as introduced in the previous assessment (Williams et al., 2000):

$$I_y^2 = \frac{\sum_{i=1}^{n_y} w_{iy}}{\sum_{i=1}^{n_y} d_{iy}}$$

Any records without information on tow duration were excluded from the analysis. This includes all records from the 1984 joint-venture fishery. As in the previous index, coefficients of variation were derived using a ratio estimator. Point estimates and coefficients of variation for indices 1 and 2 are summarized in Table A3.

Our third bycatch index (I_y^3, Index 3) was calculated using the delta-GLM method (Stefánsson, 1996). This index is comprised of two generalized linear models (GLMs). We fit both GLMs with year and latitude as categorical variables, binning latitudes into 1° increments. The first GLM estimates the probability of a positive set (widow catch per minute > 0) using a binomial GLM with a logit link function:

$$\pi_i = \frac{\exp(\mu + Y_i + \overline{L})}{1 + \exp(\mu + Y_i + \overline{L})}$$

where π_i is the probability of a positive response in year i, μ is the intercept term for the binomial GLM, Y_i is the year-specific effect, and $\overline{L}$ is the mean latitude effect.

The second GLM estimates expected values for positive tows, using a simple normal linear model with a log-transformation of the response variable:

$$\log(y_{ijk}) = \mu + Y_i + L_j + \varepsilon_{ijk}$$

where μ is now the intercept term for the regression model, Y_i is the year effect, L_j is the latitude effect, and ε_{ijk} is a normally distributed error term. Mean year-specific effects, M_i, for this model are the back-transformed regression coefficients for the 'year' factor:

$$M_i = \exp\left(\mu + Y_i + \bar{L} + \frac{\sigma^2}{2}\right)$$

where Y_i is the i^{th} year effect, $\bar{L}$ is the mean latitude effect, and σ^2 is the mean squared error of the linear model. The final delta-GLM abundance index is simply the product of the back-transformed year effects from the two GLMs:

$$I_i^3 = \pi_i M_i$$

To further investigate the influence of latitude on the index, we iteratively weighted the lognormal GLM portion of the index with estimated latitude effects from unweighted model runs. Iterative weighting had little to no effect on point estimates in each fishery. CVs associated with the weighted index were similar to the unweighted results, but slightly higher. Results of the unweighted index are reported here. The precision of each index was estimated using a jackknife routine. Year effects and associated coefficients of variation are summarized in Table A3.

Table A2. Annual total catch of Pacific hake (C_y) by the U.S. fishery and estimated annual exploitation rate (F_y) from 1976 to 2001. Data are provided by Helser et al. (2002).

Year	U.S. hake catch (C_y) (thousands t)	U.S. exploitation rate (F_y)
1976	231.549	9.2%
1977	127.502	5.9%
1978	98.372	5.1%
1979	124.680	6.7%
1980	72.352	2.8%
1981	114.760	4.7%
1982	75.577	4.1%
1983	73.150	1.6%
1984	96.332	2.0%
1985	85.439	2.0%
1986	154.964	4.3%
1987	160.448	2.7%
1988	160.698	3.3%
1989	210.996	5.1%
1990	183.800	4.6%
1991	217.505	5.6%
1992	208.576	7.0%
1993	141.222	5.2%
1994	252.729	10.9%
1995	177.589	10.4%
1996	212.902	12.8%
1997	233.423	13.5%
1998	232.817	16.0%
1999	224.522	19.7%
2000	208.418	21.7%
2001	182.377	25.6%

Table A3. Three indices and associated coefficients of variance (CV) for widow rockfish abundance based on bycatch in Pacific Hake Fisheries.

Year	Count	$\frac{C_y}{F_y} \cdot \frac{\sum_{i=1}^{n_y} w_{iy}}{\sum_{i=1}^{n_y} h_{iy}}$ Index 1	CV	$\frac{\sum_{i=1}^{n_y} w_{iy}}{\sum_{i=1}^{n_y} d_{iy}}$ Index 2 (x1000)	CV	Delta-Lognormal Index 3	CV
Foreign Fishery							
1976	109	24943	0.231	1.681	0.182	4.256	0.189
1977	740	69772	0.166	2.122	0.068	3.529	0.097
1978	1157	60705	0.159	2.497	0.050	3.853	0.072
1979	1149	65391	0.162	1.840	0.055	2.800	0.078
1980	511	170078	0.160	3.583	0.047	6.265	0.075
1981	770	113186	0.160	1.951	0.052	3.234	0.080
1982	189	13238	0.242	0.819	0.189	1.148	0.231
1984	587	207029	0.156	6.107	0.045	9.461	0.076
1985	1936	52290	0.159	0.933	0.051	1.397	0.082
1986	959	87890	0.159	3.176	0.048	3.893	0.075
1987	1966	116457	0.156	1.913	0.040	2.181	0.065
1988	758	112783	0.164	1.791	0.064	2.426	0.094
Joint-Venture Fishery							
1983	426	16415	0.158	1.150	0.052	10.591	0.111
1985	582	52391	0.162	0.994	0.060	4.706	0.140
1986	1786	39769	0.154	0.879	0.033	4.290	0.082
1987	2533	27587	0.156	0.390	0.042	1.056	0.103
1988	1947	37965	0.154	0.646	0.034	2.072	0.087
1989	2907	42459	0.152	0.900	0.022	4.644	0.059
1990	2944	28889	0.152	0.725	0.027	3.135	0.070
Domestic Fishery							
1991	593	8123	0.205	0.685	0.139	0.512	0.114
1992	1458	2589	0.186	0.265	0.109	0.213	0.098
1993	859	1506	0.178	0.232	0.096	0.304	0.087
1994	1603	3302	0.159	0.455	0.055	0.586	0.057
1995	814	1104	0.188	0.162	0.110	0.162	0.087
1996	1296	1450	0.164	0.241	0.065	0.336	0.069
1997	1842	1061	0.160	0.230	0.055	0.310	0.062
1998	2110	1516	0.162	0.338	0.061	0.439	0.065
1999	2629	694	0.162	0.112	0.061	0.177	0.066
2000	1942	493	0.163	0.121	0.062	0.145	0.070
2001	1759	166	0.185	0.075	0.107	0.107	0.076

Figure A1a:

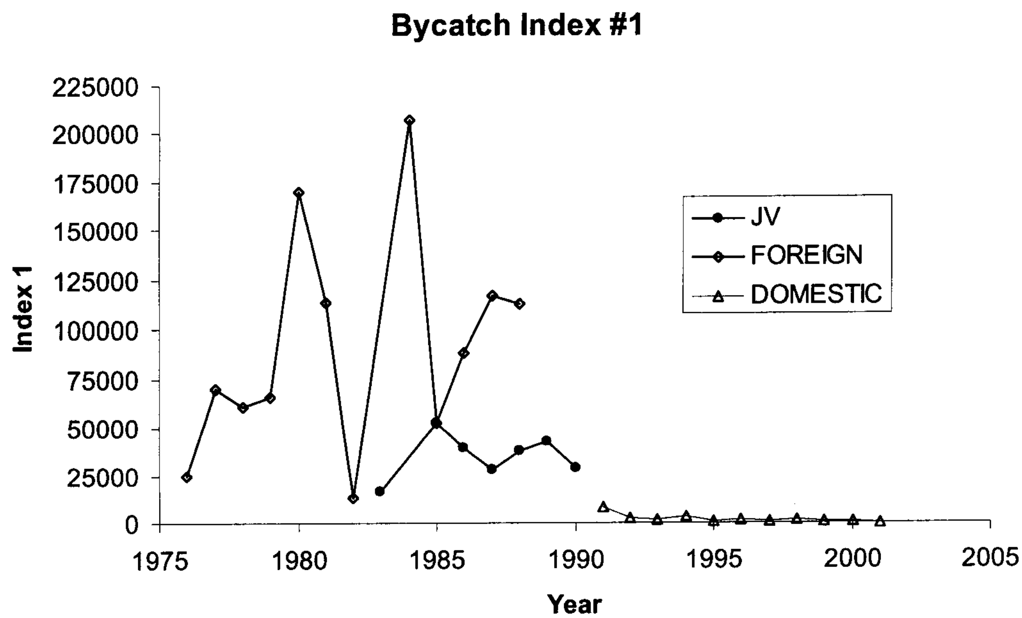


Figure A1b:

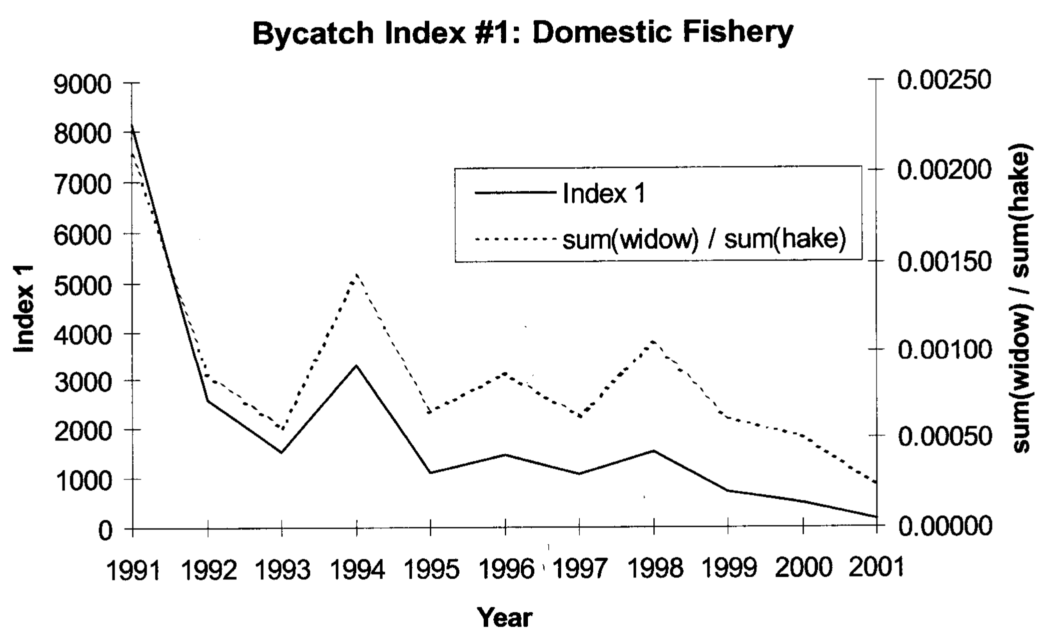


Figure A1. Time series of widow bycatch CPUE (Index 1) from three Pacific hake fisheries

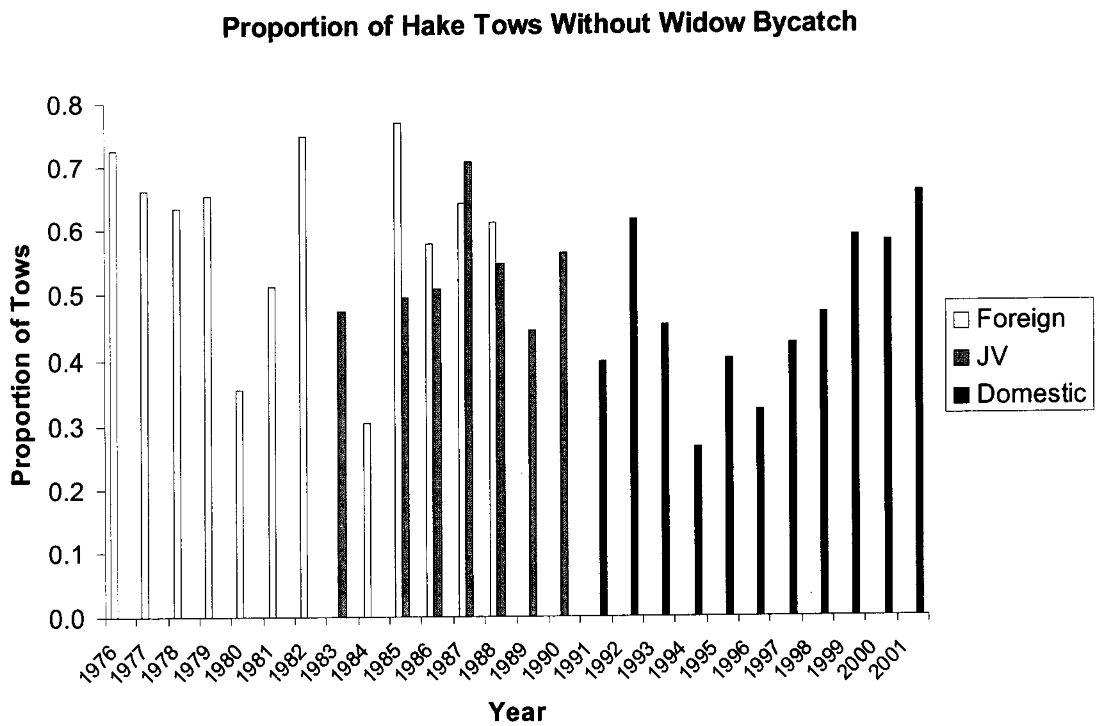


Figure A2. Proportion of tows targeting Pacific hake that resulted in zero bycatch of widow rockfish

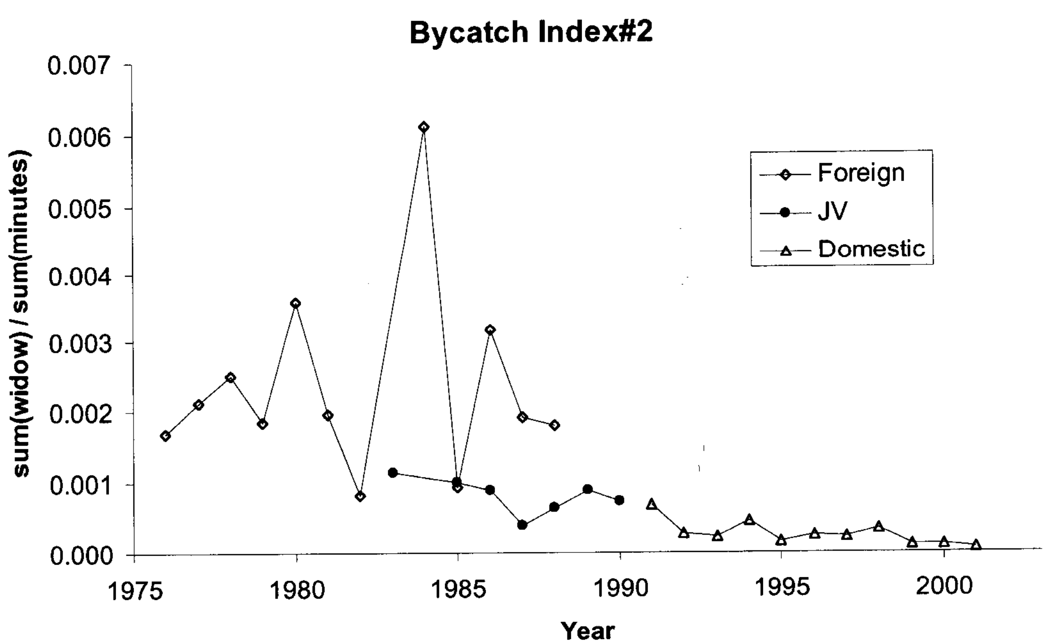


Figure A3 Time series of widow bycatch CPUE (widow/minute, Index 2) from three Pacific hake fisheries.

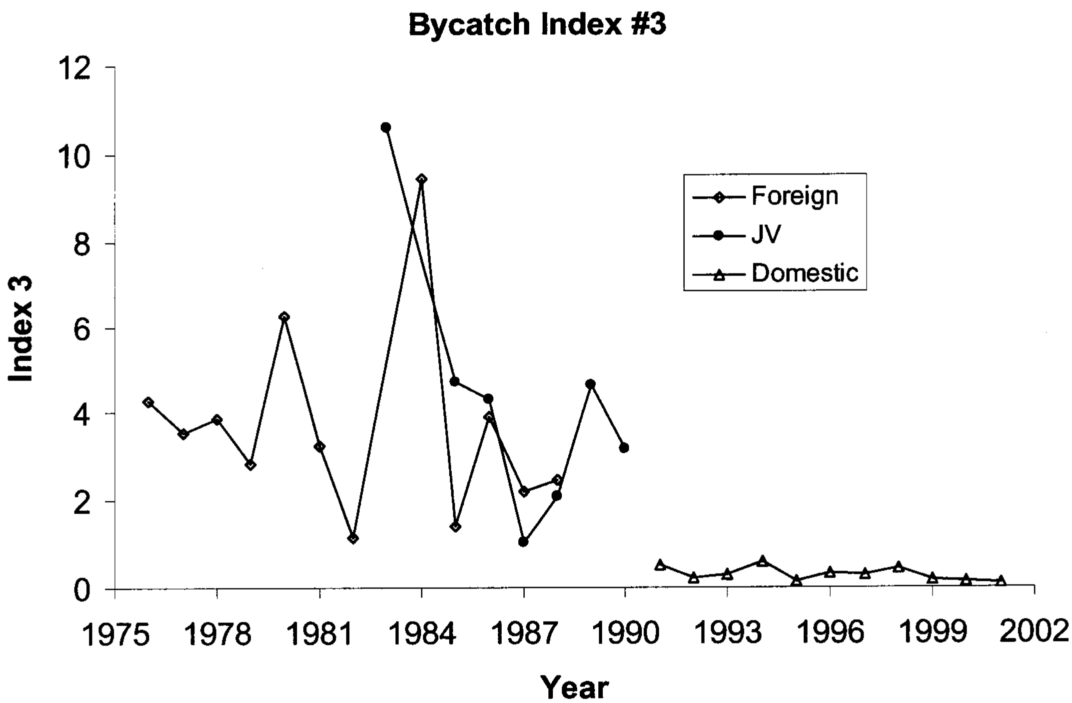


Figure A4. Time series of widow bycatch CPUE (kg widow/minute, Index 3) from three Pacific hake fisheries.

Appendix B: Description of assessment model

The widow population is assumed to be subject to four fisheries in two regions. Region 1 consists of the Vancouver-Columbia trawl fishery, Oregon midwater trawl fishery, and Oregon bottom trawl fishery. Region 2 consists of the Eureka-Monterey-Conception trawl fishery.

Initial condition and cohort growth:

Initial conditions of the population are numbers of fish at sex x, at age a and at the first model year ($y = 0$) in 1958, which is given by:

$$N_{x,0,a} = \begin{cases} 0.5Re^{R_1^\delta} & \text{if } a = a_{\min} \\ N_{x,0,a-1}e^{-M_x} & \text{if } a_{\min} < a < a_{\max} \\ \dfrac{N_{x,0,a-1}e^{-M_x}}{1-e^{-M_x}} & \text{if } a = a_{\max} \end{cases} \quad (9)$$

where R = mean recruitment

R_1^δ = recruitment residual at year 0

$a_{\min}$ = age of recruitment (minimum age in model)

$a_{\max}$ = maximum age, including age-plus groups

M_x = natural mortality for sex x, which is constant across year and age

Numbers of fish in subsequent years are given by:

$$N_{x,y,a} = \begin{cases} 0.5Re^{R_y^\delta} & \text{if } a = a_{\min} \\ N_{x,y-1,a-1}e^{-\left(M_x+\sum_f F^f_{x,y-1,a-1}\right)} & \text{if } a_{\min} < a < a_{\max} \\ N_{x,y-1,a-1}e^{-\left(M_x+\sum_f F^f_{x,y-1,a-1}\right)} + N_{x,y-1,a_{\max}}e^{-\left(M_x+\sum_f F^f_{x,y-1,a_{\max}}\right)} & \text{if } a = a_{\max} \end{cases} \quad (10)$$

where R_y^δ = recruitment residual at year y, and $\sum_y R_y^\delta = 0$.

Fishing mortality is given by:

$$F^f_{x,y,a} = FF_f e^{FF^\delta_{f,y}} S^f_{x,y,a} \quad (11)$$

where FF_f = full fishing mortality for fishery f

$FF^\delta_{f,y}$ = fishing mortality residual for fishery f and at year y with $\sum_y FF^\delta_{f,y} = 0$

$S^f_{x,y,a}$ = selectivity by fishery f, at sex x, year y, and age a.

Selectivity and catch:

Double logistic selectivity was used:

$$s_a^f = \left(\frac{1}{1+e^{-\eta_{2,f}(a-\eta_{1,f})}}\right)\left(1-\frac{1}{1+e^{\eta_{4,f}(a-\eta_{3,f})}}\right)\frac{1}{\max\left(s^f\right)} \quad (12)$$

where $\eta_{1,f}$, $\eta_{2,f}$, $\eta_{3,f}$, and $\eta_{4,f}$ = parameters to be estimated

$\max(S^f)$ = maximum selectivity by fishery f.

Double logistic selectivity allows the selectivity pattern to be dome-shaped or asymptotic on either the left or the right size of the selectivity curve. Selectivity is set to be same for both sexes, so $S_{1,y,a}^f = S_{2,y,a}^f$. However, selectivity may vary from year to year. In this case, year-specific parameters $\eta_{2,f}$, which determine steepness of the left side of the selectivity, are estimated. If selectivity does nor vary from year to year, $S_{s,y,a}^f = S_{s,1,a}^f = S_{s,2,a}^f = \ldots$. Annual catch by fishery f at sex x, and age a is given by:

$$C_{x,y,a}^f = N_{x,y,a}\frac{F_{x,y,a}^f}{M_x+\sum_f F_{x,y,a}^f}\left(1-e^{-\left(M_x+\sum_f F_{x,y,a}^f\right)}\right) \quad (13)$$

Landing by fishery f at year y, Ψ_y^f, is given by:

$$\Psi_y^f = \left(1-D_y\right)\sum_x\sum_a C_{x,y,a}^f W_{f,x,a} \quad (14)$$

where $W_{f,x,a}$ = weight of fish in fishery f, at sex x an age a, which is region specific (see below)

D_y = annual mean discard rate.

A vector of observed proportions of catch-at-age compositions for fishery f, at sex x and year y, $\boldsymbol{\Theta}_{x,y}^f$, is adjusted by an ageing error matrix:

$$\boldsymbol{\Theta}_{x,y}^f = \boldsymbol{\Omega}\tilde{\boldsymbol{\Theta}}_{x,y}^f \quad (15)$$

where $\tilde{\boldsymbol{\Theta}}_{x,y}^f$ = vector of proportions of catch-at-age compositions from catch-age expansion data

$\boldsymbol{\Omega}$ = ageing error matrix with dimension of $A*A$ (A is number of age class), and each column representing probabilities of true age.

Biomass and spawning output:

Annual biomass at sex x and age a is given by:

$$B_{x,y,a} = \sum_r \phi_r N_{x,y,a} W_{r,x,a} \quad (16)$$

where ϕ_r = proportion of population in region r, and $\sum_r \phi_r = 1$

$W_{r,x,a}$ = weight of fish in region r at sex x and age a.

Annual spawning biomass is given by:

$$SSB_y = \sum_r \phi_r P_{r,a} N_{2,y,a} W_{r,2,a} \quad (17)$$

where $P_{r,a}$ = proportion of mature females ($x = 2$) in region r and at age a.
Annual spawning output is given by:

$$SO_y = \sum_r \phi_r P_{r,a} N_{2,y,a} G_{r,a} \quad (18)$$

where $G_{r,a}$ = fecundity in region r and at age a, and is derived from an empirical relationship (Boehlert et al. 1982):

$$G_{r,a} = 605.71 W_{r,2,a} - 261830.7 \quad (19)$$

Note that the spawning output of year 0 (SO_0), which is also termed as B_0, is an important parameter often used for determining target population levels.

Growth, length-weight relationship:

$$L_{r,x,a} = L_{r,x}^{\infty}\left(1 - e^{-K_{r,x}\left(a - t_{r,x}^{0}\right)}\right) \quad (20)$$

$$W_{r,x,a} = \tau_r^1 L_a^{\tau_r^2} \quad (21)$$

where $L_{r,x,a}$ = length in region r at sex x and age a

$L_{r,x}^{\infty}$, $K_{r,x}$, and $t_{r,x}^{0}$ = growth parameters in region r and at sex x

τ_r^1 and τ_r^2 = length-weight parameters in region r.

Stock-recruit relationship:

The Beverton-Holt relationship is used:

$$R_y = \frac{SO_{y-a_{\min}}}{\alpha + \beta SO_{y-a_{\min}}} e^{R_y^{\delta}} \quad (22)$$

where R_y = recruitment in billions of eggs at year y

$SO_{y-a_{\min}}$ = spawning output at year $y - a_{\min}$

α and β = recruitment parameters to be estimated.

The relationship can be reparameterized by using a steepness parameter (h):

$$\alpha = \frac{\frac{B_0}{R}(1-h)}{4h} \quad (23)$$

and

$$\beta = \frac{5h-1}{4hR} \quad (24)$$

where B_0 and R_0 are defined previously ($B_0 = SO_0$).

The "steepness" is the expected fraction of R_0 at $0.2B_0$, and is set to range from 0.2 to 1.0. When $h = 0.2$, recruits are a linear function of spawning output ($\beta = 0$, and $R_y = \frac{1}{\alpha} SO_{y-a_{\min}} e^{R_y^{\delta}}$). When $h = 1$, recruits are constant and independent of spawning output ($\alpha = 0$, and $R_y = \frac{1}{\beta} e^{R_y^{\delta}}$).

Likelihood components:

Total likelihood is the sum of all individual likelihood from catch-at-age compositions, fishery landings, and CPUE indexes from surveys and commercial catch data. Where there are missing observed values, the likelihood values are set to zeros. The total negative logarithm of the likelihood, which will be minimized during the parameter estimation, is given by:

$$-\log(L) = \sum_i \lambda_i L_i \qquad (25)$$

where L_i = likelihood value for component i

λ_i = weighting factor for component i.

Catch-at-age composition:

$$L_1 = -\sum_f \sum_y n_y^f \sum_x \sum_a \theta_{x,y,a}^f \log\left(\frac{\hat{\theta}_{x,y,a}^f}{\theta_{x,y,a}^f}\right) \qquad (26)$$

where θ and $\hat{\theta}$ = observed and estimated proportions of catch-at-age compositions by fishery f at sex x, year y, and age a

n_y^f = sampled trips in fishery f and year y.

Landings:

$$L_2 = \sum_f \left\{ \frac{\left[\log\left(\Psi_y^f\right) - \log\left(\hat{\Psi}_y^f\right)\right]^2}{2\left(\sigma_f^\Psi\right)^2} + \log\left(\sigma_f^\Psi\right) \right\} \qquad (27)$$

where Ψ_y^f and $\hat{\Psi}_y^f$ = observed and estimated landings by fishery f in year y

σ_f^Ψ = standard error for $\log\left(\Psi_y^f\right)$ which is set to be small (0.05) based on the assumption of small observation errors of catch data.

Recruitment:

Recruitment residuals are assumed to have no autocorrelations:

$$L_3 = 0.5 \sum_y \left[\left(\frac{R_y^\delta}{\sigma_R} \right)^2 - \log(\sigma_R) \right] \qquad (28)$$

Survey and CPUE indexes:

$$L_{4-8} = \sum_j \left\{ \frac{\left[\log\left(I_{j,y}\right) - \log\left(\hat{I}_{j,y}\right)\right]^2}{2\left(\sigma_j^I\right)^2} + \log\left(\sigma_j^I\right) \right\} \qquad (29)$$

where $I_{j,y}$ and $\hat{I}_{j,y}$ = observed and estimated index from series j and year y

σ_j^I = standard error for $\log\left(I_{j,y}\right)$.

Appendix C. AD Model Builder code for the widow rockfish assessment model.

```
// ***************************************************************
//  Widow Rockfish Model
//
//  Erik H. Williams, NMFS, Santa Cruz/Tiburon Lab
//  (erik.williams@noaa.gov), May 2000
//  Modified by Xi He 2003
//  NMFS Santa Cruz Lab, xi.he@noaa.gov
// ***************************************************************

GLOBALS_SECTION
  #include <time.h>
  time_t start,finish;
  long hour,minute,second;
  double elapsed_time;
  char s1[2] = {" "};

TOP_OF_MAIN_SECTION
  arrmblsize=1000000;
  gradient_structure::set_MAX_NVAR_OFFSET(1600);
  gradient_structure::set_GRADSTACK_BUFFER_SIZE(1000000);
  gradient_structure::set_CMPDIF_BUFFER_SIZE(1000000);
  time(&start);
  cout << endl << "Start time: " << ctime(&start) << endl;

DATA_SECTION
init_int nr;
init_int nf;
init_int ns; //number of sex: male s=1 & female s=2
init_int ni;
init_int syr;
init_int eyr;
init_int ny;
init_int recage;
init_int na;
init_ivector agebins(1,na);
init_int nL;
init_vector M(1,ns);
init_vector D(1,ny);
```

```
init_vector fracLN(1,ny);
init_matrix Linf(1,nr,1,ns);
init_matrix K(1,nr,1,ns);
init_matrix t0(1,nr,1,ns);
init_vector Lena(1,ns);
init_vector Lenb(1,ns);
init_matrix mat(1,nr,1,na);
init_matrix fec(1,nr,1,na);
init_matrix obsI(1,ni,1,ny);
init_matrix obsIcv(1,ni,1,ny);
init_matrix obsL(1,nf,1,ny);

init_int nyr_agec1;
init_ivector yr_agec1(1,nyr_agec1);
init_vector nsamp_agec1(1,nyr_agec1);
init_matrix obs_agec1_f(1,nyr_agec1,1,na);
init_matrix obs_agec1_m(1,nyr_agec1,1,na);
init_int nyr_agec2;
init_ivector yr_agec2(1,nyr_agec2);
init_vector nsamp_agec2(1,nyr_agec2);
init_matrix obs_agec2_f(1,nyr_agec2,1,na);
init_matrix obs_agec2_m(1,nyr_agec2,1,na);
init_int nyr_agec3;
init_ivector yr_agec3(1,nyr_agec3);
init_vector nsamp_agec3(1,nyr_agec3);
init_matrix obs_agec3_f(1,nyr_agec3,1,na);
init_matrix obs_agec3_m(1,nyr_agec3,1,na);
init_int nyr_agec4;
init_ivector yr_agec4(1,nyr_agec4);
init_vector nsamp_agec4(1,nyr_agec4);
init_matrix obs_agec4_f(1,nyr_agec4,1,na);
init_matrix obs_agec4_m(1,nyr_agec4,1,na);
init_matrix age_error(1,na,1,na);
init_int eyr_B0;
init_int syr_rec;
init_int nyr_weight;
init_int RecruitOverRiding;

int r;
int f;
int y;
```

```
int a;
int s;
int n_output;
ivector FYWC(1,nf);

PARAMETER_SECTION
init_number logInitScale(3);
init_bounded_number h(0.2,1.0,3);
init_bounded_dev_vector rec_dev(1,ny,-2.5,2.5,1);
init_bounded_matrix Sp(1,nf,1,4,0.0,30.0,4);
init_bounded_vector log_q(1,ni,-80.0,0.0,4);
init_vector Favg(1,nf,2);
init_bounded_dev_vector F1_dev(1966,2002,-5.0,3.0,2);
init_bounded_dev_vector F2_dev(1983,2002,-3.0,2.0,2);
init_bounded_dev_vector F3_dev(1983,2002,-5.0,3.0,2);
init_bounded_dev_vector F4_dev(1966,2002,-8.0,4.0,2);

matrix Ninit(1,ns,1,na);
number B0;
number B0RecMean;
number BT;
number R0;
number alpha;
number beta;
number SPR;
3darray N(1,ns,1,ny,1,na);
3darray B(1,ns,1,ny,1,na);
vector recE(1,ny);
vector recP(1,ny);
sdreport_vector totB(1,ny);
sdreport_vector SSB(1,ny);
sdreport_vector SO(1,ny);
likeprof_number BToverB0;

4darray C(1,nf,1,ns,1,ny,1,na);
3darray CT(1,ns,1,ny,1,na);
4darray L(1,nf,1,ns,1,ny,1,na);

4darray F(1,nf,1,ns,1,ny,1,na);
matrix Fdev(1,nf,1,ny);
3darray FT(1,ns,1,ny,1,na);
```

```
3darray Z(1,ns,1,ny,1,na);

vector sigL(1,nf);

4darray obsA(1,nf,1,ns,1,ny,1,na);
4darray predA(1,nf,1,ns,1,ny,1,na);
matrix nsampA(1,nf,1,ny);
matrix predL(1,nf,1,ny);
3darray S(1,nf,1,ny,1,na);

vector SCL_I(1,ny);
matrix predI(1,ni,1,ny);
3darray Len(1,nr,1,ns,1,na);
3darray W(1,nr,1,ns,1,na);

number pow_mwt;
vector Icv(1,ni);
number sigR;
vector sigI(1,ni);
vector obsIn(1,ni);

matrix LKLA(1,nf,1,ny)
vector lambda(1,nL);
vector LKL(1,nL);
objective_function_value fv;

INITIALIZATION_SECTION

RUNTIME_SECTION
maximum_function_evaluations 1000 2000 3000 4000 5000 6000;
convergence_criteria 1e-8 1e-8 1e-8 1e-8 1e-9 1e-9;

PRELIMINARY_CALCS_SECTION
  int r,s,a,aa,i;
  //compute length and weight at age
  for(r=1;r<=nr;r++)
  for(s=1;s<=ns;s++)
  for(a=1;a<=na;a++)
  {
    aa = a+recage-1;
    if (a==na) aa += 2; //age 22 used for max age (age of 20)
```

```
  Len(r,s,a) = Linf(r,s)*(1.0-mfexp(-K(r,s)*(aa-t0(r,s))));
  W(r,s,a) = 0.001*Lena(s)*pow(Len(r,s,a),Lenb(s));                //W now is kg
}

//Weights for likelihood components
lambda(1)=1.0;     //Age comps
lambda(2)=1.0;     //Landing
lambda(3)=0.5;     //Recruitment deviations
lambda(4)=0.5;     //CPUE index SCL juvenile survey
lambda(5)=1.0;     //CPUE index OR bottom trawl logbook
lambda(6)=1.0;     //CPUE index whiting foreigh
lambda(7)=1.0;     //CPUE index whiting joint venture
lambda(8)=1.0;     //CPUE index whiting domestic

//for (y=(ny-3);y<=ny;y++) D(y) = 0.01; // for changes in discard rates

//sigmas
sigL = 0.05;
sigR = 0.5;
pow_mwt = 3.0;
Icv(1) = 0.964256;
Icv(2) = 0.408837;
Icv(3) = 0.573773;
Icv(4) = 0.792426;
Icv(5) = 0.427578;

//Icv = 0.5;

SCL_I = obsI(1);
for(y=(ny-recage+1);y<=ny;y++) obsI(1,y) = (-1.0);
predI = obsI;
predL = obsL;

// assign age comp data to 4d matrix, if no data, value = -1
// Note: no operator defined for (4darray = 0) in ADMB
for(f=1;f<=nf;f++) for(s=1;s<=ns;s++) for(y=1;y<=ny;y++) for(a=1;a<=na;a++)
  obsA(f,s,y,a) = predA(f,s,y,a) = (-1.0);

int yy;
for(a=1;a<=na;a++)
{
```

```
    for(y=1;y<=nyr_agec1;y++)
    {
      yy = yr_agec1(y)-syr+1;
      obsA(1,1,yy,a) = obs_agec1_f(y,a);
      obsA(1,2,yy,a) = obs_agec1_m(y,a);
    }

    for(y=1;y<=nyr_agec2;y++)
    {
      yy = yr_agec2(y)-syr+1;
      obsA(2,1,yy,a) = obs_agec2_f(y,a);
      obsA(2,2,yy,a) = obs_agec2_m(y,a);
    }

    for(y=1;y<=nyr_agec3;y++)
    {
      yy = yr_agec3(y)-syr+1;
      obsA(3,1,yy,a) = obs_agec3_f(y,a);
      obsA(3,2,yy,a) = obs_agec3_m(y,a);
    }

    for(y=1;y<=nyr_agec4;y++)
    {
      yy = yr_agec4(y)-syr+1;
      obsA(4,1,yy,a) = obs_agec4_f(y,a);
      obsA(4,2,yy,a) = obs_agec4_m(y,a);
    }
  }

  cout << "obsA(1,2,20,6) = " << obsA(1,2,20,6) << endl;          // should print 0.056797
  cout << "obsA(4,2,34,10) = " << obsA(4,2,34,10) << endl;        // should print 0.032407

  nsampA = (-1.0);
  for(y=1;y<=nyr_agec1;y++)
    nsampA(1,yr_agec1(y)-syr+1) = nsamp_agec1(y);
  for(y=1;y<=nyr_agec2;y++)
    nsampA(2,yr_agec2(y)-syr+1) = nsamp_agec2(y);
  for(y=1;y<=nyr_agec3;y++)
    nsampA(3,yr_agec3(y)-syr+1) = nsamp_agec3(y);
  for(y=1;y<=nyr_agec4;y++)
    nsampA(4,yr_agec4(y)-syr+1) = nsamp_agec4(y);
```

```
  for(f=1;f<=nf;f++)
  for(y=1;y<=ny;y++)
    if (obsL(f,y)>(-1.0))
    {
      FYWC(f) = y;            //FYWC = first year with catch
      break;
    }

  // compute num of years with observations for each CPUE index
  // Note: last three years (recage) SC Lab survey are not used
  for (i=1;i<=ni;i++)
  {
    if (i==1) yy = ny-recage;
    else yy = ny;
    for (y=1;y<=yy;y++)
    if ( obsI(i,y) > (-1.0) )
      obsIn(i) += 1.0;
  }
  cout << "obsIn = " << obsIn << endl;

  n_output = 0;

PROCEDURE_SECTION
  get_initial_age_structure();
  get_selectivity();
  get_mortality();
  get_numbers_at_age();
  get_catch_at_age();
  get_predI();
  get_pred_agecomps();
  evaluate_the_objective_function();

  if(mceval_phase())
  {
    n_output++;
    write_mceval_output_files(n_output);
  }

FUNCTION get_initial_age_structure
  int s,a;
```

```
  R0 = mfexp(logInitScale);
  Ninit(1,1) = Ninit(2,1) = 0.5*R0;       // assuming sex ratio = 1:1
  for(s=1;s<=ns;s++)
  {
    for(a=2;a<=na;a++) Ninit(s,a) = Ninit(s,a-1)*mfexp(-M(s));
    Ninit(s,na) = Ninit(s,na-1)*mfexp(-M(s))/(1.0-mfexp(-M(s)));  // additional term for age+ group
  }

  // Ninit(2), fracLN(1), mat(1), and fec(1) are vectors of size na
  B0 = sum(elem_prod( elem_prod((Ninit(2)*fracLN(1)    ),mat(1)),fec(1))
         + elem_prod( elem_prod((Ninit(2)*(1-fracLN(2))),mat(2)),fec(2)));
  alpha = (B0/R0)*(1.0-h)/(4.0*h);
  beta = (5.0*h-1.0)/(4.0*h*R0);

FUNCTION get_selectivity
  for(f=1;f<=nf;f++) for(y=1;y<=ny;y++) for(a=1;a<=na;a++)
    S(f,y,a) = DLogSel(Sp(f,1),double(agebins(a)),Sp(f,2),Sp(f,3),double(agebins(a)),Sp(f,4));
  for(f=1;f<=nf;f++) for(y=1;y<=ny;y++) S(f,y) /= max(S(f,y));

FUNCTION get_mortality
  for(f=1;f<=nf;f++)
  for(s=1;s<=ns;s++)
  for(y=1;y<=ny;y++)
  {
    if( y >= FYWC(f) )
    {
      if (f==1) Fdev(f,y) = F1_dev(y+syr-1);
      if (f==2) Fdev(f,y) = F2_dev(y+syr-1);
      if (f==3) Fdev(f,y) = F3_dev(y+syr-1);
      if (f==4) Fdev(f,y) = F4_dev(y+syr-1);
      F(f,s,y)=S(f,y)*mfexp(Favg(f)+Fdev(f,y));
    }
  }

  for(s=1;s<=ns;s++)
  {
      FT(s) = 0.0;
      for(f=1;f<=nf;f++)
        FT(s) += F(f,s);
    Z(s) = FT(s) + M(s);
  }
```

```
FUNCTION get_numbers_at_age
  dvariable SO1;

  for(s=1;s<=ns;s++)
  for(a=1;a<=na;a++)
    N(s,1,a) = Ninit(s,a);

  for(y=1;y<=ny;y++)
  {
    if( y<=recage ) SO1 = B0;
      else SO1 = SO(y-recage);
    recP(y) = Recruit(SO1,alpha,beta,1);
    recE(y) = recP(y)*mfexp(rec_dev(y));

    for(s=1;s<=ns;s++)
    {
      N(s,y,1) = 0.5*recE(y);
        if (y<ny)
        {
          for(a=1;a<na;a++)
            N(s,y+1,a+1) = N(s,y,a)*mfexp(-Z(s,y,a));
          N(s,y+1,na) += N(s,y,na)*mfexp(-Z(s,y,na));
        }

      for(a=1;a<=na;a++)
        B(s,y,a) = N(s,y,a)*W(1,s,a)*fracLN(y) + N(s,y,a)*W(2,s,a)*(1.0-fracLN(y));
  }

    totB(y) = sum(B(1,y)+B(2,y));
    SSB(y) = SO(y) = 0.0;
    for(a=1;a<=na;a++)
    {
      SSB(y) += N(2,y,a)*W(1,2,a)*mat(1,a)*fracLN(y) + N(2,y,a)*W(2,2,a)*mat(2,a)*(1.0-fracLN(y));
      SO(y)  += N(2,y,a)*fec(1,a)*mat(1,a)*fracLN(y) + N(2,y,a)*fec(2,a)*mat(2,a)*(1.0-fracLN(y));
    }
  }

  int NyrRecMean = eyr_B0 - syr - recage + 1;
  dvector recValue(1,NyrRecMean);
  for (y=1;y<=NyrRecMean;y++) recValue(y) = value(recE(y+recage));
```

```
  dvariable recMean,SPRnorth,SPRsouth;
  recMean = mean(recValue);
  SPRnorth = CalSPR(na, mat(1), fec(1), M(2));
  SPRsouth = CalSPR(na, mat(2), fec(2), M(2));
  SPR = fracLN(1)*SPRnorth + (1.0-fracLN(1))*SPRsouth;
  B0RecMean = SPR*recMean;
  //cout << "SPRnorth = " << SPRnorth << " SPRsouth = " << SPRsouth << " SPR = " << SPR << endl;
  //cout << "recMean = " << recMean << " B0RecMean = " << B0RecMean << endl;

  BT = SO(ny);
  BToverB0 = BT/B0;

FUNCTION get_catch_at_age
  for(s=1;s<=ns;s++)
  for(y=1;y<=ny;y++)
  for(a=1;a<=na;a++)
  {
    for(f=1;f<=nf;f++)
      C(f,s,y,a) = N(s,y,a)*F(f,s,y,a)*(1.0-mfexp(-Z(s,y,a)))/Z(s,y,a);

    CT(s,y,a)=N(s,y,a)*FT(s,y,a)*(1.-mfexp(-Z(s,y,a)))/Z(s,y,a);
  }

  for(f=1;f<=nf;f++)
  {
    if(f<=3) r=1;
    if(f==4) r=2;
    for(s=1;s<=ns;s++) for(y=1;y<=ny;y++) for(a=1;a<=na;a++)
      L(f,s,y,a) = C(f,s,y,a)*W(r,s,a)*(1.0-D(y));
  }

//predicted landings
  for(y=1;y<=ny;y++) for(f=1;f<=nf;f++)
    predL(f,y) = sum(L(f,1,y)+L(f,2,y));

FUNCTION get_predI
  int yy,fi,i;
  dvariable x;

  // predict mid-water juvenile survy index (i=1), offset by recage years
```

```
  for (y=1;y<=(ny-recage);y++)
  if ( obsI(1,y)>(-1.0) )
  {
      yy = y+recage;
      x  = (N(1,yy,1)*mfexp(M(1)*3.0) + N(2,yy,1)*mfexp(M(2)*3.0));
    predI(1,y) = mfexp(log_q(1))*pow(x,pow_mwt);
  }

  // predict Oregon bottom trawl index (i=2), and whiting fishery indexes (i=3,4,5)
  for (i=2;i<=5;i++)
  for (y=1;y<=ny;y++)
  if ( obsI(i,y)>(-1.0) )
  {
      if (i==2) fi=3;                                  //fi=3 for Oregon bottom trawl: fishery = 3
      if ( (i>=3) && (i<=5) ) fi=2;        //fi=2 for Oregon mid-water trawl: fishery = 2
      x = B(1,y)*S(fi,y) + B(2,y)*S(fi,y);
    predI(i,y) = mfexp(log_q(i))*x;
  }

FUNCTION get_pred_agecomps
  for(f=1;f<=nf;f++)
  for(s=1;s<=ns;s++)
  for(y=1;y<=ny;y++)
  if ( (nsampA(f,y))>(-1.0) )
  {
    for (a=1;a<=na;a++)             // predA = props of each is over all ages and both sexes
      predA(f,s,y,a) = C(f,s,y,a)/(sum(C(f,1,y))+sum(C(f,2,y)));
    predA(f,s,y) = age_error*predA(f,s,y);
  }

FUNCTION evaluate_the_objective_function
  dvariable x1,x2,x3;
  double tiny = 1.0e-6;

  LKLA = 0.0;
  LKL = 0.0;

  // LKL(1) = age compositions -> multinomial errors
  for(f=1;f<=nf;f++)
  for(y=1;y<=ny;y++)
  {
```

```
  if (nsampA(f,y)>(-1.0))
  {
    for(s=1;s<=ns;s++)
    for(a=1;a<=na;a++)
    {
      x1 =  obsA(f,s,y,a)+tiny;
      x2 = predA(f,s,y,a)+tiny;
      LKLA(f,y) += x1*log(x2/x1);
    }
    LKLA(f,y) *= nsampA(f,y);
  }
}
LKL(1) = (-1.0)*sum(LKLA);

// LKL(2) = landings -> lognormal
for(f=1;f<=nf;f++)
for(y=1;y<=ny;y++)
  if (obsL(f,y)>(-1.0))
  {
    x1 = log(obsL (f,y)+tiny);
    x2 = log(predL(f,y)+tiny);
    x3 = sigL(f);
    LKL(2) += 0.5 * square( (x1-x2)/x3 ) + log(x3);
  }

// LKL(3) = recruitment residuals -> lognormal
for(y=1;y<=ny;y++)
  LKL(3) += 0.5 * square(rec_dev(y)/sigR) + log(sigR);

// This addtional component from Methot (2000) Stock Synthesis
// It is related to good fits for obs mean and variability of individual year recruitment
// This component has very little effect
dvariable A7,T1,sigR1 = 0.0;
A7 = double(ny);
T1 = sum(rec_dev);
for(y=1;y<=ny;y++) sigR1 += square(rec_dev(y));
sigR1 = sqrt(sigR1/A7);

LKL(3) += 0.5*square(A7*(sigR1-sigR)/square(sigR)) + log(square(sigR)/A7)
         +0.5*square(A7*T1/sigR) + log(sigR/A7);
```

```
  // LKL(4-8) = CPUE indices -> lognormal
  // computer root mean square error (RMSE) as sigmas for indices in whiting bycatch
  // data CVs are used for SC Lab survey and OR bottom trawl indices
  int i;
  sigI = 0.0;
  for (i=1;i<=ni;i++)
  {
  for (y=1;y<=ny;y++)
    if ( obsI(i,y) > (-1.0) )
    {
      x1 = log(obsI (i,y)+tiny);
      x2 = log(predI(i,y)+tiny);
      sigI(i) += square(x1-x2);
    }
    sigI(i) = sqrt(sigI(i)/obsIn(i));
  }
  //cout << "sigI = " << sigI << endl;
  //cout << "Icv = " << Icv << endl;

  for (i=1;i<=ni;i++)
  for (y=1;y<=ny;y++)
    if ( obsI(i,y) > (-1.0) )
    {
      x1 = log(obsI (i,y)+tiny);
      x2 = log(predI(i,y)+tiny);
      x3 = Icv(i);
      //if (i<=2) x3 = obsIcv(i,y);
      //if (i>2 ) x3 = sigI(i);
                  // obs CVs of whiting bycatch indices from delta-GLM seems too small
                  // so computed sigmas are used for whiting indices
      LKL(i+3) += 0.5 * square( (x1-x2)/x3 ) + log(x3);
    }

  fv = sum(elem_prod(LKL,lambda));

  //fv += 0.5*square(log(0.52/h)/0.5);

FUNCTION dvariable CalSPR(int na, dvector mat, dvector fec, dvariable M)
  dvariable Rec,SPR=0.0;
  for(a=1;a<=na;a++)
  {
```

```
    if (a==1 ) Rec = 1.0;
    else if (a==na) Rec *= mfexp(-M)/(1.0-mfexp(-M));
    else Rec *= mfexp(-M);
    SPR += Rec*mat(a)*fec(a);
  }
  return 0.5*SPR;

FUNCTION dvariable DLogSel(dvariable s1, dvariable L1, dvariable L501, dvariable s2, dvariable L2,
dvariable L502)
  return LogSel(s1,L1,L501)*(1.-LogSel(s2,L2,L502));

FUNCTION dvariable LogSel(dvariable s, dvariable L, dvariable L50)
  return 1./(1.+mfexp(-1.*s*(L-L50)));

FUNCTION dvariable Recruit(dvariable s, dvariable a, dvariable b, int RecruitType)
  dvariable r;
  switch(RecruitType)
  {
    case 0: r = a*s; break;
    case 1: r = s/(a+b*s); break; //Beverton and Holt
    case 2: r = s*mfexp(a*(1.0-s/b)); break; //Ricker
    case 3: r = b+a*s; break;
    default: r = 0.0; break;
  }
  if (r<0.0) r = 0.0;
  return r;

REPORT_SECTION
  report << SO << endl;
  report << SSB << endl;

FINAL_SECTION
  write_output_files();
  write_rebuild_file();
  bool runmcmc1 = false, runsir1 = false;
  adstring ar,ar1="-mcmc1",ar2="-sir1";
  for(int i=0;i<argc;i++)
  {
    ar = argv[i];
    if (ar == ar1) runmcmc1 = true;
    if (ar == ar2) runsir1 = true;
```

```
}
if (runmcmc1) mcmc1();
if (runsir1) sir1();
time(&finish);
elapsed_time = difftime( finish, start );
hour = long(elapsed_time)/3600;
minute = long(elapsed_time)%3600/60;
second = (long(elapsed_time)%3600)%60;
cout << ctime(&start);  .
cout << ctime(&finish);
cout << hour << s1 << minute << s1 << second << endl;
```

Appendix D. AD Model Builder data file for the widow rockfish assessment model.

```
#--><>--><>--><>--><>--><>--><>--><>--><>--><>--><>--><>--><>--><>
#
#  Widow Rockfish Model
#
#  Erik H. Williams, NMFS, Santa Cruz/Tiburon Lab
#  (erik.williams@noaa.gov), May 2000
#  Modified by Xi He, NMFS Santa Cruz Lab, 2002
#--><>--><>--><>--><>--><>--><>--><>--><>--><>--><>--><>--><>--><>
# number of region
2
# number of fishery
4
# number of sex
2
# number of observed indexes
5
# Starting and ending year of the model
1958
2002
45
# Recruitment age and total number of age bins
3
18
# Vector of ages for age bins
3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20

# number of likelihood components
8

# Natural mortality
0.15 0.15

# Discard rate (D value) by year (landing = catch * (1-D) )
0.06  0.06  0.06  0.06  0.06
0.06  0.06  0.06  0.06  0.06
0.06  0.06  0.06  0.06  0.06
0.06  0.06  0.06  0.06  0.06
0.06  0.06  0.06  0.06  0.06
```

```
0.16  0.16  0.16  0.16  0.16
0.16  0.16  0.16  0.16  0.16
0.16  0.16  0.16  0.16  0.16
0.16  0.16  0.16  0.16  0.16

# Smoothed fraction of total landings in the north\
# fractions from 1968-77 was used in years before 1968, same as in 2000 assessment
# foreign landings from Jean Rogers were not used to compute fractions before 1968
0.548 0.548 0.548 0.548 0.548
0.548 0.548 0.548 0.548 0.548
0.548 0.548 0.548 0.548 0.548
0.548 0.548 0.548 0.548 0.569
0.598 0.594 0.593 0.600 0.609
0.669 0.675 0.673 0.709 0.732
0.751 0.775 0.793 0.796 0.784
0.776 0.777 0.762 0.765 0.746
0.735 0.750 0.750 0.750 0.750

# Biological information
# Growth parameters (Linf,K,t0 for male north, female north, male south, female south)
# age 22 used for wgt of 20+
44.00 50.54 41.50 47.55
 0.18  0.14  0.25  0.20
-2.81 -2.68 -0.28 -0.17

# Length weight parameters (b and a for male and female)
0.01188     0.00545
3.06631     3.28781

# proportions of maturity of females
# north
0.01  0.02  0.10  0.32  0.68  0.90  0.98  0.99  1.00
1.00  1.00  1.00  1.00  1.00  1.00  1.00  1.00  1.00
# south
0.13  0.21  0.64  0.90  0.90  1.00  1.00  1.00  1.00
1.00  1.00  1.00  1.00  1.00  1.00  1.00  1.00  1.00

# fecundity of females (millions of eggs)
# north
0.0000     0.0000     0.0723     0.1526     0.2325     0.3102     0.3843     0.4540     0.5186
0.5780     0.6322     0.6812     0.7253     0.7648     0.8000     0.8313     0.8590     0.9241
```

```
# south
0.0050      0.0100      0.0300      0.0861      0.1788      0.2664      0.3466      0.4184      0.4813
0.5358      0.5824      0.6219      0.6552      0.6831      0.7064      0.7258      0.7419      0.7751

# index values 1968-1999 (-1 = no data)
# NMFS Tiburon/Santa Cruz Lab midwater trawl index
# note that there were no estimates in 1992, 1996, and 1998 because of no positive catches
# 1/2 of historical low estimates (value in 1994) were uesed in those years.
# CVs were set very high.
-1.000000   -1.000000   -1.000000   -1.000000   -1.000000
-1.000000   -1.000000   -1.000000   -1.000000   -1.000000
-1.000000   -1.000000   -1.000000   -1.000000   -1.000000
-1.000000   -1.000000   -1.000000   -1.000000   -1.000000
-1.000000   -1.000000   -1.000000   -1.000000   -1.000000
-1.000000   5.632788    14.888214   0.217432    4.905919
3.429141    0.141987    0.177756    1.178180    0.061000
0.821537    0.122072    0.164556    0.061000    0.176620
0.061000    0.191478    0.219956    0.889779    6.779168

# Oregon bottom trawl index
-1.00000    -1.00000    -1.00000    -1.00000    -1.00000
-1.00000    -1.00000    -1.00000    -1.00000    -1.00000
-1.00000    -1.00000    -1.00000    -1.00000    -1.00000
-1.00000    -1.00000    -1.00000    -1.00000    -1.00000
-1.00000    -1.00000    -1.00000    -1.00000    -1.00000
-1.00000    331.47          100.88          227.08          169.08
93.97       164.10          78.49       73.59       83.16
53.58       100.34          109.96          94.81       97.23
56.56       84.46       -1.00000    -1.00000    -1.00000

# Whiting bycatch index - foreign
-1.000000   -1.000000   -1.000000   -1.000000   -1.000000
-1.000000   -1.000000   -1.000000   -1.000000   -1.000000
-1.000000   -1.000000   -1.000000   -1.000000   -1.000000
-1.000000   -1.000000   -1.000000   4.256054    3.529378
3.853356    2.800117    6.265249    3.234098    1.147622
-1.000000   9.460566    1.397218    3.893429    2.181040
2.426066    -1.000000   -1.000000   -1.000000   -1.000000
-1.000000   -1.000000   -1.000000   -1.000000   -1.000000
-1.000000   -1.000000   -1.000000   -1.000000   -1.000000
```

```
# Whiting bycatch index - joint venture (JV)
-1.000000   -1.000000   -1.000000   -1.000000   -1.000000
-1.000000   -1.000000   -1.000000   -1.000000   -1.000000
-1.000000   -1.000000   -1.000000   -1.000000   -1.000000
-1.000000   -1.000000   -1.000000   -1.000000   -1.000000
-1.000000   -1.000000   -1.000000   -1.000000   -1.000000
10.590847   -1.000000   4.706416    4.289842    1.055527
2.072460    4.643640    3.134886    -1.000000   -1.000000
-1.000000   -1.000000   -1.000000   -1.000000   -1.000000
-1.000000   -1.000000   -1.000000   -1.000000   -1.000000

# Whiting bycatch index - domestic
-1.000000   -1.000000   -1.000000   -1.000000   -1.000000
-1.000000   -1.000000   -1.000000   -1.000000   -1.000000
-1.000000   -1.000000   -1.000000   -1.000000   -1.000000
-1.000000   -1.000000   -1.000000   -1.000000   -1.000000
-1.000000   -1.000000   -1.000000   -1.000000   -1.000000
-1.000000   -1.000000   -1.000000   -1.000000   -1.000000
-1.000000   -1.000000   -1.000000   0.512110    0.213267
0.303543    0.585991    0.161586    0.336235    0.309890
0.438514    -1.000000   -1.000000   -1.000000   -1.000000
# last three years (1999-2001) are not used - STAR recommandation
# 0.438514  0.176929    0.144952    0.107496    -1.000000

# cv for each index
# cv for NMFS Tiburon/Santa Cruz Lab midwater trawl index
-1.0000     -1.0000     -1.0000     -1.0000     -1.0000
-1.0000     -1.0000     -1.0000     -1.0000     -1.0000
-1.0000     -1.0000     -1.0000     -1.0000     -1.0000
-1.0000     -1.0000     -1.0000     -1.0000     -1.0000
-1.0000     -1.0000     -1.0000     -1.0000     -1.0000
-1.0000     0.4346      0.4897      0.5020      0.2485
0.2869      0.4164      0.4297      0.3197      2.0000
0.2849      0.4880      0.4941      2.0000      0.4214
2.0000      0.5001      0.3657      0.2721      0.3156

# cv for Oregon bottom trawl index
-1          -1          -1          -1          -1
-1          -1          -1          -1          -1
-1          -1          -1          -1          -1
-1          -1          -1          -1          -1
```

```
-1          -1          -1          -1          -1
-1.0  0.2121      0.1875      0.2928      0.2730
0.2897      0.1749      0.1348      0.1275      0.1179
0.1314      0.1128      0.1387      0.1357      0.1502
0.1718      0.1684      -1.0  -1.0  -1.0

# cv for Whiting bycatch index - foreign
-1          -1          -1          -1          -1
-1          -1          -1          -1          -1
-1          -1          -1          -1          -1
-1          -1          -1          0.18894     0.09723
0.07181     0.07846     0.07539     0.07952     0.23103
-1          0.07614     0.08170     0.07524     0.06524
0.09403     -1          -1          -1          -1
-1          -1          -1          -1          -1
-1          -1          -1          -1          -1

# cv for Whiting bycatch index - joint venture (JV)
-1          -1          -1          -1          -1
-1          -1          -1          -1          -1
-1          -1          -1          -1          -1
-1          -1          -1          -1          -1
-1          -1          -1          -1          -1
0.11129     -1          0.14007     0.08222     0.10281
0.08677     0.05863     0.07033     -1          -1
-1          -1          -1          -1          -1
-1          -1          -1          -1          -1

# cv for Whiting bycatch index - domestic
-1          -1          -1          -1          -1
-1          -1          -1          -1          -1
-1          -1          -1          -1          -1
-1          -1          -1          -1          -1
-1          -1          -1          -1          -1
-1          -1          -1          -1          -1
-1          -1          -1          0.11368     0.09850
0.08674     0.05702     0.08717     0.06880     0.06190
0.06534     -1          -1          -1          -1
# 0.06534   0.06557     0.06951     0.07568     -1

# landings
```

```
# VAN-COL Fishery
       -1        -1             -1        -1          -1
       -1        -1             -1   3670           3900
     1693       356            554    701            410
      617       293            454    948           1318
    605.0     966.0   16190.0  21769.8  14793.9
   3213.3    1450.0    1534.4   2551.2   3711.7
   3075.8    3375.2    2231.6   1148.3    935.2
   1702.9    1061.7    1077.5    956.5   1003.7
    539.2     515.5     385.9    297.1     61.2

# OR Midwater Trawl Fishery
-1 -1 -1 -1 -1
-1 -1 -1 -1 -1
-1 -1 -1 -1 -1
-1 -1 -1 -1 -1
-1 -1 -1 -1 -1
   1452.0    3567.6    3185.0   2976.9   4984.8
   4101.6    4870.9    3234.8   1845.5   1149.4
   1754.8    1678.4    1584.7   1851.0   2032.2
    925.9    2237.4    2284.5    957.6    148.1

# OR Bottom Trawl Fishery
-1 -1 -1 -1 -1
-1 -1 -1 -1 -1
-1 -1 -1 -1 -1
-1 -1 -1 -1 -1
-1 -1 -1 -1 -1
   1487.6    1334.2     870.8   1170.6   1169.5
   1126.1    1970.9    2168.0   1940.1   2624.4
   3385.3    2382.2    2278.3   2114.1   2281.3
   1330.7     796.1      18.4     44.5      6.0

# EUR-CON Fishery
       -1        -1             -1       -1           -1
       -1        -1             -1       96          249
      336        21              1        1           13
      207       280            358    412            883
    502.0    2326.0    5666.0   5168.6  11239.4
   4167.7    3464.4    3552.1   2727.3   2716.7
   2148.0    2261.9    2478.3   1355.6   1326.8
```

```
    1347.4    1243.8    2011.9    1556.4    1671.4
    1294.3     900.8    1120.3     495.2      48.2

# Age compositions from four fisheries
# VAN-COL Fishery
# number of years of age comps
23
# years of age comps
1980 1981 1982 1983 1984 1985 1986 1987 1988 1989 1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000
2001 2002
# number of sampled trips
18   31   40   25   22   16   27   36   20   30
41   35   31   36   28   33   27   30   22   29
21   10   12

# male age comps
  0.000000  0.000000  0.009363  0.021512  0.020342  0.055539  0.095547  0.110577  0.046018  0.029204
0.011890  0.013060  0.005852  0.004096  0.002341  0.002341  0.001170  0.002926
  0.000444  0.006609  0.024435  0.063737  0.045524  0.024041  0.047744  0.087771  0.067569  0.047083
0.025763  0.017104  0.011660  0.005331  0.004276  0.003388  0.002887  0.008502
  0.000155  0.008491  0.030499  0.084375  0.030692  0.044964  0.020568  0.021494  0.032650  0.071686
0.044941  0.034309  0.034855  0.021097  0.014068  0.008806  0.005466  0.016884
  0.000000  0.007569  0.153715  0.113485  0.028422  0.017474  0.014261  0.013099  0.013587  0.018363
0.020143  0.014780  0.015317  0.008811  0.006339  0.006692  0.005666  0.019890
  0.000000  0.003350  0.053703  0.161029  0.083344  0.033419  0.013850  0.004392  0.005597  0.006802
0.007517  0.012931  0.012788  0.010684  0.006802  0.007681  0.007681  0.028558
  0.000000  0.008297  0.074816  0.080420  0.124782  0.066450  0.021605  0.009465  0.003556  0.005909
0.005317  0.006053  0.005460  0.002658  0.005909  0.004724  0.002514  0.028344
  0.000000  0.007004  0.060179  0.173641  0.075174  0.048950  0.014384  0.005971  0.005285  0.005216
0.003465  0.003122  0.004632  0.006073  0.003224  0.002297  0.001542  0.029481
  0.000000  0.006265  0.024049  0.120012  0.194208  0.046191  0.012870  0.008530  0.002837  0.004189
0.005540  0.004207  0.003007  0.004055  0.003750  0.002112  0.001504  0.011251
  0.000000  0.000000  0.014864  0.060144  0.136868  0.198865  0.034969  0.013274  0.004554  0.002449
0.000858  0.002620  0.003135  0.000858  0.000172  0.000515  0.000687  0.014040
  0.000000  0.002563  0.017604  0.093364  0.094971  0.157016  0.087374  0.009204  0.003722  0.001159
0.000000  0.001282  0.000232  0.000927  0.000232  0.000463  0.001513  0.008465
  0.000000  0.000464  0.025076  0.077340  0.152504  0.068069  0.097414  0.029968  0.011480  0.004530
0.000978  0.000464  0.000000  0.000464  0.000515  0.000978  0.001029  0.007465
  0.000000  0.001239  0.010045  0.061670  0.114107  0.107255  0.073670  0.043534  0.049590  0.010278
0.003949  0.002903  0.001665  0.000619  0.004045  0.001142  0.001142  0.018289
```

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  0.000000  0.002617  0.019543  0.030904  0.071547  0.077266  0.081931  0.048736  0.051519  0.029442
0.019792  0.007933  0.004908  0.002700  0.001717  0.000000  0.000900  0.011616
  0.000166  0.000166  0.016699  0.058371  0.051097  0.062834  0.056883  0.035553  0.028608  0.030428
0.022822  0.020172  0.012236  0.006448  0.005291  0.004299  0.001984  0.013891
  0.000000  0.001331  0.010571  0.041365  0.086872  0.057053  0.045358  0.037129  0.028132  0.022809
0.025977  0.016475  0.012951  0.011152  0.004929  0.003598  0.002699  0.017486
  0.000685  0.010197  0.030883  0.056198  0.096140  0.099800  0.063944  0.028600  0.030630  0.018687
0.015002  0.023660  0.010430  0.007430  0.006143  0.007229  0.002457  0.012001
  0.000674  0.010919  0.054020  0.107421  0.101373  0.061162  0.033894  0.020952  0.014655  0.011940
0.007780  0.006875  0.009128  0.003043  0.003832  0.003717  0.002253  0.008454
  0.000000  0.002832  0.036763  0.148924  0.129091  0.049634  0.015218  0.009554  0.006238  0.006812
0.006634  0.008139  0.001327  0.003317  0.002653  0.000663  0.000753  0.003980
  0.000000  0.001088  0.014273  0.042774  0.145688  0.109655  0.039772  0.014534  0.007136  0.008529
0.007703  0.003307  0.002481  0.002481  0.006615  0.000827  0.000000  0.005788
  0.000000  0.001831  0.011040  0.040933  0.080730  0.107025  0.081930  0.041423  0.022625  0.009912
0.009801  0.009154  0.004577  0.005224  0.003662  0.004577  0.001831  0.005224
  0.000000  0.000000  0.004590  0.057898  0.112775  0.071080  0.073505  0.072582  0.038422  0.012587
0.012326  0.005244  0.002098  0.009113  0.006293  0.003147  0.002098  0.005244
  0.000000  0.000000  0.004118  0.051457  0.125630  0.084317  0.061792  0.053584  0.037141  0.039296
0.033078  0.008290  0.016525  0.006218  0.006190  0.006218  0.002073  0.006218
  0.000000  0.001565  0.020347  0.025043  0.056347  0.097041  0.062607  0.051651  0.023478  0.025043
0.010956  0.014087  0.001565  0.001565  0.004696  0.001565  0.001565  0.003130
# female age comps
  0.000000  0.000000  0.009150  0.018485  0.013561  0.025721  0.087940  0.141807  0.084614  0.062747
0.034713  0.017742  0.021253  0.018513  0.005267  0.007023  0.006437  0.013246
  0.000000  0.007494  0.017214  0.046582  0.043915  0.020375  0.020432  0.062351  0.078447  0.071291
0.037376  0.028320  0.018543  0.010161  0.005388  0.005778  0.005167  0.027296
  0.000311  0.007559  0.018373  0.059590  0.028839  0.041575  0.018823  0.014979  0.014679  0.049251
0.039979  0.040337  0.032736  0.032280  0.016563  0.015107  0.005932  0.037088
  0.000000  0.005567  0.153308  0.113974  0.040329  0.020551  0.009182  0.013519  0.013334  0.016294
0.029275  0.022800  0.021589  0.013149  0.010306  0.006877  0.004523  0.027811
  0.001062  0.001941  0.044000  0.152020  0.075377  0.025555  0.018160  0.005270  0.006496  0.007007
0.011378  0.016832  0.025126  0.023716  0.020100  0.010888  0.013543  0.081403
  0.000000  0.008297  0.070811  0.081461  0.117263  0.057561  0.027515  0.008568  0.006951  0.005317
0.007526  0.005460  0.012394  0.009592  0.010921  0.007221  0.007526  0.099337
  0.000000  0.002024  0.053314  0.177620  0.091239  0.069749  0.020146  0.013248  0.003947  0.006967
0.007652  0.006142  0.008884  0.008402  0.007717  0.009157  0.003497  0.060653
  0.000152  0.004475  0.013899  0.095086  0.224047  0.056797  0.036973  0.025570  0.009424  0.006740
0.003750  0.001960  0.007062  0.007536  0.004833  0.007518  0.004225  0.035374
  0.000000  0.002449  0.007346  0.056150  0.150874  0.206257  0.035267  0.017267  0.012072  0.008204
0.002964  0.000343  0.002620  0.000515  0.000343  0.000858  0.000172  0.007426
```

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  0.000000  0.002563  0.007104  0.075898  0.092900  0.183621  0.104392  0.008972  0.009790  0.005822
0.000695  0.001050  0.001050  0.001513  0.000000  0.000927  0.003613  0.020000
  0.000000  0.001442  0.027599  0.062046  0.115589  0.077798  0.119346  0.059062  0.012203  0.005508
0.002522  0.002935  0.000464  0.001029  0.002471  0.000978  0.000927  0.029343
  0.000000  0.000000  0.003852  0.054295  0.084317  0.099027  0.065619  0.056732  0.053596  0.010801
0.009329  0.004665  0.004142  0.002477  0.000619  0.003000  0.002381  0.040005
  0.000000  0.003025  0.023468  0.025345  0.055355  0.091344  0.081860  0.056669  0.069345  0.045876
0.029850  0.011693  0.007850  0.004417  0.000900  0.003600  0.002125  0.024208
  0.000000  0.000992  0.008103  0.059030  0.037868  0.067636  0.070119  0.054907  0.049947  0.084023
0.047961  0.029274  0.015218  0.008769  0.002978  0.004465  0.001986  0.028777
  0.003524  0.002662  0.013345  0.046763  0.073830  0.067831  0.043766  0.054391  0.041440  0.043277
0.052123  0.034749  0.024646  0.016044  0.012951  0.007591  0.004423  0.030757
  0.000685  0.009311  0.032027  0.050314  0.077627  0.081629  0.055487  0.036799  0.023485  0.027229
0.017200  0.020543  0.009686  0.006887  0.010773  0.004772  0.001571  0.013857
  0.000000  0.001579  0.066768  0.107961  0.105186  0.062608  0.054288  0.024226  0.015657  0.019161
0.015329  0.012845  0.019161  0.004622  0.003948  0.002253  0.002253  0.020066
  0.000000  0.000663  0.028713  0.167230  0.141834  0.052823  0.033179  0.023574  0.016851  0.018000
0.017336  0.010039  0.007297  0.010614  0.005396  0.001990  0.002653  0.029277
  0.000000  0.001088  0.012053  0.047736  0.165170  0.153428  0.046648  0.020322  0.022758  0.023063
0.019540  0.021454  0.014273  0.004395  0.011271  0.004656  0.002481  0.017014
  0.000000  0.001239  0.012224  0.046000  0.066841  0.126525  0.104824  0.052952  0.032861  0.022838
0.015081  0.013195  0.014378  0.008562  0.005816  0.011308  0.005492  0.018364
  0.000000  0.000000  0.001770  0.053434  0.088249  0.097235  0.076904  0.069235  0.046092  0.021372
0.009834  0.009440  0.006293  0.006293  0.006293  0.009440  0.002098  0.007015
  0.000000  0.000000  0.002073  0.024679  0.053475  0.090370  0.057511  0.014371  0.031033  0.024843
0.047668  0.035205  0.016580  0.018653  0.004145  0.006190  0.008290  0.022770
  0.000000  0.001565  0.023478  0.025043  0.026608  0.101737  0.097041  0.042260  0.043825  0.032869
0.028173  0.025043  0.021913  0.009391  0.001565  0.010956  0.004696  0.020347

# OR Midwater Trawl Fishery
# number of years of age comps
19
# years of age comps
1984 1985 1986 1987 1988 1989 1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000 2001 2002
#sampled trips
33   51   56   62   38   61   60   60   29   50
22   12   14   21    9   11   34   23   15
# male age comps
  0.000000  0.001249  0.016659  0.187552  0.113736  0.008303  0.018400  0.006489  0.008219  0.007183
0.014697  0.021419  0.001752  0.007367  0.003349  0.001785  0.000757  0.011289
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 0.000000  0.002236  0.061929  0.066605  0.224736  0.060317  0.007770  0.005961  0.003059  0.000000
0.001733  0.005233  0.014244  0.002656  0.002328  0.000000  0.000000  0.010138
 0.000000  0.000000  0.005472  0.104226  0.073530  0.195109  0.059656  0.004993  0.005095  0.003740
0.000000  0.000447  0.001136  0.012770  0.003982  0.002755  0.001405  0.007587
 0.000000  0.000000  0.016510  0.125854  0.221917  0.070980  0.037336  0.018807  0.002107  0.002889
0.002529  0.000356  0.000199  0.001560  0.003057  0.000000  0.001158  0.002806
 0.000484  0.001185  0.014211  0.075913  0.238582  0.131816  0.032351  0.021121  0.008094  0.000000
0.000000  0.000460  0.000889  0.000000  0.002745  0.002132  0.000000  0.003647
 0.000000  0.004102  0.016060  0.047419  0.116290  0.188631  0.070785  0.012981  0.014107  0.002258
0.000247  0.000087  0.000497  0.000672  0.002144  0.002143  0.003487  0.005763
 0.000000  0.003321  0.028176  0.029987  0.057839  0.100289  0.132836  0.067550  0.033021  0.015717
0.007527  0.003601  0.000000  0.000974  0.000000  0.001817  0.000000  0.004279
 0.000000  0.000000  0.007709  0.066309  0.100305  0.105528  0.064610  0.088096  0.038765  0.009553
0.011144  0.003093  0.002417  0.001644  0.001308  0.000000  0.000542  0.009658
 0.000000  0.000000  0.035945  0.039720  0.087052  0.083027  0.080416  0.041211  0.085709  0.030049
0.021923  0.013500  0.002018  0.004160  0.000000  0.000000  0.001193  0.013024
 0.000000  0.000000  0.016302  0.070921  0.055203  0.081487  0.049299  0.038564  0.034325  0.059574
0.026062  0.017941  0.014803  0.006404  0.000000  0.003025  0.001142  0.010385
 0.000060  0.001656  0.008803  0.075885  0.155556  0.079729  0.046850  0.041458  0.011685  0.019825
0.031305  0.000000  0.001604  0.005385  0.000000  0.000000  0.000000  0.009487
 0.000000  0.004118  0.016270  0.020655  0.131529  0.101559  0.050600  0.047015  0.033035  0.022577
0.030138  0.007105  0.000000  0.000000  0.000000  0.005901  0.000000  0.000875
 0.000000  0.008826  0.074117  0.094208  0.072464  0.067619  0.049638  0.034572  0.013109  0.007989
0.023724  0.008520  0.017650  0.008086  0.002783  0.000000  0.004642  0.004642
 0.000000  0.002806  0.033832  0.259303  0.124430  0.041638  0.024120  0.026377  0.013285  0.011185
0.006524  0.000000  0.010993  0.012657  0.000000  0.000000  0.000000  0.002096
 0.000000  0.000000  0.015530  0.098950  0.199935  0.091861  0.057067  0.013497  0.027997  0.012242
0.001408  0.004779  0.000000  0.000000  0.010976  0.000000  0.000000  0.000000
 0.000000  0.000000  0.016491  0.032183  0.108712  0.188452  0.091741  0.023373  0.004784  0.003869
0.000000  0.000000  0.000000  0.000000  0.000000  0.000000  0.000000  0.000000
 0.000000  0.000000  0.004870  0.033511  0.071985  0.086101  0.115372  0.089305  0.048252  0.032821
0.004816  0.007448  0.008363  0.001826  0.000484  0.000000  0.000000  0.000000
 0.000000  0.000000  0.001276  0.018646  0.099895  0.100433  0.122495  0.062026  0.049961  0.041285
0.016040  0.005449  0.000917  0.002853  0.001224  0.001309  0.003946  0.003427
 0.000000  0.004930  0.009861  0.045050  0.075314  0.187089  0.173179  0.053133  0.005955  0.010136
0.011321  0.006201  0.000000  0.015429  0.002614  0.000000  0.007491  0.002614
# female age comps
 0.000000  0.001430  0.018876  0.168858  0.180568  0.014028  0.027547  0.005962  0.006322  0.003556
0.026679  0.057693  0.015561  0.008459  0.006485  0.005497  0.005571  0.016705
 0.000000  0.000000  0.045566  0.066237  0.254100  0.090627  0.009295  0.013232  0.009939  0.000000
0.001286  0.007335  0.018569  0.002860  0.001582  0.001291  0.002024  0.007111
```

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  0.000000  0.000000  0.009637  0.136513  0.082163  0.168330  0.067111  0.004429  0.010694  0.004409
0.000000  0.000378  0.003912  0.016306  0.001360  0.002328  0.001568  0.008958
  0.000000  0.001091  0.014721  0.115256  0.203142  0.080172  0.040652  0.021862  0.001310  0.004031
0.001509  0.000112  0.000776  0.001381  0.002411  0.001268  0.000368  0.001872
  0.001029  0.004892  0.013675  0.075696  0.192004  0.101985  0.026823  0.017744  0.009244  0.004444
0.004669  0.000000  0.001092  0.000000  0.001435  0.004233  0.002816  0.004590
  0.000000  0.003358  0.022650  0.033519  0.075956  0.195248  0.087347  0.031686  0.015902  0.015279
0.009010  0.001810  0.000000  0.000736  0.000000  0.001558  0.006418  0.011850
  0.000000  0.000000  0.018465  0.032629  0.054334  0.076913  0.146584  0.105843  0.038064  0.021354
0.009218  0.002280  0.001955  0.000588  0.000855  0.000000  0.000000  0.003982
  0.000000  0.000000  0.010833  0.062981  0.095774  0.061101  0.068012  0.097786  0.042921  0.013368
0.009791  0.004393  0.003129  0.000766  0.000475  0.000475  0.002365  0.015151
  0.000000  0.000000  0.023080  0.029597  0.070216  0.075317  0.042247  0.063636  0.088798  0.031001
0.015295  0.006497  0.001193  0.001984  0.002030  0.002224  0.000000  0.007939
  0.000000  0.000619  0.010235  0.067949  0.036055  0.079940  0.065430  0.035775  0.045776  0.067009
0.033835  0.023914  0.020267  0.010147  0.004298  0.005024  0.001773  0.006514
  0.000000  0.000060  0.008346  0.048716  0.157869  0.064175  0.055961  0.041445  0.034903  0.024695
0.028568  0.014965  0.020718  0.004541  0.000000  0.000000  0.002325  0.003423
  0.000000  0.005120  0.001749  0.023846  0.051270  0.087778  0.092110  0.056424  0.041653  0.040139
0.034589  0.049286  0.013028  0.008287  0.015797  0.000000  0.000000  0.007545
  0.000000  0.007283  0.070601  0.056463  0.077147  0.081687  0.050333  0.023961  0.038670  0.014234
0.017401  0.021785  0.017618  0.005426  0.000000  0.000000  0.000000  0.024802
  0.000000  0.002383  0.012543  0.175490  0.080717  0.036773  0.032677  0.015670  0.011586  0.010607
0.011692  0.012565  0.005771  0.016006  0.000000  0.002109  0.000000  0.004163
  0.000000  0.000000  0.006109  0.048113  0.185918  0.077374  0.040626  0.030824  0.030518  0.012242
0.013650  0.014337  0.000000  0.000000  0.006044  0.000000  0.000000  0.000000
  0.000000  0.000000  0.017880  0.032733  0.079706  0.200105  0.096218  0.042890  0.021087  0.008190
0.011668  0.007799  0.000000  0.007859  0.004260  0.000000  0.000000  0.000000
  0.000000  0.000000  0.009708  0.033562  0.060751  0.104919  0.079882  0.089598  0.056252  0.023820
0.014228  0.003328  0.005488  0.001495  0.003434  0.000000  0.004947  0.003434
  0.000000  0.000000  0.000000  0.013107  0.068597  0.067549  0.072160  0.068760  0.048729  0.061027
0.016128  0.008625  0.007554  0.007749  0.013160  0.007822  0.005252  0.002596
  0.000000  0.004930  0.004930  0.014738  0.030937  0.087590  0.092853  0.100610  0.029888  0.003936
0.008815  0.002614  0.000000  0.000000  0.002614  0.000000  0.002614  0.002614
# OR Bottom Trawl Fishery
# number of years of age comps
16
# years of age comps
1984 1985 1986 1987 1988 1989 1990 1991 1992 1993 1994 1995 1996 1997 1998 1999
# number of trips sampled
26   21   22   26   32   43   49   77   82   61   63   43   27   40   30   26
```

```
# male age comps
  0.000000  0.002256  0.034350  0.158286  0.114997  0.018091  0.017290  0.003513  0.003880  0.002198
0.020528  0.014953  0.010928  0.008799  0.006910  0.003303  0.001141  0.010381
  0.000000  0.003438  0.049274  0.096921  0.194764  0.048663  0.002711  0.005276  0.001901  0.000000
0.001433  0.003908  0.026266  0.000000  0.007354  0.001080  0.000239  0.006845
  0.000000  0.002454  0.013898  0.200133  0.081381  0.084669  0.058429  0.002879  0.018189  0.005390
0.002106  0.000000  0.001446  0.017614  0.002031  0.001018  0.002843  0.015690
  0.000000  0.000000  0.011376  0.110773  0.203604  0.071707  0.039611  0.016169  0.002925  0.002485
0.007011  0.000000  0.000000  0.006076  0.005411  0.002037  0.000000  0.007864
  0.001883  0.011101  0.016738  0.079601  0.207562  0.102228  0.021546  0.011411  0.007454  0.003072
0.000493  0.000111  0.001149  0.000178  0.002458  0.003537  0.001278  0.006354
  0.000000  0.009287  0.024672  0.051324  0.094312  0.176468  0.063539  0.026553  0.014418  0.008453
0.000000  0.005166  0.000206  0.000021  0.001340  0.000702  0.006404  0.006529
  0.000000  0.003583  0.046610  0.044816  0.055997  0.068434  0.115960  0.057955  0.020822  0.019537
0.009585  0.004483  0.001307  0.002656  0.000000  0.000000  0.000000  0.011648
  0.000000  0.000153  0.004361  0.066335  0.099842  0.071706  0.042144  0.077733  0.037488  0.009870
0.012275  0.003344  0.001112  0.003725  0.000190  0.000000  0.001242  0.010660
  0.000000  0.000210  0.017104  0.021507  0.083738  0.072799  0.059036  0.034356  0.048167  0.017539
0.028795  0.015892  0.004209  0.004150  0.005980  0.001566  0.002672  0.017018
  0.000000  0.000000  0.005855  0.035253  0.034549  0.088243  0.091091  0.046518  0.033369  0.054327
0.034564  0.022812  0.013524  0.004287  0.002129  0.003937  0.000464  0.016873
  0.000000  0.003066  0.014275  0.056658  0.107092  0.068690  0.042280  0.016704  0.020763  0.028991
0.023737  0.008231  0.006195  0.004521  0.008745  0.002407  0.000000  0.010728
  0.000000  0.002979  0.033648  0.108932  0.073740  0.135371  0.039055  0.044337  0.020910  0.017927
0.007067  0.012256  0.004705  0.005004  0.005162  0.000343  0.000000  0.002308
  0.000000  0.001546  0.078624  0.082232  0.058865  0.058378  0.022296  0.017354  0.016860  0.020354
0.015502  0.002110  0.016646  0.004691  0.001983  0.010887  0.000918  0.007283
  0.000000  0.006259  0.044095  0.229768  0.118118  0.047116  0.031456  0.020552  0.009284  0.017502
0.007340  0.006334  0.000686  0.005679  0.001947  0.000212  0.000000  0.003644
  0.000000  0.000000  0.008048  0.051295  0.182533  0.115763  0.034581  0.021837  0.017118  0.020333
0.006225  0.009028  0.000040  0.001808  0.007220  0.000000  0.003032  0.007934
  0.000000  0.004410  0.028185  0.065780  0.117624  0.177422  0.072072  0.027160  0.008664  0.000260
0.000000  0.007039  0.001389  0.000369  0.000145  0.000260  0.006664  0.002549
# female age comps
  0.000000  0.000000  0.032939  0.135291  0.187894  0.031169  0.017811  0.012851  0.008093  0.005203
0.014013  0.033771  0.016960  0.009134  0.005225  0.005921  0.002984  0.048939
  0.000607  0.000000  0.023198  0.061654  0.199215  0.121213  0.015786  0.006508  0.006886  0.000105
0.001217  0.025712  0.037555  0.005527  0.006142  0.003854  0.004280  0.030468
  0.000000  0.001065  0.024774  0.106338  0.062243  0.095637  0.067655  0.006901  0.017638  0.013061
0.000257  0.000000  0.003720  0.043907  0.009912  0.006982  0.004653  0.025086
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  0.000000  0.001612  0.010471  0.118577  0.167351  0.059526  0.050732  0.029897  0.003664  0.003772
0.001553  0.003126  0.000279  0.004793  0.016950  0.013894  0.003419  0.023334
  0.009667  0.014422  0.009462  0.077392  0.171968  0.102983  0.040671  0.026837  0.015251  0.010129
0.004653  0.006024  0.000836  0.002500  0.006400  0.010212  0.002776  0.009663
  0.000000  0.001306  0.027152  0.028407  0.067983  0.145676  0.089559  0.038399  0.040758  0.015682
0.005735  0.004099  0.004103  0.004168  0.005656  0.003995  0.010155  0.017774
  0.000000  0.000346  0.045983  0.035820  0.037131  0.067841  0.137383  0.107247  0.036003  0.017221
0.008657  0.004878  0.006605  0.002256  0.002494  0.001175  0.001334  0.024232
  0.000000  0.000288  0.007202  0.054594  0.060310  0.065256  0.074390  0.108814  0.058457  0.034054
0.034290  0.007292  0.004797  0.004545  0.002187  0.000548  0.003433  0.037360
  0.000000  0.000000  0.009753  0.008144  0.081541  0.088796  0.068771  0.057565  0.089954  0.047986
0.031772  0.019963  0.014438  0.004916  0.006446  0.001441  0.002506  0.031269
  0.000000  0.000000  0.000299  0.025279  0.025262  0.075644  0.073311  0.044332  0.040169  0.066328
0.042838  0.028744  0.017316  0.020636  0.005716  0.008841  0.005620  0.031867
  0.000000  0.002217  0.008820  0.042980  0.100462  0.063347  0.056897  0.063275  0.046037  0.026311
0.064738  0.028538  0.019849  0.012475  0.012450  0.006566  0.006008  0.015944
  0.000000  0.004849  0.012570  0.037066  0.109137  0.084212  0.050834  0.038905  0.045410  0.025559
0.017455  0.024881  0.003947  0.002003  0.013073  0.001605  0.000000  0.014750
  0.000097  0.007272  0.076010  0.101629  0.082023  0.086098  0.050735  0.028263  0.040649  0.032268
0.008394  0.004318  0.039893  0.000000  0.001771  0.010131  0.002891  0.011030
  0.000000  0.008041  0.030840  0.103883  0.094444  0.030399  0.046719  0.030626  0.019097  0.014813
0.008142  0.013020  0.009741  0.016087  0.004702  0.000592  0.005036  0.013827
  0.000000  0.000000  0.011607  0.047322  0.140566  0.110448  0.053762  0.024241  0.030259  0.017303
0.025682  0.013208  0.015729  0.002847  0.008011  0.001866  0.001373  0.008983
  0.000000  0.000000  0.023360  0.057678  0.067752  0.146783  0.062621  0.042079  0.039373  0.008637
0.011882  0.006203  0.007617  0.002111  0.000000  0.001389  0.001141  0.001385

# EUR-CON Fishery
# number of years of age comps
23
# years of age comps
1980 1981 1982 1983 1984 1985 1986 1987 1988 1989 1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000
2001 2002
# number of trips sampled
70    100   126   167   137   118   102   101   74    72
85    54    33    20    25    11    33    52    31    31
14    7     10
# male age comps
  0.000000  0.000000  0.001101  0.020452  0.012065  0.006539  0.056207  0.040580  0.069361  0.040111
0.059960  0.010733  0.036832  0.016148  0.003139  0.002890  0.005833  0.012366
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0.000000	0.007525	0.003359	0.026620	0.027215	0.023253	0.017584	0.063422	0.086313	0.059538
0.032106	0.011993	0.008724	0.014630	0.002378	0.002646	0.009223	0.001450		
0.000000	0.000022	0.035921	0.004753	0.034537	0.037436	0.031183	0.014870	0.043597	0.108641
0.034402	0.040403	0.024284	0.010358	0.013375	0.013230	0.006330	0.024984		
0.000000	0.000023	0.019684	0.134354	0.027445	0.031902	0.014049	0.005503	0.006724	0.007225
0.015465	0.017042	0.010764	0.010665	0.003746	0.024730	0.001883	0.041946		
0.000000	0.000000	0.022177	0.136865	0.144882	0.027534	0.035797	0.014452	0.013815	0.001723
0.010158	0.030363	0.014161	0.004130	0.005053	0.003807	0.004250	0.029903		
0.000000	0.000227	0.008622	0.062244	0.162794	0.144850	0.012740	0.025432	0.011326	0.002269
0.002575	0.010161	0.021668	0.002268	0.004800	0.003061	0.003256	0.026758		
0.000000	0.002672	0.041614	0.045810	0.082096	0.123917	0.129130	0.013757	0.021789	0.017389
0.001018	0.000893	0.008456	0.029102	0.005577	0.008659	0.003709	0.037843		
0.001179	0.000152	0.054998	0.114196	0.043553	0.059667	0.090873	0.112021	0.019943	0.029954
0.021102	0.002845	0.000000	0.018666	0.014648	0.002809	0.011094	0.025925		
0.000044	0.035380	0.000332	0.065560	0.060575	0.090206	0.060701	0.051129	0.034404	0.014184
0.008844	0.007881	0.003430	0.003586	0.006491	0.016135	0.001500	0.016273		
0.000000	0.004922	0.108813	0.072992	0.077959	0.119011	0.046296	0.050071	0.019741	0.011676
0.020419	0.015728	0.008211	0.000000	0.000338	0.007197	0.005816	0.008951		
0.000198	0.000005	0.045231	0.116161	0.029490	0.046574	0.037731	0.056019	0.029941	0.024640
0.016278	0.022979	0.019002	0.014258	0.003722	0.002474	0.008377	0.005882		
0.000000	0.002436	0.015488	0.119032	0.119577	0.049449	0.037842	0.065086	0.022067	0.016393
0.020120	0.012377	0.001613	0.003541	0.003664	0.002594	0.002776	0.017436		
0.000000	0.001110	0.011299	0.018839	0.138318	0.094889	0.037718	0.016739	0.044004	0.027766
0.021343	0.019358	0.011102	0.005458	0.016019	0.001048	0.001845	0.023196		
0.000000	0.000000	0.084585	0.163306	0.095533	0.077734	0.009972	0.001732	0.009303	0.006881
0.010719	0.000920	0.020993	0.004707	0.001861	0.004059	0.000628	0.032682		
0.001882	0.003574	0.007108	0.070279	0.148029	0.109588	0.064736	0.021235	0.023515	0.006816
0.007885	0.004744	0.006368	0.008510	0.000880	0.004805	0.000299	0.005238		
0.000000	0.033490	0.039138	0.033789	0.056445	0.196870	0.044622	0.066035	0.057784	0.003157
0.028233	0.006769	0.020519	0.001013	0.004425	0.008088	0.000051	0.003038		
0.003544	0.005653	0.046056	0.045052	0.066636	0.114331	0.117781	0.033128	0.026658	0.018426
0.015394	0.003008	0.024927	0.006853	0.002391	0.002031	0.008824	0.013330		
0.000000	0.001634	0.008364	0.108288	0.040725	0.051077	0.052119	0.048417	0.049544	0.035874
0.026884	0.022934	0.012512	0.005025	0.004030	0.012426	0.006304	0.012199		
0.000000	0.007713	0.081754	0.060620	0.092682	0.068982	0.053847	0.020544	0.045442	0.025031
0.018261	0.017733	0.005455	0.007462	0.009450	0.000313	0.000000	0.012849		
0.000792	0.001303	0.018542	0.072137	0.059251	0.100602	0.069004	0.051386	0.026777	0.022079
0.029557	0.016272	0.006032	0.005804	0.005619	0.012011	0.004983	0.031026		
0.000000	0.000000	0.003526	0.043905	0.060881	0.116213	0.055216	0.044377	0.027284	0.028240
0.009386	0.000345	0.002868	0.003058	0.008237	0.002356	0.002153	0.001940		

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 0.000000  0.000172  0.000000  0.010409  0.072637  0.012072  0.064488  0.092402  0.034594  0.039625
0.032375  0.030079  0.041966  0.021130  0.004095  0.003259  0.000000  0.006689
 0.000000  0.009841  0.001600  0.000640  0.013962  0.030804  0.042245  0.101372  0.027563  0.019642
0.100732  0.029764  0.058887  0.000400  0.029524  0.000000  0.034644  0.040165
# female age comps
 0.000000  0.000000  0.001807  0.004663  0.003000  0.001639  0.091261  0.161763  0.074516  0.069882
0.075663  0.044014  0.012274  0.005410  0.023290  0.007119  0.003319  0.026065
 0.000000  0.005785  0.001472  0.019295  0.026989  0.013633  0.006454  0.048933  0.130691  0.095476
0.045230  0.058596  0.044370  0.041559  0.019433  0.007923  0.010682  0.025498
 0.000000  0.000176  0.020384  0.011435  0.025904  0.021826  0.026403  0.009879  0.028476  0.093480
0.052245  0.041606  0.036602  0.030329  0.026629  0.036041  0.016737  0.043521
 0.000000  0.008585  0.067236  0.183436  0.044969  0.047447  0.013754  0.009714  0.003219  0.006921
0.031805  0.022378  0.013769  0.026297  0.017827  0.013855  0.023165  0.092470
 0.000000  0.000000  0.025400  0.124378  0.113089  0.026752  0.029462  0.011598  0.007136  0.003342
0.019946  0.045211  0.009560  0.010595  0.006944  0.007132  0.010240  0.050144
 0.000000  0.000151  0.001560  0.038649  0.152562  0.144097  0.019940  0.038756  0.006481  0.001962
0.002983  0.010131  0.022748  0.001717  0.006368  0.006675  0.009452  0.030716
 0.000000  0.001094  0.032346  0.027042  0.073440  0.081848  0.100382  0.007086  0.021131  0.009354
0.004758  0.001774  0.001549  0.027713  0.003342  0.003768  0.003633  0.026310
 0.001179  0.000098  0.047208  0.095361  0.021292  0.050757  0.050894  0.055412  0.011451  0.010172
0.004021  0.002340  0.000793  0.004487  0.002818  0.005991  0.000865  0.011236
 0.000140  0.085843  0.037469  0.075957  0.071866  0.055259  0.032502  0.037143  0.021209  0.003896
0.014219  0.019743  0.004235  0.006851  0.003575  0.006002  0.008808  0.038628
 0.000000  0.003411  0.081763  0.042605  0.042417  0.081496  0.053703  0.037811  0.021243  0.009702
0.007578  0.003805  0.006337  0.005543  0.000000  0.000650  0.001295  0.022498
 0.000005  0.003187  0.050819  0.108911  0.056288  0.036766  0.088722  0.070834  0.037058  0.024351
0.009827  0.008493  0.006215  0.001197  0.003355  0.001205  0.002170  0.011633
 0.000226  0.007123  0.008134  0.112901  0.128173  0.060714  0.030229  0.033110  0.023240  0.016982
0.013082  0.010959  0.008170  0.008172  0.006845  0.000731  0.001688  0.018028
 0.000000  0.000232  0.015337  0.031121  0.108172  0.086481  0.039057  0.030308  0.037403  0.026187
0.025779  0.043862  0.015023  0.000488  0.001450  0.001391  0.005892  0.041767
 0.000000  0.004208  0.033435  0.135163  0.123584  0.096949  0.036693  0.004437  0.001141  0.009519
0.007614  0.001330  0.000782  0.000971  0.001365  0.005160  0.005189  0.006846
 0.001882  0.001724  0.022476  0.067422  0.161344  0.066366  0.050772  0.019637  0.025889  0.016917
0.015069  0.006851  0.009371  0.007548  0.006287  0.000228  0.001724  0.023001
 0.000000  0.008129  0.009087  0.015496  0.050148  0.136555  0.049764  0.068335  0.023258  0.004577
0.007731  0.002032  0.005057  0.007653  0.000000  0.007704  0.000000  0.001013
 0.005316  0.007498  0.039650  0.042831  0.041834  0.081434  0.058032  0.049604  0.037617  0.029501
0.010778  0.009947  0.012242  0.002580  0.001429  0.007214  0.004894  0.003579
 0.000076  0.001013  0.007263  0.082973  0.037783  0.055790  0.052979  0.041542  0.064828  0.047760
0.030352  0.020260  0.004756  0.021095  0.006388  0.006955  0.005416  0.014417
```

```
  0.000000  0.001686  0.053952  0.029427  0.075695  0.029682  0.045987  0.045308  0.052631  0.060361
0.028177  0.007907  0.009615  0.006146  0.006612  0.001982  0.003342  0.013353
  0.000193  0.001612  0.010229  0.073635  0.045978  0.093642  0.041606  0.047047  0.038160  0.022148
0.021134  0.015287  0.014316  0.014162  0.003980  0.008607  0.001844  0.013246
  0.000000  0.000000  0.006821  0.032812  0.098604  0.073335  0.075038  0.056790  0.039492  0.027416
0.059198  0.032557  0.032994  0.021127  0.002356  0.000562  0.023627  0.007284
  0.000000  0.000000  0.000000  0.008190  0.060086  0.098599  0.036981  0.065238  0.063643  0.032407
0.037632  0.022603  0.020863  0.000945  0.012646  0.022527  0.033776  0.017871
  0.000000  0.010241  0.001600  0.000800  0.030164  0.012522  0.040965  0.111813  0.052606  0.071569
0.001280  0.034244  0.032244  0.034884  0.005921  0.005521  0.000000  0.011841
# Ageing Error Matrix
# row is true age, column is observed age (column sums to 1)
0.7620      0.1217      0.0006      0.0000      0.0000      0.0000      0.0000      0.0000      0.0000
      0.0000      0.0000      0.0000      0.0000      0.0000      0.0000      0.0000      0.0000
      0.0000
0.2315      0.7560      0.1244      0.0006      0.0000      0.0000      0.0000      0.0000      0.0000
      0.0000      0.0000      0.0000      0.0000      0.0000      0.0000      0.0000      0.0000
      0.0000
0.0065      0.1217      0.7500      0.1274      0.0007      0.0000      0.0000      0.0000      0.0000
      0.0000      0.0000      0.0000      0.0000      0.0000      0.0000      0.0000      0.0000
      0.0000
0.0000      0.0005      0.1244      0.7440      0.1303      0.0008      0.0000      0.0000      0.0000
      0.0000      0.0000      0.0000      0.0000      0.0000      0.0000      0.0000      0.0000
      0.0000
0.0000      0.0000      0.0006      0.1274      0.7380      0.1332      0.0009      0.0000      0.0000
      0.0000      0.0000      0.0000      0.0000      0.0000      0.0000      0.0000      0.0000
      0.0000
0.0000      0.0000      0.0000      0.0006      0.1303      0.7320      0.1361      0.0010      0.0000
      0.0000      0.0000      0.0000      0.0000      0.0000      0.0000      0.0000      0.0000
      0.0000
0.0000      0.0000      0.0000      0.0000      0.0007      0.1332      0.7260      0.1390      0.0011
      0.0000      0.0000      0.0000      0.0000      0.0000      0.0000      0.0000      0.0000
      0.0000
0.0000      0.0000      0.0000      0.0000      0.0000      0.0008      0.1361      0.7200      0.1419
      0.0012      0.0000      0.0000      0.0000      0.0000      0.0000      0.0000      0.0000
      0.0000
0.0000      0.0000      0.0000      0.0000      0.0000      0.0000      0.0009      0.1390      0.7140
      0.1448      0.0014      0.0000      0.0000      0.0000      0.0000      0.0000      0.0000
      0.0000
```

```
0.0000      0.0000      0.0000      0.0000      0.0000      0.0000      0.0000      0.0010      0.1419
      0.7080      0.1476      0.0015      0.0000      0.0000      0.0000      0.0000      0.0000
      0.0000
0.0000      0.0000      0.0000      0.0000      0.0000      0.0000      0.0000      0.0000      0.0011
      0.1448      0.7020      0.1505      0.0017      0.0000      0.0000      0.0000      0.0000
      0.0000
0.0000      0.0000      0.0000      0.0000      0.0000      0.0000      0.0000      0.0000      0.0000
      0.0012      0.1476      0.6960      0.1533      0.0019      0.0000      0.0000      0.0000
      0.0000
0.0000      0.0000      0.0000      0.0000      0.0000      0.0000      0.0000      0.0000      0.0000
      0.0000      0.0014      0.1505      0.6900      0.1561      0.0020      0.0000      0.0000
      0.0000
0.0000      0.0000      0.0000      0.0000      0.0000      0.0000      0.0000      0.0000      0.0000
      0.0000      0.0000      0.0015      0.1533      0.6840      0.1590      0.0023      0.0000
      0.0000
0.0000      0.0000      0.0000      0.0000      0.0000      0.0000      0.0000      0.0000      0.0000
      0.0000      0.0000      0.0000      0.0017      0.1561      0.6780      0.1617      0.0026
      0.0007
0.0000      0.0000      0.0000      0.0000      0.0000      0.0000      0.0000      0.0000      0.0000
      0.0000      0.0000      0.0000      0.0000      0.0019      0.1590      0.6720      0.1657
      0.0313
0.0000      0.0000      0.0000      0.0000      0.0000      0.0000      0.0000      0.0000      0.0000
      0.0000      0.0000      0.0000      0.0000      0.0000      0.0020      0.1617      0.6660
      0.3080
0.0000      0.0000      0.0000      0.0000      0.0000      0.0000      0.0000      0.0000      0.0000
      0.0000      0.0000      0.0000      0.0000      0.0000      0.0000      0.0023      0.1657
      0.6600

# Parameter for rebuilding data output
# end year for B0 calculation
1982
# start year for recruitment resampling
1986
# number of recent years for weighting fecundity, weight, and selectivity
5
# recruitment overidding for rebuilding analysis (1 = yes, 0 = no)
1
```

Rebuilding analysis for widow rockfish in 2003

Xi He[1], Andre Punt[2,] Alec D. MacCall[1], and Stephen V. Ralston[1]

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[1]National Marine Fisheries Service
Southwest Fisheries Science Center
Santa Cruz Laboratory
110 Shaffer Road
Santa Cruz, CA 95060

[2]School of Aquatic and Fishery Sciences
Box 355020
University of Washington
Seattle, WA 98195-5020

Introduction

In 1998, the PFMC adopted Amendment 11 of the Groundfish Management Plan, which established a minimum stock size threshold of 25% of unfished spawning potential. In 2001, and based on the stock assessment in 2000 (Williams et al. 2000), widow rockfish was declared formally to be overfished, thereby requiring the development of a Rebuilding Plan. The most recent stock assessment (He et al. 2003) estimated that the spawning output in 2002 was just below 25% of unfished spawning output. This rebuilding analysis provides information needed to develop the Rebuilding Plan for widow rockfish, and is in accord with the SSC Terms of Reference for Groundfish Rebuilding Analyses.

The stock has declined since fishing began in the late 1970's (Table 1). The relative decline in total biomass has been somewhat less than that in spawning output (the best measure of stock reproductive potential). Older fish have a higher fecundity per body weight than do young fish. Widow rockfish bear their offspring live as larvae, and spawning output is measured in million fertilized eggs, at a stage prior to parturition of larvae.

Table 1. Current (2002) population status of widow rockfish relative to pre-fishing years estimated by the base model in the stock assessment (He et al. 2003).

	Age 3+ biomass (mt)	Spawning output (millions of eggs)
Average 1958-79	233,722	39,567
2002	57,480	9,755
Percent	24.59%	24.65%

Data and Parameters

This rebuilding analysis uses the SSC Default Rebuilding Analysis as implemented by Punt (2003) (Version 2.6). Historical estimates of spawning output and recruitment are taken from the assessment by He et al. (2003). Life history parameters and selectivity are based on a simplification of the two-area, two-sex, four-fishery selectivity model used in the assessment (Appendix A). The rebuilding analyses are based on a coastwide population. However, fecundity- and weight-at-age differ between the southern and northern areas. Therefore, spatially-averaged fecundity- and weight-at-age, based on a weighting factor computed from the total catches for two areas from the last five years, are used in the rebuilding analysis. The age-specific selectivity pattern is calculated by averaging selectivity functions for four fisheries, using weighting factors computed from the total catches by each fishery over the last five years. Fecundity-at-age, weight-at-age and selectivity-at-age are presented in Figures 1 and 2. These functions are very similar to those used in the 2002 rebuilding analysis for widow rockfish (MacCall and Punt 2001).

Management Reference Points

B_{MSY}: The rebuilding target is the spawning output that produces MSY, B_{MSY}. B_{MSY} cannot be determined easily, but experience in other fisheries has shown that B_{MSY} is often near 40% of the average initial unfished spawning output (B_0), and this value ($B_{40\%}$) is used here as a proxy for B_{MSY} (see the SSC's Terms of Reference). Values of B_0 are estimated by multiplying mean recruitment by the spawning output-per-recruit at F=0 (1.053 million eggs of spawning output-per-recruit). As in the previous rebuilding analysis, the average recruitment used when computing B_0 was based on the pre-fishery recruitments (the 1958-79 year-classes, Table 2). Figure 3 shows the simulated frequency distribution for B_0 determined by re-sampling recruitments at random from those for 1958-79. The mean of this distribution was used as the estimate of B_0 in the subsequent analyses. There is a highly significant difference between the pre-fishery (pre-1982) recruitments and the post-fishing-down (post-1982) recruitments (one-tailed t-test, P<0.01). This difference is presumably due to the decline in spawning abundance, but may also be associated with a less favorable climate in the most-recent period. For the scenarios in which future recruitment is determined by re-sampling historical recruits-per-spawner ratios, the re-sampling period was set to 1986-2002; the same period on which the previous rebuilding analysis was based (MacCall and Punt 2001).

Table 2. Rebuilding parameters (units: millions of eggs) for the base model in the stock assessment. The estimated B_0 differs from the value in Table 1 because the fecundity function used in the rebuilding program is for the most recent years; one consequence of this is that the current depletion (B_{2002}/B_0) is lower (22.39%) than that in Table 1 (24.65%)

Rebuilding parameter	Value
Estimated B_0	43,580
Rebuilding target	17,432
Current spawning output (B_{2002})	9,756
Percent of B_{2002}/B_0	22.39%

Mean generation time: If the stock cannot be rebuilt with in ten years, then the maximum time allowed for rebuilding, T_{max}, is the length of time required to rebuild at F=0 (T_{min}) plus one mean generation time. Mean generation time can be estimated from the net maternity function (product of survivorship and fecundity at age), and for widow rockfish is estimated to be 16.4 years, which is rounded to an integer value of 16 years.

Simulation Model

The simulation model tracks numbers at age, with age 20 being treated as a plus-group. Fecundity-, weight-, and selectivity-at-age are given in Appendix A and plotted in Figures 1 and 2. When computing $T_{\min}$, the population simulations begin with the age-structure at the start of 2001 because 2001 was the year in which widow rockfish was declared to be overfished. The 2002 age-structure was used for estimating the Optimal Yield (OY) for 2004 and beyond. The detailed specifications of the simulation model are given by Punt (2003).

Initial test runs were conducted to determine the number of simulations needed to achieve stable outputs. The test was conducted using the Model 8 (described below) with numbers of simulations of 500, 1,000, 2,000, 3,000, 5,000, and 10,000. The results showed that the outputs did not change much with increasing numbers of simulations once the number of simulations reached 3,000. Therefore, all of the model runs in this rebuilding analysis are based on 3,000 simulations.

Twelve simulation scenarios (Models 1-12) were constructed from three factors: (1) whether the recruitments (age 3) for 2003-5 were pre-specified, (2) whether a stock-recruitment relationship or recruits-per-spawner ratios were used to generate future recruitment, and (3) a range for the power coefficient for the midwater juvenile survey index (Table 3):

(1) The juvenile (age 0 fish) survey conducted by the Santa Cruz Laboratory indicated a strong recruitment of age 0 fish in 2002 (Fig. 8 in He et al. 2003). This 2002 year-class is not included in the stock assessment, but it could have potential impacts on the future population size. To include the information on this year-class in the projections, the sizes of the recruitments for 2003-5 (i.e. the 2000-2 year-classes) were pre-specified rather than being generated. The equation used to compute the pre-specified recruitments for 2003-5 was:

$$R_i = e^{\frac{1}{p}\log(\frac{I_i}{q}) - a_{\min}M} \tag{1.1}$$

where I_i is survey index for year i, q is catchability, p is a power coefficient for the survey index, $a_{\min}$ is minimum age, and M is the instantaneous rate of natural mortality.

(2) The stock assessment incorporated a Beverton-Holt stock-recruitment relationship. However, the stock assessment also indicated that there is great uncertainty about the stock-recruitment relationship and about the relationship between the juvenile survey index and recruitment for widow rockfish. The previous rebuilding analysis for widow rockfish (MacCall and Punt 2001) generated future recruitment by re-sampling historical recruits-per-spawner ratios. Therefore, both methods for generating future recruitment were used in this rebuilding analysis.

(3) The stock assessment also indicated that the power coefficient is an important parameter in determining the level of recent recruitments, and thus the slope of the stock-recruitment relationship, and when translating the juvenile survey indices into future recruitments. Three values for the power coefficient (2.0, 3.0 and 4.0) are used in this rebuilding analysis to bound the value (3.0) used in the base model in the stock assessment.

An estimate of the total catch of widow rockfish during 2003 needs to be specified. The harvest guideline for widow rockfish set by the Council for 2003 was 832mt. However, the most recent estimate of the total catch for 2002 from the PacFIN database is 263mt, much less than the harvest guideline for 2002 set by the Council (856mt). It is therefore very possible that total catch for 2003 will also be less than the harvest guideline. The most recent estimate of total catch in 2003 by the GMT is 274mt. Therefore, the total catch for 2003 is assumed to be 300mt in this analysis.

Rebuilding Projections

The rebuilding projections used $B_{40\%}$ =17,201, 17,432, and 17,714 as the rebuilding targets for the models that have the power coefficients of 2.0, 3.0, and 4.0, respectively. Table 4 lists the Optimum Yield (OY) for 2004, the constant fishing mortality (*F*) from 2004, the probability that the population will be rebuilt by $T_{\max}$ ($P_{\max}$), and median time in years from 2001 until the population will be rebuilt with 50% probability (T_{target}) for five rebuild strategies and the 12 simulation scenarios. The first four rebuilding strategies apply constant fishing mortality rates from 2004 that correspond to four probabilities of rebuild by T_{max} (50%, 60%, 70%, and 80%, P_{max} = 0.5, 0.6, 0.7, and 0.8, respectively). The fifth "rebuilding strategy" is the "40:10" control rule.

The simulated frequency distribution of $T_{\min}$ for Model 8 is presented in Figure 4. The distribution has a long tail in the right side, a pattern similar to distributions of other models. Figure 5 shows time series of the probability of the spawning output exceeding the target for four rebuilding strategies and a scenario of no fishing for Model 8. Table 5 shows Optimum Yields for the next 10 years under the five rebuilding strategies for the 12 simulation scenarios. In general, OYs are greater when recruitment is pre-specified, when future recruitment is generated by re-sampling from historical recruits-per-spawner ratios and when the power coefficient is high (Tables 4 and 5). The high power coefficients are associated with higher steepness values, indicating increased compensations in the stock-recruitment relation at low abundance. Also, the high power coefficients raised the mean level of recruitment in recent years, again suggesting increased compensations at low abundance (Table 3). This result is also supported by the fact that the allowable biological catches (ABC) for 2004 increase as the power coefficients increase (Table 3).

Rebuilding cannot occur if the power coefficient is low (P = 2.0) and future recruitment is generated using the estimated stock-recruitment relationship (Models 4 and 10). The simulation scenario in which recruitment for 2003-5 is pre-specified, future recruitment is generated by re-sampling recruits-per-spawner ratios and the power coefficient is set to 4 (Model 9) has the shortest rebuilding time in the absence of fishing and the highest OYs (Table 4b).

Fishing mortalities from all models ranged from 0 to 0.017, lower than the value of 0.0268 estimated in the previous rebuilding analysis and used for determining the 2002 and 2003 OYs (MacCall and Punt 2001), and much lower than F_{MSY} estimated for widow rockfish (= 0.118). If Model 8 is selected for determining the 2004 OY, the fishing mortality of Model 8 is 0.0093, which is about 1/3 of the fishing mortality estimated from the previous rebuilding analysis and is less than 8% of F_{MSY}.

Four models (Models 2, 5, 8, and 11) are based on the same assumptions as the stock assessment base model. However, even restricting the final decision of an OY for 2004 to these models (because the base model presumably has higher credibility than the other models) still leads to a wide range of possible 2004 OYs. For example, the OYs corresponding to $P_{\max} = 60\%$ range from <1mt (Model 5) to 284mt (Model 8). To assist management decisions, a risk analysis was conducted based on three of these four models (Models 2, 5, and 8); Model 11 was not included in the risk analysis since it is intermediate between Models 2 and 5 (Table 4). Four levels of catch (i.e. OYs from 2004) were examined to each of the three models: 35mt ($P_{\max} = 50\%$, 2004 OY from Model 5), 194mt ($P_{\max} = 60\%$, 2004 OY from Model 2), 284mt ($P_{\max} = 60\%$, 2004 OY from Model 8), and 501mt ($P_{\max} = 60\%$, 2004 OY from Model 9). The highest catch level was included in the risk analysis to assess the implications if the OY is based on a model with a high value for the power coefficient when the "correct" model has P=3. Fishing mortality in 2004 estimated from each of the four levels of catch were applied in future years. That is, all simulations in the risk analysis used constant fishing police. Risks are expressed as changes to $P_{\max}$, T_{target} and P_{100}. P_{100} is an indicator of population sustainability - the probability of the spawning output being above the current spawning output in 100 years.

The analysis shows that the risks are high for catch levels ≥ 194mt if the Model 5 is the "correct" model. The sustainability of the population, as measured by P_{100}, will fall to 27.1% if a catch level of 501mt is applied and Model 5 is 'correct" (Table 6). The analysis also shows that the risks are low if Model 8 is "correct"; at a catch level of 284 mt, $P_{\max} = 60\%$, $T_{target} = 2037$ and $P_{100} = 100\%$. If this model is "correct", the population will be able to sustain with $P_{100} = 100\%$ even if the catch level of 501mt is applied. That is, there is a 100% of probability that spawning outputs will be above the current spawning output in 100 years if the catch is 501mt (Table 6).

Model 8 uses the base model from the stock assessment and generates future recruitment by re-sampling historical recruits-per-spawner ratios – this is how the previous rebuilding analysis (MacCall and Punt 2001) was conducted. Model 8 also pre-specifies the recruitment for 2003-5. As a result, the projections imply that strong 2002 year-class will greatly increase the spawning output once it recruits to the population in 2005. The strong 2002 year-classes of other rockfishes indicates that the current environmental conditions may be favorable for rockfish recruitment, but the assumption that the 2002 widow rockfish year-class will actually be strong when it recruits to the fishery can only be tested in time.

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Table 3. Specifications of the 12 simulation scenarios (models) based on: whether recruitment is pre-specified, how future recruitment is generated, and the value of the power coefficient for the midwater juvenile survey index. The value of steepness (h) is listed when the projections are based on a stock-recruitment relationship. Abbreviations: NA = not applicable; ABC = allowable biological catch (mt).

Model	Recruitment pre-specified?	Stock recruitment relationship used?	Power coefficient for midwater survey	*h*	ABC (2004)
1	No	No	2.0	NA	3,076
2	No	No	3.0	NA	3,460
3	No	No	4.0	NA	3,909
4	No	Yes	2.0	0.201	NA
5	No	Yes	3.0	0.217	3,460
6	No	Yes	4.0	0.237	3,909
7	Yes	No	2.0	NA	3,076
8	Yes	No	3.0	NA	3,460
9	Yes	No	4.0	NA	3,909
10	Yes	Yes	2.0	0.201	3,076
11	Yes	Yes	3.0	0.217	3,460
12	Yes	Yes	4.0	0.237	3,909

Table 4. Optimum yield (OY) for 2004 (mt), fishing mortality (*F*) during rebuild (yr^{-1}), probability of recovery by T_{max} (P_{max}), and the year in which the probability of rebuild is 0.5 (T_{target}) for five rebuild strategies for various simulation scenarios. T_{max} is T_{target} for $P_{max} = 0.5$. Abbreviations: SR = stock-recruitment relationship is used; P = value of the power coefficient of the midwater juvenile index; NA = not applicable.

(a) Recruitment for 2003-5 is not pre-specified

				Rebuilding strategy				
Model	SR	P		$P_{max} = 50\%$	$P_{max} = 60\%$	$P_{max} = 70\%$	$P_{max} = 80\%$	40:10
1	N	2.0	OY	128	72	15	<1	1088
			F	0.0047	0.0026	0.0005	0.0000	NA
			P_{max}	50.0	60.1	70.0	72.6	0.0
			T_{target}	2072	2066	2061	2060	NA
2	N	3.0	OY	259	194	123	41	1439
			F	0.0085	0.0064	0.0040	0.0013	NA
			P_{max}	50.0	60.1	70.0	19.7	0.0
			T_{target}	2057	2053	2049	2045	NA
3	N	4.0	OY	426	354	276	183	1887
			F	0.0124	0.103	0.0080	0.0053	NA
			P_{max}	50.0	60.1	70.0	79.9	0.0
			T_{target}	2045	2042	2039	2036	NA
4	Y	2.0	OY	0	0	0	0	NA
			F	0	0	0	0	NA
			P_{max}	<50%	<50%	<50%	<50%	NA
			T_{target}	>2500	>2500	>2500	>2500	NA
5	Y	3.0	OY	35	<1	<1	<1	1439
			F	0.0012	0.0000	0.0000	0.0000	NA
			P_{max}	49.9	55.9	55.9	55.9	0.0
			T_{target}	2123	2111	2111	2111	NA
6	Y	4.0	OY	185	98	2	<1	1888
			F	0.0054	0.0028	0.0001	0.0000	NA
			P_{max}	50.1	60.0	70.0	70.2	0.0
			T_{target}	2063	2055	2049	2049	NA

(Table 4 Continued)

(b) Recruitment for 2003-5 is pre-specified

Model	SR	P		Rebuilding strategy $P_{max}=50\%$	$P_{max}=60\%$	$P_{max}=70\%$	$P_{max}=80\%$	40:10
7	N	2.0	OY	248	181	111	30	1088
			F	0.0092	0.0067	0.0041	0.0011	NA
			P_{max}	50.1	60.0	70.0	80.1	0.0
			T_{target}	2042	2038	2034	2030	NA
8	N	3.0	OY	354	284	212	123	1439
			F	0.0117	0.0093	0.0070	0.0040	NA
			P_{max}	50.0	60.1	70.0	80.0	0.0
			T_{target}	2041	2037	2034	2031	NA
9	N	4.0	OY	582	501	419	323	1888
			F	0.0170	0.0146	0.0122	0.0094	NA
			P_{max}	49.9	60.0	69.9	79.9	0.0
			T_{target}	2036	2033	2030	2027	NA
10	Y	2.0	OY	<1	<1	<1	<1	1088
			F	0.0000	0.0000	0.0000	0.0000	NA
			P_{max}	49.8	49.8	49.8	49.8	0.0
			T_{target}	2155	2155	2155	2155	NA
11	Y	3.0	OY	67	<1	<1	<1	1439
			F	0.0022	0.0000	0.0000	0.0000	NA
			P_{max}	50.5	59.2	59.2	59.2	0.0
			T_{target}	2070	2058	2058	2058	NA
12	Y	4.0	OY	281	172	55	<1	1888
			F	0.0082	0.0050	0.0016	0.0000	NA
			P_{max}	49.9	60.0	69.9	74.9	0.0
			T_{target}	2044	2038	2032	2030	NA

Table 5. Projected Optimal Yields (mt, median annual catches) for 2004-13 for five rebuild strategies and 12 simulation scenarios (models).

(a) For Models 1-3

Year	$P_{max} = 50\%$			$P_{max} = 60\%$			$P_{max} = 70\%$			$P_{max} = 80\%$			40:10 rule		
Model	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3
2004	128	259	426	72	194	354	15	123	276	0	41	182	1088	1439	1888
2005	128	260	430	72	195	358	15	124	279	0	41	185	1015	1358	1798
2006	128	263	436	72	197	364	15	125	284	0	42	189	968	1308	1746
2007	130	267	444	73	201	371	15	128	290	0	43	193	943	1287	1721
2008	132	271	448	74	204	374	16	130	293	0	43	195	944	1275	1688
2009	134	272	450	75	205	376	16	131	294	0	44	196	936	1259	1659
2010	135	274	452	76	207	378	16	132	296	0	44	198	936	1250	1636
2011	136	276	455	76	209	381	16	133	299	0	45	200	933	1243	1624
2012	137	278	458	77	210	383	16	134	301	0	45	201	925	1231	1604
2013	138	281	464	78	212	388	16	135	305	0	46	204	918	1218	1589

(b) For Models 4-6

Year	$P_{max} = 50\%$			$P_{max} = 60\%$			$P_{max} = 70\%$			$P_{max} = 80\%$			40:10 rule		
Model	4	5	6	4	5	6	4	5	6	4	5	6	4	5	6
2004	0	35	185	0	<1	98	0	<1	2	0	<1	<1	0	1438	1888
2005	0	36	187	0	<1	99	0	<1	2	0	<1	<1	0	1358	1798
2006	0	36	191	0	<1	101	0	<1	2	0	<1	<1	0	1303	1738
2007	0	36	193	0	<1	102	0	<1	2	0	<1	<1	0	1256	1683
2008	0	36	193	0	<1	102	0	<1	2	0	<1	<1	0	1206	1621
2009	0	36	192	0	<1	102	0	<1	2	0	<1	<1	0	1155	1560
2010	0	36	191	0	<1	102	0	<1	2	0	<1	<1	0	1104	1501
2011	0	36	191	0	<1	102	0	<1	2	0	<1	<1	0	1064	1460
2012	0	36	192	0	<1	102	0	<1	2	0	<1	<1	0	1034	1429
2013	0	36	193	0	<1	103	0	<1	2	0	<1	<1	0	995	1385

Table 5 (continued).

(a) For Models 7-9

Year	$P_{max} = 50\%$			$P_{max} = 60\%$			$P_{max} = 70\%$			$P_{max} = 80\%$			40:10 rule		
Model	7	8	9	7	8	9	7	8	9	7	8	9	7	8	9
2004	248	354	583	180	284	501	111	212	418	30	123	323	1088	1439	1888
2005	247	355	587	180	285	505	111	213	423	30	124	327	1016	1359	1799
2006	247	359	595	181	289	513	111	216	430	30	126	333	974	1317	1755
2007	256	373	617	187	300	532	116	225	447	31	131	346	994	1347	1790
2008	293	410	666	214	330	575	132	247	483	36	144	374	1246	1558	1991
2009	393	492	761	287	396	657	177	297	552	48	173	428	2023	2082	2441
2010	469	549	823	343	442	712	212	332	598	57	194	464	2886	2570	2816
2011	465	543	813	340	438	703	211	329	592	57	192	460	3064	2624	2808
2012	443	526	791	325	425	685	202	319	578	55	187	449	2810	2451	2641
2013	422	509	772	310	411	670	192	310	565	52	182	440	2470	2230	2438

(b) For Models 10-12

Year	$P_{max} = 50\%$			$P_{max} = 60\%$			$P_{max} = 70\%$			$P_{max} = 80\%$			40:10 rule		
Model	10	11	12	10	11	12	10	11	12	10	11	12	10	11	12
2004	<1	67	281	<1	<1	172	<1	<1	55	<1	<1	<1	1088	1439	1888
2005	<1	68	285	<1	<1	175	<1	<1	56	<1	<1	<1	1016	1359	1799
2006	<1	69	290	<1	<1	179	<1	<1	57	<1	<1	<1	974	1317	1755
2007	<1	72	302	<1	<1	186	<1	<1	59	<1	<1	<1	994	1347	1790
2008	<1	79	327	<1	<1	201	<1	<1	64	<1	<1	<1	1246	1557	1990
2009	<1	95	373	<1	<1	230	<1	<1	74	<1	<1	<1	2018	2076	2432
2010	<1	105	402	<1	<1	248	<1	<1	79	<1	<1	<1	2852	2531	2770
2011	<1	103	395	<1	<1	244	<1	<1	78	<1	<1	<1	2957	2532	2727
2012	<1	99	383	<1	<1	237	<1	<1	76	<1	<1	<1	2656	2316	2523
2013	<1	95	371	<1	<1	230	<1	<1	74	<1	<1	<1	2264	2051	2286

Table 6. Risk analysis of four catch levels for three models (Models 5, 2 and 8 – see Table 3 for definitions). These models use the outputs from the base model in the stock assessment but with assumptions about whether recruitment for 2003-5 should be pre-specified and how future recruitment should be generated. The number in bold-italic typeface indicate the basis for the first three catch levels. Model numbers are same as in Tables 3 and 4. Abbreviations are: RP = recruitment is pre-specified; SR = the stock-recruitment relationship is used to generate future recruitment; P = the value of the power coefficient of the midwater juvenile index; and NA = not applicable. Symbols are: OY = Optimum Yield for 2004; F = fishing mortality; P_{max} = probability (%) to rebuild by T_{max}; T_{target} = year in which the probability of recovery is 0.5; and P_{100} = probability (%) of the spawning output being above the current spawning output in 100 years (year 2103).

Catch level (2004 OY (mt))		Model 5 (RP=N, SR=Y, P=3)	Model 2 (RP=N, SR=N, P=3)	Model 8 (RP=Y, SR=N, P=3)
35	OY	***35***	35	35
	F	***0.0012***	0.00115	0.00114
	P_{max}	***49.9***	80.4	87.8
	T_{target}	***2123***	2045	2028
	P_{100}	***91.2***	100.0	100.0
194	OY	195	***194***	194
	F	0.0064	***0.0064***	0.00634
	P_{max}	26.0	***60.1***	72.2
	T_{target}	NA	***2053***	2033
	P_{100}	75.4	***100.0***	100.0
284	OY	283	282	***284***
	F	0.0093	0.00925	***0.0093***
	P_{max}	14.9	46.7	***60.1***
	T_{target}	NA	2058	***2037***
	P_{100}	61.8	100.0	***100.0***
501	OY	502	499	501
	F	0.0165	0.0164	0.0165
	P_{max}	2.6	18.1	30.9
	T_{target}	NA	2081	2052
	P_{100}	27.1	99.6	100.0

Figure 1. Fecundity-at-age and weight-at-age by sex for widow rockfish as used in the rebuilding analyses.

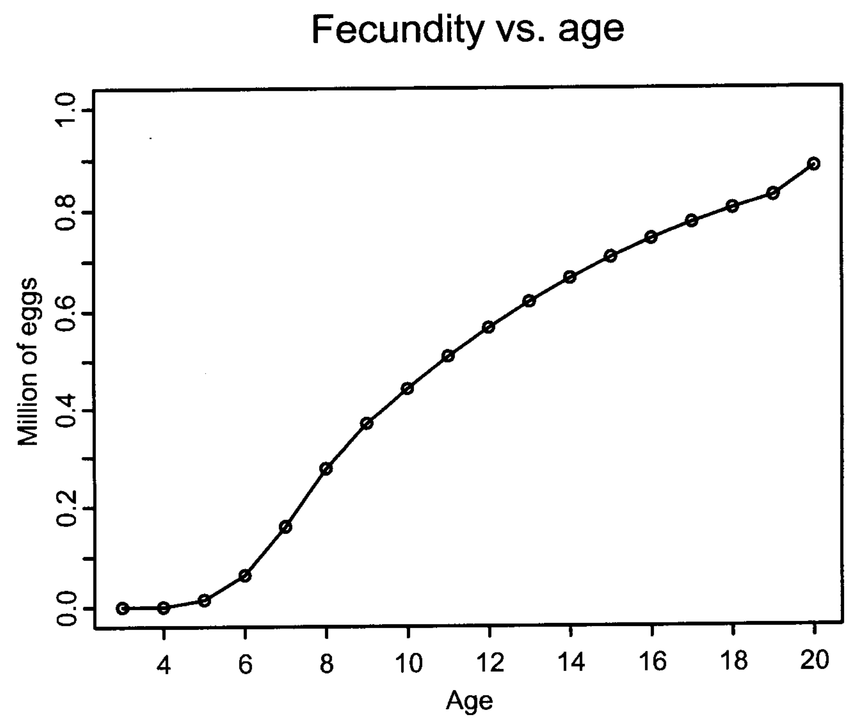


Figure 2. The selectivity pattern for widow rockfish used in the rebuilding analyses.

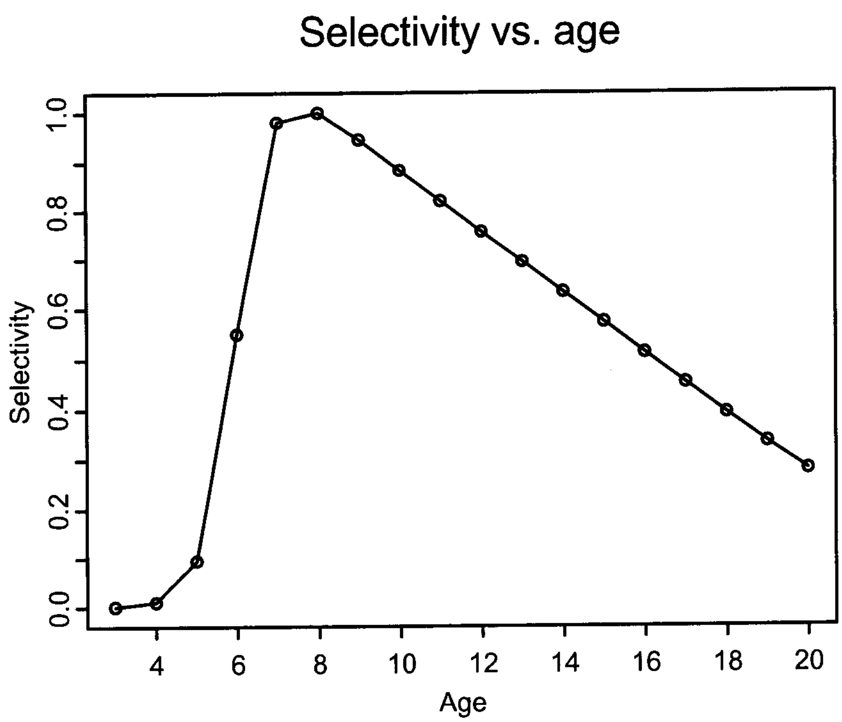


Figure 3. Simulated frequency distribution of unfished spawning output (B_0) from 3,000 simulations in which the sizes of the cohorts in the unfished population are determined by randomly re-sampling pre-fishing recruitments. The vertical line represents the mean B_0 used in the rebuilding analyses.

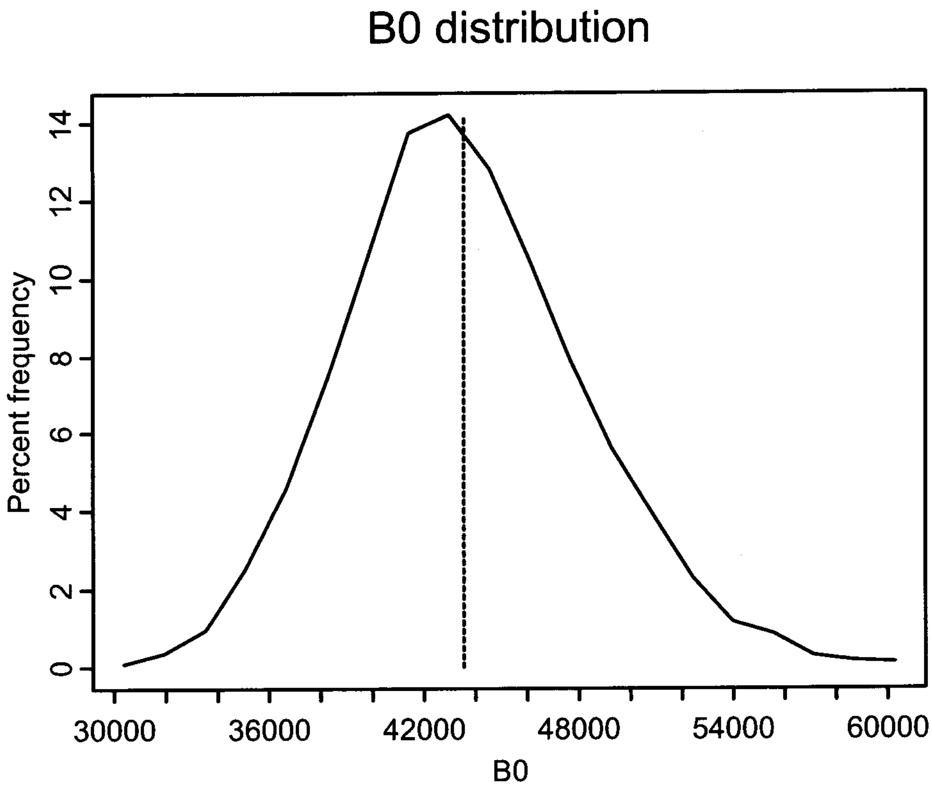


Figure 4. Simulated frequency distribution of the time to recover to 0.4 B_0 from 2001 with fishing (T_{min}), computed from 3,000 simulations based on the specifications of the Model 8. The vertical line represents the value of T_{min} used in the rebuilding analyses.

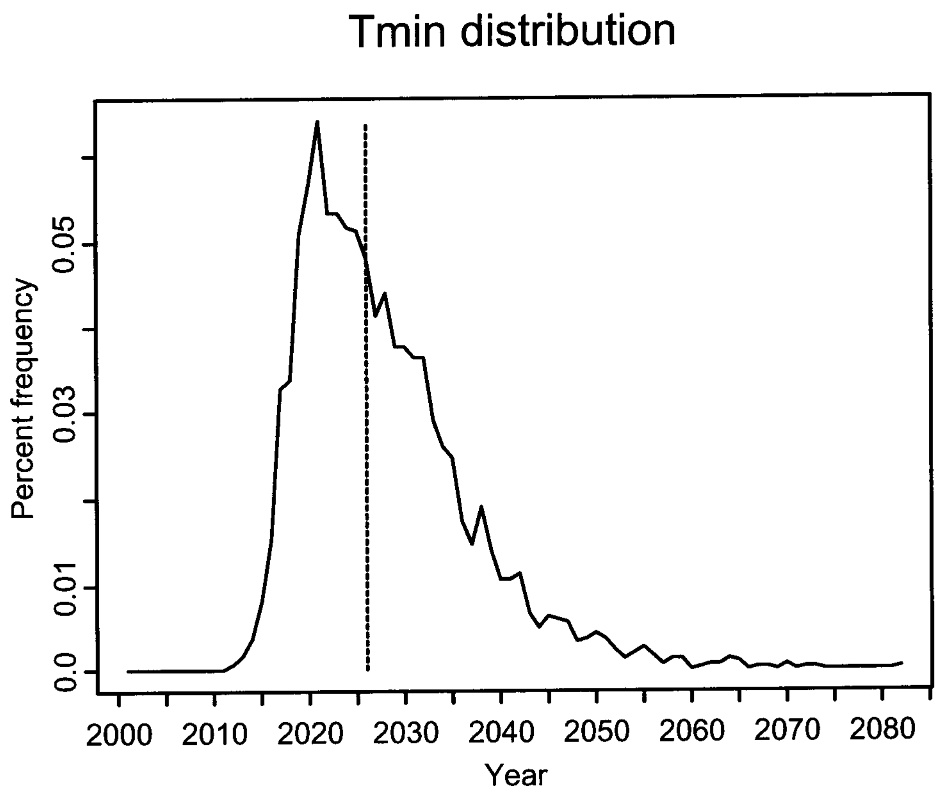
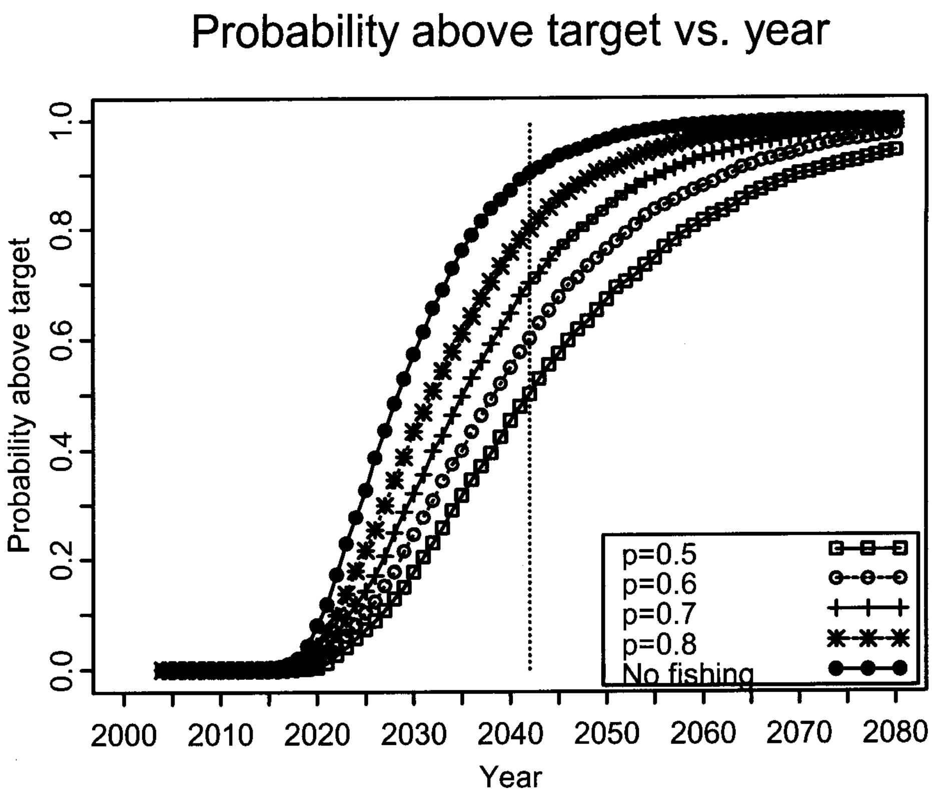


Figure 5. Time-series of the probability of the spawning output exceeding the target ($0.4B_0$) for four rebuilding strategies and a scenario of no fishing. The results are bases on Model 8. The vertical line is T_{target}.



Appendix A. The "rebuild.dat" file used in the rebuilding analysis for Model 8. Model 8 is the stock assessment base model with pre-specified recruitment for 2003-5 and in which future recruitment is generated by re-sampling historical recruits-per-spawner ratios.

```
# Title
Widow (RO=1 R=2 P=3)
# Number of sexes
2
# Age range to consider (minimum age; maximum age)
3 20
# Number of fleets to consider
1
# First year of the projection
2003
# Year declared overfished
2001
# Is the maximum age a plus-group (1=Yes;2=No)
1
# Generate future recruitments using historical recruitments (1), historical
recruits/spawner (2), or a stock-recruitment (3)
2
# Constant fishing mortality (1) or constant Catch (2) projections
1
# Pre-specify the year of recovery (or -1) to ignore
-1
# Fecundity-at-age
#  3  4  5  6  7  8  9 10
 0.0001 0.0002 0.0146 0.0634 0.1605 0.2757 0.3677 0.4399 0.5071 0.5650 0.6171
0.6635 0.7046 0.7410 0.7730 0.8011 0.8257 0.8824
# Age specific information (Females then males), weight and selectivity
# Females
 0.2623 0.3841 0.5176 0.6558 0.7932 0.9257 1.0507 1.1665 1.2726 1.3685 1.4547
1.5316 1.5998 1.6601 1.7131 1.7597 1.8005 1.8944
 0.0009 0.0097 0.0944 0.5498 0.9806 1.0000 0.9453 0.8830 0.8198 0.7569 0.6948
0.6336 0.5730 0.5128 0.4526 0.3929 0.3345 0.2792
# Males
 0.3031 0.4098 0.5155 0.6151 0.7060 0.7869 0.8578 0.9191 0.9715 1.0161 1.0537
1.0854 1.1120 1.1343 1.1529 1.1684 1.1814 1.2086
 0.0009 0.0097 0.0944 0.5498 0.9806 1.0000 0.9453 0.8830 0.8198 0.7569 0.6948
0.6336 0.5730 0.5128 0.4526 0.3929 0.3345 0.2792
# Age specific information (Females then males), natural mortality and
numbers at age
# Females
 0.1500 0.1500 0.1500 0.1500 0.1500 0.1500 0.1500 0.1500 0.1500 0.1500 0.1500
0.1500 0.1500 0.1500 0.1500 0.1500 0.1500 0.1500
     6274.02      4219.67      4443.77      2428.76      2128.70      2287.86
2868.73      1529.30      3492.11      1528.23      763.42      666.90
753.59       244.06       434.89       433.69       260.16      1900.81
# Males
 0.1500 0.1500 0.1500 0.1500 0.1500 0.1500 0.1500 0.1500 0.1500 0.1500 0.1500
0.1500 0.1500 0.1500 0.1500 0.1500 0.1500 0.1500
     6274.02      4219.67      4443.77      2428.76      2128.70      2287.86
2868.73      1529.30      3492.11      1528.23      763.42      666.90
753.59       244.06       434.89       433.69       260.16      1900.81
# Initial age-structure (for Tmin)
```

```
     4902.82      5165.99      2838.84      2566.73      2845.16      3569.44
1893.83      4302.17      1873.12       931.09       809.53       910.67
293.67       521.16       517.66       309.35       244.81      2000.34
     4902.82      5165.99      2838.84      2566.73      2845.16      3569.44
1893.83      4302.17      1873.12       931.09       809.53       910.67
293.67       521.16       517.66       309.35       244.81      2000.34
# Year for Tmin Age-structure
2001
# Number of simulations
3000
# Recruitment and Spanwer biomasses
# Number of historical assessment years
45
# Historical data: Year, Recruitment, Spawner biomass, Used to compute B0,
Used to project based
# on R, Used to project based on R/S
1958      42425      39568 1 0 0
1959      42862      39569 1 0 0
1960      43310      39589 1 0 0
1961      43450      39675 1 0 0
1962      43484      39870 1 0 0
1963      43588      40171 1 0 0
1964      38812      40532 1 0 0
1965      37029      40920 1 0 0
1966      36109      41294 1 0 0
1967      41850      40763 1 0 0
1968      56748      39987 1 0 0
1969      38332      39553 1 0 0
1970      56976      39558 1 0 0
1971      48694      39775 1 0 0
1972      45931      40223 1 0 0
1973     114065      40903 1 0 0
1974      32197      41586 1 0 0
1975      10281      42616 1 0 0
1976      13405      44140 1 0 0
1977      18353      45821 1 0 0
1978      27513      46409 1 0 0
1979       9198      45497 1 0 0
1980      60680      43132 1 0 0
1981      62387      36181 1 0 0
1982      25945      28394 1 0 0
1983      53363      21674 0 0 0
1984      77180      19954 0 0 0
1985      28235      19304 0 0 0
1986      27537      19015 0 1 1
1987      34969      19188 0 1 1
1988      27526      19056 0 1 1
1989      12418      18741 0 1 1
1990      29889      17297 0 1 1
1991      20008      16076 0 1 1
1992      17124      15525 0 1 1
1993      24993      14779 0 1 1
1994      41204      13536 0 1 1
1995      13379      12701 0 1 1
1996      18878      11757 0 1 1
```

```
1997     11283     11258 0 1 1
1998      8153     10898 0 1 1
1999      7673     10928 0 1 1
2000     12005     10558 0 1 1
2001      9806     10027 0 1 1
2002     12548      9755 0 1 1
# Number of years with pre-specified catches
1
# Catches for years with pre-specified catches
2003 300
# Number of future recruitments to override
3
# Process for overiding (-1 for average otherwise index in data list)
2003 1 13321
2004 1 21225
2005 1 41765
# Which probability to product detailed results for (1=0.5,2=0.6,etc.)
2
# Steepness and sigma-R and auto-correlations
  0.217141  0.500000 0.000000
# Target SPR rate (FMSY Proxy)
0.500000
# Target SPR information: Use (1=Yes) and power
0 20
# Discount rate (for cumulative catch)
0.100000
# Truncate the series when 0.4B0 is reached (1=Yes)
0
# Set F to FMSY once 0.4B0 is reached (1=Yes; 2=Apply 40:10 rule after
recovery)
0
# Percentage of FMSY which defines Ftarget
0.900000
# Maximum possible F for projection (-1 to set to FMSY)
2
# Conduct MacCall transition policy (1=Yes)
0
# Defintion of recovery (1=now only;2=now or before)
2
# Results for rec probs by Tmax (1) or 0.5 prob for various Ttargets
1
# Produce the risk-reward plots (1=Yes)
0
# Calculate coefficients of variation (1=Yes)
0
# Number of replicates to use
20
# First Random number seed
-89102
# Conduct projections for multiple starting values (0=No;else yes)
0
# File with multiple parameter vectors
MCMC.PRJ
# Number of parameter vectors
100
```

```
# User-specific projection (1=Yes); Output replaced (1->6)
1 5
# Catches and Fs (Year; 1/2 (F or C); value); Final row is -1
2004 1 0.000000
2005 1 0.000000
2010 1 0.000000
2100 1 0.000000
-1 -1 -1
# Split of Fs
2003 1
-1 1
```

Widow rockfish

STAR Panel Meeting Report

Northwest Fisheries Science Center
Seattle, Washington
April 14-18, 2003

STAR Panel Members

Ray Conser, Southwest Fisheries Science Center, SSC member, reviewer
Jean-Jacques Maguire, Halieutikos inc, Center for Independent Experts, reviewer
Richard Methot, Northwest Fisheries Science Center, (Chair)
Paul Spencer, Alaska Fisheries Science Center, reviewer

PFMC Committee representatives

Rod Moore, West Coast Seafood Processors Association, GAP
Mark Saelens, Oregon Department of Fisheries and Wildlife, GMT

STAT Team members present

Xi He, Southwest Fisheries Science Center, Santa Cruz Laboratory

Overview

The 2003 STAR Panel reviewed the assessment document prepared by the STAT for widow rockfish (*Sebastes entomelas*). As in the previous assessment conducted in 2000, the stock was assessed under the hypothesis of a single stock from the USA - Canada border in the north to Point Conception in the south (INPFC Areas US-Vancouver, Columbia, Eureka, Monterey and Conception). The age-structured population dynamics model was again implemented in the AD Model Builder software, but the model was re-coded. Similar data to that in the 2000 assessment were used. The absence of a fishery independent stock size index and of recent reliable fishery dependent indices of stock size remain a limiting factor in assessing the status of the stock.

The consensus of the 2003 Panel is that the assessment has been conducted using state-of-the-art population dynamics modelling and sound statistical estimation techniques. The stock assessment should be used as the basis for the Council's management decisions for the widow rockfish fishery.

The 2003 STAR Panel thanks the STAT, in particular the STAT member present at the review, for his excellent work and cooperation with the Panel.

Analyses requested by the STAR Panel

1. **Recalculation of input data**: all input data series (landings, CPUE, by-catch index, proportions caught at age, juvenile index) were re-extracted from the databases, in the case of the whiting by-catch index using different filtering criteria. In addition, the standardised CPUEs were re-calculated using a Delta-GLM (to take account of the zero tows) rather than a GLM model to address an issue raised by the 2000 STAR Panel. The 2003 Panel asked that the various input data series be compared. Differences in landing estimates had already been identified by the STAT, but not explained. There are relatively large differences in the CPUE series. The Panel considers that the new standardisation is an improvement over the previous approach. The comparisons of proportions caught at age between this assessment and the previous one is recommended for inclusion in the updated version of the assessment document.

2. **Filtering of the whiting by-catch data**: the draft assessment removed some catch and effort records from the whiting by-catch database prior to standardisation. The Panel considered that most of the filtering criteria were appropriate, but others had the potential of biasing the CPUE downwards. The Panel requested that tows with widow catches larger than 5 tons and those outside 2 standard deviations NOT be removed. It was not possible to re-do the data extraction and standardisation during the meeting and the Panel subsequently concluded that it would be preferable to consider this request as a research recommendation for the next assessment of this stock.

3. **Foreign landings**: estimates of rockfish landings by the foreign fleets have recently become available and those for widow rockfish have been added to the assessment at the request of the 2003 Panel. The modelling was correspondingly extended backwards to start in 1958 rather than in 1968 as in the previous assessment.

4. **Catch at age**: data files for the observed and predicted catch at ages were requested. The predicted catch at age were provided. The observed catch at age remains to be calculated for inclusion in the updated version of the assessment document.

5. **Triennal surveys**: the 2000 STAR Panel recommended that the triennial survey "be examined more closely to reconcile the discrepancies between the survey trends and the apparent population trends based on the population dynamics model", because it considered that the triennial survey, being the only fishery independent index of stock size, should be given a higher weight. This examination was not done, and the draft assessment did not use the triennial survey in model fitting. The 2003 STAR Panel supports the observation and the recommendation of the 2000 Panel that the triennial survey be analysed further (by area, post-stratification, exclude anomalous tows etc.) and be considered for

inclusion in the assessment. This should be done in the next assessment of widow rockfish.

6. **Selectivity**: the draft assessment estimated yearly selectivities for four fisheries. The results indicated variability over time, but little systematic changes, while those changes that were seen were counterintuitive with management action. In addition, the Panel noted that the mesh size in the bottom trawl fishery had been changed in 1992 (in the cod end) and 1995 (for the whole net). The Panel requested that selectivities be estimated by block of years: Vancouver-Columbia would have 3 periods (before 1983 when bottom trawl and midwater trawl are not separated in the statistics, 1983 to 1995 for bottom trawl when mesh size was 3 inches in the body of the trawl, and from 1996 with 4.5 inches mesh). The other areas / fishery would have two blocks: prior to 1996 and since 1996. The results suggested it was only in the Oregon bottom trawl fishery that the selectivity had changed, and the change was counterintuitive with higher selectivity on younger fish since the increase in mesh size. Given the paucity of reliable information on recruitment since 1996, and because the juvenile midwater index suggest that recruitment was low, it may be that the model explain higher catches of young fish in recent years that could be due to stronger year classes as higher selectivities. Although the 2000 assessment included time-varyin g selectivity, The 2003 STAR Panel concluded that one selectivity curve should be estimated for the whole time period for each of the four fisheries. The Panel considers that this topic may require further analyses in the next assessment.

7. **Natural mortality**: the draft assessment allowed the model to estimate a slightly higher natural mortality for males than for females based on the observation that there were more older females than males in the fishery. The Panel noted that the catch composition by gender showed a greater proportion of males at younger ages, possibly due to difference in selectivity by gender. Allowing for different natural mortality had little impact on model results and the difference in M were small. The Panel considered that until the reason for the difference in age composition has been elucidated, the same natural mortality value should be used for both genders.

8. **Spawner-recruitment**: The current assessment includes estimation of a spawner-recruitment curve and annual recruitment deviations from this curve, in contrast to the previous assessment which estimated each recruitment as a free parameter. The Panel requested an exploratory model run in which the recruitments were freely estimated. The first batch of these runs gave larger than expected initial stock conditions for the years prior to any data availability - although biomass at the beginning of the period for which data are available was similar to runs with the S-R relationship imposed. In subsequent runs, the S-R relationship was re-introduced primarily to smooth the transition from the no-data period to to the data period.

9. **Iterative re-weighting**: the panel noted that the estimation of sigma R (for recruitment deviations) and some of the CV's on the by-catch indices were estimated as model parameters in the draft assessment. The Panel notes that internal estimation of variance can contribute to unstable model performance. Although this did not necessarily occur here, the Panel requested that Sigma R and the bycatch CVs be assigned fixed values before running the model. The panel was also concerned that the CVs estimated by the GLM analyses may not capture all of the variability in the CPUE indices, such as inter-annual changes in catchability. The subject of how to assign weights to the various sources of information needs further investigation. In the end, the Panel recommended that the root mean squared error of the fit to each index in a preliminary run be used to calculate the CV to be used in subsequent model runs.

10. **Juvenile survey index:** The index is compared to the model's estimate of recruitment raised to a Power. The index has a range of about 100 and the recruitment estimated by the model has a range of 10. However, the estimated power of 10 in the draft model configuration implies a dynamic recruitment range of only 1.5 from the survey range of 100. Hence the inclusion in the model of the juvenile index with a power of 10 does not provide information on recruitment variability but in fact dampens the estimate of recruitment variability. Although the previous assessment argued for a power relationship due to compensatory larval mortality, there is no bio-ecological explanation for such a high power. The Panel asked for a profile of assessment results on the power, which showed that the power of the relationship between recruitment and the juvenile index has a large influence on the population estimate. In the end, the Panel recommended a fixed power of 3.0 for the base model and a

profile from 1.0 to 5.0 to describe a relevant component of the uncertainty in the model results. Approximate probabilities for these results can be determined from the respective likelihood values.

11. **Base model**: more than 20 additional model formulations were requested by the Panel and performed by the STAT to investigate the behaviour of the model under different hypothesis on natural mortality, selectivity, stock and recruitment variability, stock and recruitment relationships, reliability of stock size indices, and the functional form of the juvenile index relationship with recruitment at age 3. The Base run used a fixed value of M=0.15, it included foreign landings from 1966 onwards, the last 3 points of the whiting domestic index were excluded, one fishery selectivity over time was estimated for each fishery, the power on juvenile survey index was fixed at 3.0 and the index's contribution to the objective function was downweighted to 0.50, Sigma R for recruitment deviations was fixed at 0.50, and the CVs on each CPUE or survey index were set equal to the RMSE for the fit to that index in an initial model run with CVs set at 0.50 for all indices.

Some of the above issues were raised by the 2000 STAR Panel also. More attention to the previous STAR report could have improved preparation for this review.

Comments on technical issues and recommendations for remedies

The modelling in the assessment of widow rockfish is state-of-the-art. However, there remains considerable uncertainty in current stock status and recent trends because of the absence of fishery independent stock size index and of recent reliable fishery dependent indices of stock size. The CPUE indices derived from the by-catch in the whiting fishery do not provide information on current stock size: the index derived from the foreign whiting fishery covers 1976 to 1988, that for the joint venture fishery covers 1983 to 1990, and even though that for the domestic whiting fishery covers 1991 to 2001, values from 1999 onwards are not considerable representative of changes in stock size and they were not included in model fitting. The Oregon bottom trawl CPUE index derived from logbook data cannot be calculated after 1999 because the catches have been too small to be considered representative of changes in stock size and changes in management measures are expected to have more influence on the CPUE than changes in stock size, particularly in recent years. In addition, the CPUE from logbooks is calculated from landings, not from catches, and there is no account for changes in efficiency over time. The midwater trawl juvenile index is available from 1984 to 2002, but the area sampled is small compared to the distribution area of the stock, there are some years with insufficient catches to calculate the index suggesting that juveniles were probably distributed outside of the sampled area in those years (because recruitment was not zero and not considerably lower than neighbouring years), and the functional form of the relationship between the abundance of 100 days old juveniles in the survey and year class size estimated three years later in the population model is unknown. There is therefore an obvious need for collecting data with a view to derive abundance indices. The 2000 Panel recommended that "a hydro-acoustic survey for widow rockfish, possibly using industry vessels, could provide invaluable information that would improve the assessment". The 2003 Panel supports that recommendation.

Areas of Disagreement

There was no unresolved area of disagreement.

Unresolved problems and major uncertainties

The stock is arbitrarily defined from the USA-Canada border and south even though the species does exist in Canadian waters and a fishery developed since the mid-1980s. The current assessment assumes that the Canadian fishery has no influence on the resource in US waters. This assumptions needs to be evaluated. If it is concluded that the catches in Canadian waters have no influence on the resource in US waters, the current approach can be continued. Otherwise, it may be necessary to do a joint assessment.

Recent management measures have been such that catches in the Oregon bottom trawl fishery have been insufficient to derive CPUE estimates for 2000-2002. However, even if catches had been higher, there would remain considerable concerns in treating the CPUE series as a consistent series. Changes in management measures over time have been such that it could be desirable to divide the logbook data in two or more time series with relatively consistent management. This was recommended by the 2000 Panel, and the absence of overlap between periods was considered an impediment. The 2003 Panel did not investigate this further but further research is required.

The 2002 juvenile index derived from the Santa Cruz laboratory midwater trawl survey is considerably higher than any other estimates since 1989. As indicated earlier, the index is derived from sampling in a relatively small geographical area compared to the expected distribution of the juveniles and the index is expected to be sensitive to changes in distribution and not only changes in juvenile abundance. If the 2002 year class is as large as the index suggests, it could result in substantial stock increases. However, the relationship between the index and subsequent recruitment has been highly variable, and given the concerns about the reliability of the index, there remains considerable uncertainty about the size of the 2002 year class.

The value of the power in the curvilinear relationship between the juvenile index and subsequent recruitment is a major source of uncertainty on current stock status and recent trends. This subject requires further research in order to identify reasons for the existence of such a curvilinear relationship and for reducing the range of possible values for the exponent.

Various assessments in the Council's area treat time-varying selectivity in different manners. The widow rockfish assessment used a parameterised curve with one parameter allowed to change each year in the draft assessment. The Pacific Ocean Perch assessments uses a non parametric approach, while the whiting assessment uses a parameterised approach, but with random walk and penalty. These various approaches should be examined and compared with the view of providing guidelines for a structured approach. As a general rule, changes in selectivities should be linked to known changes in management, in the behaviour of the fleets (market conditions) or in changes in fish distribution / migration. Alternatively, the statistical properties of the random walk approaches need to be well investigated.

Similar to other rockfish species in the area, the biomass of widow rockfish has decreased steadily since the early 1980s and recruitment during that period is estimated to have been considerably smaller than before the mid 1970s. The reason for the lower recruitment since the early 1980s could be due to lower spawning stock biomass, but it could also be due to a lower productivity regime. If recruitment is currently low because of hydro-climatically unproductive conditions, it may not be possible to rebuild to the target biomass until more productive conditions occur. If the conditions improve, rebuilding could be faster than expected. The spawner-recruitment curve included in this assessment appears to track the trend in recent recruitment and to provide a stabilization of early, data-poor recruitment estimates. If recruitment is truly related to spawning output by this relationship, the current assessment indicates that rebuilding will be slow. However, the estimated parameters of this relationship are relevant for the climate regime of the past approximately 20 years and other aspects of the model formulation. Because of this uncertainty, the panel does not recommend that this estimated s-r relationship be used as the only basis for calculation of rebuilding targets and rates for widow rockfish. Long-term fluctuations in the climate could result in revised spawner-recruitment parameters as the stock is monitored over a longer period.

Recommendations for future research and data collection

1. For the next assessment, the STAT should systematically compare data and results with those of the 2003 assessment. In the same spirit, the STAT should explicitly report progress on the recommendations made in the current Panel report.

2. The Panel recommends that a rockfish survey by hydro-acoustics or other methods be initiated, possibly in cooperation with the fishing industry (this was also recommended by the 2000 Panel).

3. The 2003 STAR Panel supports the observation and the recommendation of the 2000 Panel that the triennal bottom trawl survey be analysed further and be considered for inclusion in the assessment.

4. Preliminary information for 2002 suggest that discards may have decreased substantially compared to the assumed 16% currently used. New discard data should be analysed and, if warranted, past discard estimates should be adjusted.

5. The assessment assumes a unit stock from the USA/Canada border and south, but there is little information to ascertain the stock structure of widow rockfish. This should be studied through genetic studies and other stock identification techniques.

6. Investigate with recent data whether growth and maturity in the northern area and in the southern area are really different.

7. The model included estimation of a spawner-recruitment curve. Such a curve can stabilize estimation of recruitments from data-poor portions of the time series, and it can provide a basis for calculation of Bzero and future recruitments. However, inclusion of a curve with a particular parametric form (in this case the Beverton-Holt curve, and with some runs using a Ricker curve) has the potential to influence the trend in recruitment if there are not sufficient data to provide solid information about the trend. Since some assessments use the s-r curve internally and others do not, the Panel recommends an analysis to fully investigate the pros and cons of this approach.

8. Considerable uncertainties exist in the estimated stock and recruitment relationship, and it is likely that additional factors besides stock size in US waters are contributing to recruitment variability. The Panel recommends compiling oceanographic time series and investigating whether these data can be used as covariates in estimating the stock-recruitment relationship of widow rockfish. This investigation should take into account stock structure, including consideration of fish in Canadian waters, and should take a multiple species approach because of the possible synchronicity of rockfish recruitment.

9. Filtering of whiting by-catch data should NOT exclude tows with widow catches greater than 5 tons NOR those outside 2 standard deviations of the standardised values.

10. The current CPUE standardisation treats each 64 OR bottom trawlers and 61 geographical units as individual categories. The Panel recommends that the usefulness of regrouping the vessels and geographical units be investigated. In all standardizations, the straight average index should be compared with the standardized estimates to appraise the magnitude of the effect of the standardization.

11. The Oregon CPUE is an important index in the assessment, yet it is may not be a consistent index of stock size over the period of the assessment because of changes in fishery management and of changes in fishing efficiency of individual fishing units. The data should be analysed to evaluate the desirability of breaking the series in two or more time periods.

12. The base case assessment estimates a single selectivity for each of the four fisheries, but the Panel considers that the topic of time-varying selectivity requires further research.

13. Similarly, the weighting of the various indices, including iterative re-weighting of the series and the weights of individual points within each series, should be re-investigated in future assessments.

Exhibit B.3
Attachment 7
June 2003

STATUS OF BOCACCIO OFF CALIFORNIA IN 2003
(Draft 2–still not complete)

by

Alec D. MacCall

Santa Cruz Laboratory
Southwest Fisheries Science Center
National Marine Fisheries Service, NOAA
110 Shaffer Road., Santa Cruz CA 95060

May 2003

EXECUTIVE SUMMARY

SPECIES/AREA: Bocaccio rockfish (*Sebastes paucispinis*) occurring in waters off the state of California. For management purposes, the stock may be considered to reside in U.S. waters south of Cape Mendocino. This stock assessment treats the resource in Southern and Central California as a combined unit.

YEAR	1951	1960	1965	1970	1975	1980	1985	1990	1995
TOT BIOMASS(mtons, age1+)	22924	15967	38660	43676	30039	28918	12634	8190	4896
SPAWN OUTPUT (10^9 eggs)	3630	2413	2690	8073	4864	3477	2074	1040	738
ABUND REL TO UNFISHED	27%	18%	20%	60%	36%	26%	15%	8%	6%
CATCH	2148	2702	1971	2451	5750	6037	2633	2451	777
EXPLOITATION RATE	9.4%	16.9%	5.1%	5.6%	19.1%	20.9%	20.8%	29.9%	15.9%

YEAR	1996	1997	1998	1999	2000	2001	2002	2003
TOT BIOMASS(mtons, age1+)	4560	4429	4260	4330	5166	5702	6506	7133
SPAWN OUTPUT (10^9 eggs)	721	711	704	734	764	790	843	984
ABUND REL TO UNFISHED	5%	5%	5%	5%	6%	6%	6%	7%
CATCH	573	480	209	197	187*	171*	201	
EXPLOITATION RATE	12.6%	10.8%	4.9%	4.5%	3.6%	3.0%	3.1%	

VALUES IN THIS TABLE ARE FROM THE STATc MODEL

* catch is partially based on unobserved, assumed discard rate

CATCHES: Catches declined from the 1970s to 1990s, levelling off since 1998, reflecting both a long-term decline in abundance and progressive restrictions on harvest of bocaccio. Values of catches in recent years are imprecise, for example because of undocumented discarding. Discard rate in 2001 and 2002 commercial fisheries is assumed to be half of that observed in 2003.

DATA AND ASSESSMENT: The last assessment was conducted in 2002. Like the previous assessment, this assessment uses a length-based stock synthesis model, extending back to 1951. Data included catches from five fisheries segments reflecting three statewide commercial gears (trawl, setnet, hook&line), and separate southern California and northern California recreational fisheries, length compositions from six sources (all five fisheries segments, and the Triennial Survey), and six indexes of abundance (trawl logbook CPUE, three recreational CPUEs, Triennial Survey abundance, and CalCOFI larval index of spawning output). Three indexes of recruitment were developed (Central California Juvenile Rockfish Survey, Southern California Power Plant Impingement Index, and recreational CPUE from fishing piers), but were not used. The assumed natural mortality rate was reduced to 0.15 from 0.20 in the 1999 and 2002 assessments.

WHY IS THIS 2003 ASSESSMENT DIFFERENT FROM THE 2002 ASSESSMENT? The 2002 assessment model was dominated by the 2001 Triennial Survey, which showed a very low bocaccio abundance and no sign of the 1999 year class. The result was that both abundance and productivity appeared to be very low; projected rebuilding times were over 100 years, and allowable catches for rebuilding were near zero. In this 2003 assessment, additional CalCOFI larval abundance information, and both length composition and CPUE information from the recreational fisheries indicate a sharp increase in abundance and a much stronger 1999 year class. The 2003 assessment more closely resembles the 1999 assessment, and median rebuilding times are in the 20-25 year range with currently allowable rebuilding catches in the hundreds of tons.

UNRESOLVED PROBLEMS AND MAJOR UNCERTAINTIES: The contrasting information from the low 2001 Triennial Survey and the high recent recreational CPUE has not been reconciled. The STAR Panel adopted two "equally likely" but separate models, one omitting the Triennial Survey data (STARb1), and the other omitting the recreational CPUE data (STARb2). The STAT Team prefers a single intermediate model (STATc) including all of the data despite their inconsistencies, with the STAR models serving as sensitivity analyses.

The low level of abundance (15 to 27% of estimated unfished abundance) in 1951-1965 raises questions regarding the validity of the estimate of unfished abundance, and the appropriateness of the rebuilding target. In the 53 years covered by this assessment, stock abundance was above the current rebuilding target in only 8 years, from 1967 to 1974.

	2003			2004		REBUILDING SUMMARY				
MODEL	SPAWNOUT	REL	TOT(MT)	ABC(MT)	C(40-10)	TARGET	OY(70%)	Tmed(70%)	Tmax	Tmin
STARb1	1136	8.5%	8913	660	0	5365	625	20	26	12
STARb2	733	5.6%	5455	400	0	5226	250	25	31	17
STATc	984	7.4%	7133	501	0	5355	306	23	30	16

REFERENCE POINTS: Population reproductive potential is measured as spawning output (units of billion eggs). Unfished abundance cannot be estimated reliably from historical stock and recruitment due to lack of curvature in the relationship. An imprecise estimate of unfished spawning output was obtained by multiplying the average age-1 recruitment (1951 to 1986) by unfished SPR, giving 13387 billion eggs, which is similar among all three models.

Based on the 50%SPR exploitation rate of 0.0638 (F=0.103 at full selectivity) used as a proxy Fmsy rate by the PFMC, the 2003 exploitation rate of 0.0309 is well below the maximum fishing mortality threshold. At Fmsy, the STATc model gives a 2004 catch of 501MT. Proxy Bmsy (40% of Bunfished) corresponds to an equilibrium total biomass of 39,255MT, and if this is fished at proxy Fmsy, the MSY is estimated to be 2504MT.

STOCK BIOMASS: Estimated spawning output in 2003 is 984 billion eggs, or 7.4% of the estimated unfished level. The estimated 2003 total biomass (age 1+) is 7133 MT.

RECRUITMENT: The last significant recruitment appeared as age 1 fish in 2000 (the 1999 year class). The strength of this cohort has been difficult to determine until it appeared clearly in 2002 fishery catches. It is now estimated to be much larger than it was in the 2002 assessment.

MANAGEMENT PERFORMANCE: The stock was heavily overfished up to the late 1990s, but exploitation rates have favored rebuilding since 1998. Recent catches exceeded the 100 MT rebuilding target set for 2000-2002, but appear not to have compromised the stock's rebuilding capacity (contrary to the findings of the 2002 assessment).

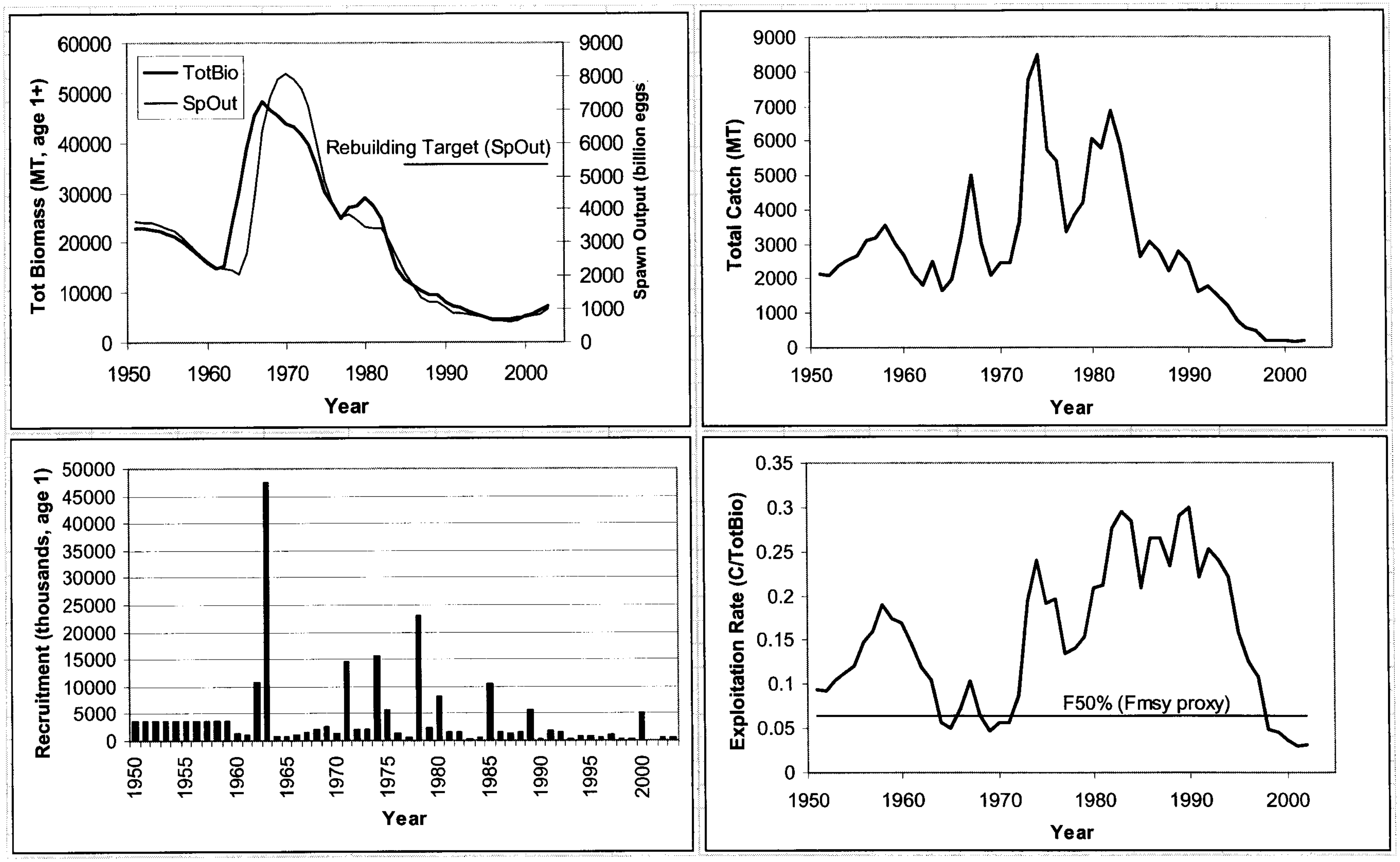
FORECASTS: Spawning abundance will continue to increase for several years as the 1999 year class matures. Various harvest levels are possible, depending on choice of rebuilding policy. The STATc model provides approximate values of future fishing effort necessary to achieve a constant fishing mortality rate. The 2002 fishery effort is used as a reference level.

C2004(MT)	200	300	400	500
F	0.035	0.055	0.0774	0.103*
Effort rel to 2002				
2004	84%	131%	182%	240%
2005	80%	125%	174%	229%
2006	76%	118%	164%	216%
2007	72%	112%	156%	206%
2008	69%	108%	152%	200%
2009	68%	107%	150%	198%
2010	68%	107%	150%	198%

* Fmsy

RECOMMENDATIONS: A revised rebuilding analysis will accompany this assessment document. Future assessments will continue to improve the estimate of the important 1999 year class, and will also help resolve the conflict between the Triennial Survey and recreational fishery information.

REFERENCES: STAR Panel Report, Rebuilding Analysis



Long-term patterns of bocaccio abundance, catch, recruitment and exploitation rate.

STATUS OF BOCACCIO OFF CALIFORNIA IN 2002

Introduction

A bocaccio assessment was completed in 2002, and indicated a low abundance with poor prospects for rebuilding. Due to the harvests taken in 2000 through 2002, rebuilding within the time frame established by the National Standard Guidelines could not be accomplished. Management imposed major restrictions on goundfish fishing off California in order to keep bocaccio catches as low as possible while providing limited fishing opportunities for other groundfish species. Several aspects of the 2002 assessment needed further analysis, and a re-assessment was requested for 2003.

The 2003 re-assessment included many new analyses, and was reviewed by a STAR Panel in April, 2003. The STAR Panel provided a number of corrections and improvements to the assessments, which are gratefully acknowledged. However, with respect to the overall assessment, a dispute exists between the STAR Panel and STAT Team: The STAT Team contends that the STAR Panel functioned as an alternative STAT Team (i.e., assessment author) rather than a review body. The specifications of the two bocaccio models (STARb1 and STARb2) developed by the STAR Panel were developed independently and without any significant input from the STAT Team. The STAT Team considers the two "equally likely" STAR models to be inappropriate as a basis for bocaccio management, and presents a third intermediate model (STATc) as a proposed basis for management. All three models are fully described in this document, and technical details are presented in later sections.

New Aspects of this Assessment

– The assumed natural mortality rate was revised (from 0.2 in 1999 and 2002) to a value of 0.15.

– Estimates of bocaccio catches by the foreign fisheries (1966-1976) are included in the catch history. About 12,000 mtons were caught during this period.

– Delta-lognormal and delta-gamma GLMs are used extensively, and precision is estimated by full jacknife of individual observations.

– The CalCOFI Index includes recent data from 2001, 2002 and February 2003, and includes all stations from Mexico to San Francisco. The stock synthesis model now fits the spawning biomass index directly, rather than by means of an artificial selectivity curve. The historical geographic distribution of the resource also was determined from these data.

– Recreational CPUE from the RecFIN database is based on a new method that identifies relevant fishing trips by species composition. Recreational CPUE was adjusted for the effect of discards, avoidance, and for the change in bag limits.

– Recreational CPUE from the CDF&G northern California partyboat monitoring was analyzed by a GLM including site and depth effects. A depth distribution of bocaccio recreational availability was determined from this source.

– A new (but imprecise) index of recruitment strength was developed from bocaccio catch rates at fishing piers. The geographic pattern of bocaccio recruitment was identified from these data.

History of Management

Only the most recent regulations for bocaccio are presented here. Earlier regulations appear in previous stock assessments. Regulations were complicated by various emergency actions. California-regulated fisheries (e.g., pink shrimp) are not included.

January 2001 (Emergency closure on October 29, 2001)
Recreational
- Bag limit: 10 rockfish, only 2 bocaccio, 10" minimum size
- North of Cape Mendocino: open year round
- Cape Mendocino - Pt. Conception: closed March-June except inside 20 fathoms - open May-June
- Pt. Conception south: Closed January-February except inside 20 fathoms (open all year)

Commercial:
- Limited Entry (fixed and trawl):
- Southern Area: 300 lbs/month Jan-April and Nov-Dec, otherwise 500 lbs/month
- Open Access: 200 lbs/month year round

January 2002
Recreational — Note: Emergency closure was enacted outside 20 fm on July 1, 2002, with no recreational retention of bocaccio
- Bag limit: 10 rockfish, no more than 2 bocaccio if not prohibited
  - Inside 20 fathoms, central area: recreational fishing allowed May-June and Sep-Oct, but bocaccio may not be retained
  - Outside 20 fathoms, central area: open January-February and July-August
- All southern waters: open March - October

Commercial — Note: Under emergency action, bocaccio cannot be retained commercially after July 1.
- Limited Entry Trawl: Jan-April 600 lbs/2 months, May-Oct 1,000 lbs/2 months, Nov-Dec 600 lbs/2 months
- Limited Entry Fixed Gear:
  - North of Cape Mendocino: 200 lbs/month
  - Cape Mendocino - Pt Arguello: 200 lbs/month Jan-Feb and July-Aug, closed otherwise
  - South of Pt. Arguello: 200 lbs/month March-Oct, closed otherwise
- Open Access:
  - North of Cape Mendocino: 200 lbs/month
  - Cape Mendocino - Pt Arguello: 200 lbs/month Jan-Feb and July-Aug, closed otherwise
  - South of Pt. Arguello: 200 lbs/month March-Oct, closed otherwise

May 2002
- Limited Entry and Open Access fixed gear:
  - no retention between Cape Mendocino and Pt. Arguello, 200 lbs/month south of Pt. Arguello

September 2002
- Limited Entry and Open Access Trawl:
  - no retention south of Cape Mendocino

January 2003
Recreational
- No bocaccio may be retained

Commercial
- Limited Entry Trawl and Fixed gear: no bocaccio may be retained south of 40-10. Northern limit is 2 fish.
- Open Access Gear: no bocaccio may be retained

Stock Distribution and Life History

Stock Distribution: The bocaccio stock addressed by this assessment ranges from Northern Baja California, Mexico, to the California-Oregon border, but with a functional northern limit of Bodega Bay, just north of San Francisco. The historical distribution of spawning abundance over this range is 4.6 percent in Mexican waters, 46 percent in Southern California waters, and 50 percent in Central/Northern California waters from Pt. Conception to Bodega Bay (see CalCOFI Index of Spawning Output, below). This assessment treats the stock as a single unit, in keeping with the recommendations of the 2002 STAR Panel. A new analysis of bocaccio recruitment along the California coast (see Recruitment Index Based on MRFSS Pier Sampling, below) indicates that bocaccio recruitment typically occurs from Santa Barbara to Santa Cruz, and is rare south of Ventura, with no evidence of separate southern California recruitment events. Nonetheless, the stock is sufficiently widespread that status may differ between Southern California and Central California. Proper representation of such internal stock structure is technically impossible at present and this assessment does not attempt to distinguish between the two regions except in estimating separate selectivity curves for the respective recreational fisheries.

Natural Mortality Rate: In 1996, Ralston and Ianelli reviewed the information relating to the natural mortality rate of bocaccio, and settled on M=0.15. In 1999, MacCall encountered computational instability in the stock synthesis model (resulting in "crashes") when using M=0.15, but was able to complete model development and exploration using M=0.2, which was adopted as the base model. Richard Methot (NMFS, Pers. Comm.) subsequently improved the computational methods in the synthesis model, eliminating the computational problem. In the 2002 assessment, MacCall examined both M=0.15 and M=0.25, but retained M=0.2 as the base model because it was consistent with the previous assessment and rebuilding analysis. During discussions following the 2002 STAR Panel, it was generally agreed that M=0.2 was probably too high, and lower values of natural mortality rate should be considered.

As reported by Ralston and Ianelli (1996), the maximum known age of bocaccio is 45 years (this maximum age has been confirmed in an independent study of bocaccio off Oregon, Kevin Piner, Pers. Comm.). Although age determinations of bocaccio are known to be imprecise, this value will be assumed to be valid. The method of Hoenig (1983) gives an estimated total mortality rate of 0.092 for this maximum age, but the Hoenig estimate is a geometric mean (this does not seem to be widely recognized). The standard error of Hoenig's estimator is not given, but visual inspection of his data suggest a value of about s=0.4 on a log scale. The geometric mean bias correction, $\exp(s^2/2)$ is about 1.08, giving a bias-corrected estimate of 0.1 for the total mortality rate.

The STAT Team prefers use of M=0.1, but the STAR Panel decided that the appropriate value should be M=0.15 (see STAR Report). Consequently, a value of M=0.15 is used in the base model.

Length at Maturity (Spawning Ogive): Previous assessments used length at 50% maturity of 47.6 cm FL, based on Wyllie Echeverria (1987). This value is from samples taken 20 years ago, when the bocaccio population size was much higher than it is now. Recent maturity observations (n=18,205 during 1993-2001) are available from port sampling (Don Pearson, Pers. Comm.). When presence of "eyed larvae" is used as the criterion for maturity, the results agree closely with the Wyllie Echeverria value, which is retained in this assessment. It is interesting to note that when the criterion of "eggs present" is used, the 1993-2001 maturity ogive appears to shift toward younger fish. This merits further study, and cannot be reconciled here.

Length at Age: Female bocaccio grow to a larger size than males. Because this assessment is based on length compositions, growth curves for males and females are fit within the model rather than specified externally. This is possible because of the strong modal structure of length compositions associated with rare strong year classes. However there does appear to be long-term variability in expected length at age, leading to imprecise fits at larger sizes and low estimated effective sample sizes (see Effective Sample Size, below).

Fishery Catches and Fishery-Based Abundance Indexes

Catches were divided into five fishery segments. Commercial fisheries were aggregated statewide, and were divided into three gear groups, trawl, hook and line, and setnet (gillnet). Recreational fisheries were aggregated for all modes of fishing, but were divided into northern and southern California regions.

Commercial Fishery Data

Catches: The history of commercial catches (Table 1a) was estimated following the procedure developed by Ralston and Ianelli (1996) and also used by MacCall (1999). The MacCall (2002) assessment considered separate northern and southern California segments of the commercial fisheries, but given subsequent treatment as a single stock, that approach has been abandoned in order to simplify the model. California commercial catches since 1978 were obtained from the CALCOM database. In cases of unknown species, samples were allocated to bocaccio according to typical patterns in corresponding market categories (Don Pearson, Pers. Comm.). Rogers (2003) has estimated catches by the foreign fishing fleets during 1963-73, and these historical catches have now been included.

Discarding was monitored by a NMFS observer program during 2002, giving a ratio of 5.45 tons of fish caught (retained + discarded) per ton of fish retained. The reported value of commercial bocaccio landings in 2003 was multiplied by this ratio to obtain the estimated bocaccio catch. Fishing before 2000 is assumed to have been unrestricted, and no correction is made for discarding. Fishing in 2000 and 2001 was restricted, but less so than in 2002. As an approximation, the discarding correction in 2000 and 2001 was assumed to be half of the 2002 value, i.e., 2.7 tons of fish caught (retained + discarded) per ton of fish retained (Table 1b).

Length Composition: Length composition of commercial landings were obtained from the CALCOM database, and cover years 1978-2002. Figure 1 shows the length compositions for female bocaccio. In 2002, the observer program provided a small sample of length compositions of retained (n=53) vs. discarded (n=142) bocaccio from trawl fisheries off California (Jonathan Cusick, Pers. Comm.). In most observed trips, bocaccio were either all retained or all discarded. In the two trip with partial discard, there was a clear tendency to retain the larger fish. Although this indicates that size-dependent discard has occurred to some extent, data are not yet sufficient to develop reliable size-dependent discard rates for use in the assessment model.

Trawl Catch per Unit Effort: Ralston (1999) developed a CPUE index of bocaccio abundance based on California trawl logbooks (Figure 2). Because the logbooks do not identify most individual species such as bocaccio, Ralston applied species compositions from local port sampling to the overall catch rates of rockfish from the trawl logbooks. This assessment uses Ralston's "area-weighted" index of bocaccio CPUE, and the associated standard errors (average CV is 29%).

Recreational Fishery Data

Catches: Catches, including estimated discards (RecFIN type "B1" – discarded dead) since 1980 were obtained from the RecFIN website. Recreational catches prior to 1980 were estimated according to the methods described in Ianelli and Ralston (1996) and MacCall (2002). Pre-1980 northern and southern California catches were estimated from published estimates of total rockfish caught in those areas. The history of estimated recreational catches is shown in Tables 1a and 1b.

Length compositions: Length compositions of bocaccio caught by recreational fisheries were obtained from three sources. Bocaccio lengths from both private boat and partyboat fisheries have been collected by MRFSS intercept samplers since 1980 (except for 1990-92) in both Northern (n=6,438) and Southern California (n=14,345). These data are available from the RecFIN database. The CDF&G conducted on-board partyboat sampling program in Northern California from 1983-98 (n=11,753, Deb Wilson-Vandenberg, CDF&G, Pers. Comm.). This assessment also incorporates a newly-discovered large data set of bocaccio lengths (n=78,371) from on-board sampling of the Southern California partyboat fishery during the period 1975-78.

Visual examination of length compositions from the private boat and partyboat catches indicated that the length compositions are similar, allowing samples from both partyboat and private boat fishing modes to be combined. Recreational fisheries in Southern California and Northern California could exhibit different selectivity curves and were treated as independent fisheries. Length compositions from recreational fisheries include many young, fast-growing fish, and combining raw lengths from all months causes "smearing" of the length modes, and also can cause difficulty in estimating likelihoods because the synthesis model assumes all fish to be captured at mid-year. In order to reduce the magnitude of this fitting problem, fish lengths were converted to equivalent lengths on July 1 of the year of capture, using the von Bertalanffy growth equation (Quinn and DeRiso 1999, equation 4.10):

$$L(t+\Delta t) = L(t) + (L_\infty - L(t))*(1-\exp(-k\ \Delta t))$$

where asymptotic length (L_∞) and growth rate (k) are the mean of the male and female values estimated in the 2002 assessment (708mm FL, 0.19/yr). Sex-specific length corrections cannot be used because sex is unknown for fish sampled from the recreational fisheries. Depending on the available information on date of capture, the incremental time, Δt in years, is calculated as

$\Delta t =$ (calendar date - 180)/360 where all months are assumed to be 30 days in length, or

$\Delta t =$ (wave - 3.5)/6 in the case of RecFIN samples, where date of capture is known only by bimonthly sampling wave.

The resulting recreational fishery length compositions are shown in Figure 3. Strong yearclasses appear as distinct modes, progressing in size as they grow through their first several years of age; the 1977, 1984 and 1999 year classes are especially notable.

Catch per Unit Effort: Recreational catch and effort data were taken from two sources, the RecFIN database (Wade VanBuskirk, Pers. Comm.) and the Northern California partyboat monitoring conducted by CDF&G (Deb Wilson-Vandenberg, Pers. Comm.). These two sources contain different kind of information and were treated differently. Only the partyboat catch and effort data from the RecFIN database were used in this analysis. Bocaccio catch rates from private boats appeared to be less consistent than those from partyboats.

RecFIN CPUE: The RecFIN intercept data (which include MRFSS data) reflect sampling and interviews conducted at the end of a fishing trip, and do not include information on specific fishing locations. A new multispecies discriminant function analysis was developed to identify which fishing trips are appropriate to include in calculation of a CPUE index of abundance. The concept behind the new method is that the species mix in the catch of a fisherman or a fishing trip is indicative of the habitat where fishing occurred, allowing discrimination between those trips where the target species (bocaccio in this case) could have been caught and trips where bocaccio were unlikely to have been caught. The latter trips are not informative, and should be excluded from the CPUE analysis.

The first step in the analysis consists of identifying the general list of species commonly caught on fishing trips in the region under consideration. Those species occurring in at least one percent of the records are included in the analysis (a typical data set included at least 50,000 records spanning the period 1980-2002). Records for each fishing trip, ideally at the aggregate boat level rather than at the individual fisherman level, are converted to a vector of presences (1) and absences (0) of those species. Note that quantitative catch could be used, but presence and absence should be less influenced by trends in species abundance. For each trip record (j), the probability of the target species (bocaccio) being present was fit by maximum likelihood using a logit function based on an indicator function (I) consisting of the sum of estimated species-specific coefficients, C_i:

$$I_j = \sum_i s_i C_{ij}$$

where $s_i = \begin{cases} 1 \text{ if species i is present} \\ 0 \text{ if species i is absent} \end{cases}$

and i = 1 to n non-bocaccio species.

Estimated probability (p_j) that bocaccio is present is given by the logit function

$$p_j = \exp(I_j)/(1 + \exp(I_j))$$

and the log-likelihood function is

$$\ln \mathcal{L} = \sum_j \ln(L_j)$$

where $L_j = \begin{cases} p_j \text{ if } s_T = 1 \text{ (i.e. bocaccio are present)} \\ (1-p_j) \text{ if } s_T = 0 \text{ (bocaccio are absent)} \end{cases}$

and s_T indicates presence (1) or absence (0) of the target species T in record j.

The coefficients are estimated by maximizing the log-likelihood (this was done in an Excel spreadsheet, using the "solver" tool). The species-specific coefficients (Figures 4, 5) include large positive values for species that consistently co-occur with bocaccio (e.g., chilipepper and bank rockfish), and large negative values for species that occur in habitats where bocaccio are unlikely to be encountered (e.g., oceanic species such as albacore, and nearshore species such as barracuda). Comparison of coefficients estimated from years1980-1989 with those estimated from 1993-2001 indicate that estimated coefficients are stable over time; this analysis uses coefficients estimated from all years combined.

In the second step, each trip record is assigned an estimated probability that bocaccio could have been encountered. The trip records are sorted by descending probability, and a threshold probability is chosen for exclusion of trips from the CPUE calculation. Average bocaccio catch per angler declines with decreasing estimated probability of encounter (Figure 6). Selection of a threshold probability requires balancing the sample size (favoring a low threshold probability) against the suitability of fishing trips for calculation of CPUE (favoring high threshold probabilities). In the present case, a threshold probability was chosen corresponding to an average catch rate of one bocaccio per record (where the slope of cumulative fish is equal to the slope of cumulative records, see Figure 6).

In the third step, records were corrected for discarded fish. The RecFIN database was queried to obtain numbers of fish retained (RecFIN type "A"), numbers discarded and presumed dead (RecFIN type "B1"), and numbers discarded and presumed alive (RecFIN type "B2"). For each record, the retained catch (numbers of fish) per angler was divided by the retention rate (A/(A+B1+B2)) for that year and wave to obtain a total catch per angler estimate. Discarded fish are assumed to have the same characteristics as retained fish. It is likely that discarded fish tended to be smaller than retained fish, but there are no data by which to test this "high-grading" hypothesis, or to correct for its potential effects.

The fourth step is to apply a delta-GLM to the retention-corrected records. Data from 1980 through the third wave of 2002 were included. The GLM included year (22) and wave (6) effects (region effects could have been used to produce a single coastwide analysis, but possible regional differences in selectivity at age argues for separate abundance indexes, see selectivity curves estimated below). Delta-gamma GLMs produced lower average CVs and were used in this analysis.

The fifth step is to correct the CPUE index for bag limits and for intentional avoidance of bocaccio. Beginning in 2000, partyboats attempted to avoid fishing in areas where bocaccio were present, and often would change locations if bocaccio were encountered. In 2002, a two-fish bag limit was enacted, and although not all fishermen observed the limit strictly (the 2002 records include numerous bags exceeding two bocaccio per angler), the two-fish bag limit presumably caused a decrease in CPUE relative to the previous unrestricted condition.

Bag sizes (number of bocaccio) follows an exponential distribution (Figure 7). For each year, the average bag size was plotted against the ratio of bags 2 or larger to bags of size 1. This ratio is correct independently of whether the two-fish bag limit is strictly observed. For years preceding 2000, the data are described by linear relationships (Figure 8), and were fit by linear regression. Presumably due to abandoning fishing locations where bocaccio were encountered, the average bocaccio bag sizes in 2000 fall slightly below the linear relationship. In 2002, under the impact of a two-fish limit, the average bocaccio bag sizes fall far below the historical pattern. For each region separately, a correction factor consisting of the ratio of average historical bag size predicted by the linear regression to the observed average bag size was applied to the respective year effect from the GLM to produce a value that would be expected to have occurred in the absence of avoidance and bag limits. Final CPUE abundance indexes are shown in Figures 9 and 10.

CDF&G Partyboat CPUE: The California Department of Fish and Game conducted on-board monitoring of partyboat catches in Northern California from 1988 to 1998. Presence of location and depth information associated with catch and effort at individual fishing sites (Deb Wilson-Vandenberg, Pers. Comm.) allowed a more direct identification of appropriate records for use in a CPUE calculation. The analysis used only those fishing sites with at least seven occupations and at least five positive occurrences of bocaccio catch in the data set. Initial exploration allowed collapse of monthly effects into a seasonal winter (January, February and March) and nonwinter effect; also the few records from depths greater than 80 fm were combined to form an 80+ fm depth effect. The final delta-lognormal GLM included year (12), season (2), site (100) and depth(8) effects. The estimated depth effects (Figure 11) show a very clear tendency for bocaccio catch rates to increase to a maximum at about 60 fm. The site effects (Figure 12) indicate a number of coastal areas where local catch rates of bocaccio tend to be high. The CPUE index is shown in Figure 13.

Fishery-Independent Data

Triennial Survey Index: The Alaska Fisheries Science Center has conducted bottom trawl surveys every three years off the west coast since 1977, with the most recent survey in 2001. The Monterey INPFC area was sampled on every survey, but the Conception area was not sampled on the 1980, 1983 and 1986 surveys. The 1977 survey did not sample the 55-91m depth range, but Ralston et al (1996) showed that very few bocaccio tend to be encountered in this range, so no attempt is made in this assessment to adjust the 1977 index for this small difference. Recent analysis of historical Triennial Survey trawl performance identified a problem with the extent of bottom contact by the net during the early years of the survey (Zimmerman et al. 2001). The questionable trawl samples have been deleted from the Triennial Survey data used in this analysis (pers. comm., Mark Wilkins, AFSC).

I used a simple log-transformed GLM to obtain bocaccio abundance indexes from the triennial survey stratum means; the GLM treatment provided a means of estimating the index despite the Conception region not having been surveyed in some years. Factors were survey year, area (Conception vs. Monterey), and depth stratum (nearshore, 55-183m, vs. and offshore, 184-366m). Values from the Eureka INPFC area were not included, as bocaccio were too rare in the catches to be informative. The coefficient of variation of the GLM index was assumed to be the same as the directly-calculated CV for the combined strata. The resulting index was imprecise, with CVs ranging from 30% to 80% (Figure 14).

The Triennial Survey also provides length compositions of the sampled fish (Figure 15). Length compositions from before 1989 were not used in this assessment, as the STAR Panel questioned whether the earlier samples were comparable to those collected more recently.

CalCOFI Index of Spawning Output: Abundances of larval bocaccio sampled by CalCOFI surveys in most of the years from 1951 to 2003 (Moser et al. 2000) provide an index of bocaccio spawning output off Mexico and California. Bocaccio larvae have been quantified for all surveys since 1972, but for years before 1972, samples with reliable bocaccio identifications are only available for CalCOFI Lines 77 (Port San Luis) to 93 (San Diego).

Initially, the full data were analyzed by a pivot table to identify months when bocaccio larvae were consistently present. This period was November through May; the remaining months were deleted from consideration. Year values were adjusted to year+1 for November and

December samples in order to associate those samples with the relevant spawning season. A delta-lognormal GLM with year, month and station effects (a station required at least one positive observation to be included) was used to describe the overall monthly and station distributions. A separate GLM with at least three positive stations was used as the basis for jackknife estimates of precision; many stations off Mexico (lines 100 to 113) had less than three positive observations.

Spawning Seasonality: The monthly distribution of larval abundance has a clear peak in January, and November and May values are very low (Figure 16). Bocaccio are known to spawn in other months, but the pattern is not consistent from year to year, and restriction to the months considered here decreases the imprecision that could arise from multiple spawnings.

Geographic Distribution of the Stock: CalCOFI lines are perpendicular to the coastline and are equally spaced at about 40-mile intervals. The geographic distribution of spawning bocaccio was summarized by line-specific relative population sizes. Areas represented by individual stations were calculated by the midpoints between stations along the CalCOFI line, and assuming constant width between lines. The shoreline was used as the nearshore boundary, and the outermost station was assumed to lie at the midpoint between its inner and outer boundaries. Abundances at stations were estimated by multiplying by the area represented by the larval density at that station. This procedure is equivalent to a two-dimensional Sette-Ahlstrom abundance estimate.

The long-term geographic distribution of bocaccio spawning putput is shown in Figure 17. Historically, 50 percent of the spawning population has resided north of Pt. Conception, 46 percent in southern California waters, and 4.6 percent in Mexican waters. Precision of line-specific abundances was calculated as the average CV of the individual stations on that line. Lines 77 to 93 have a much lower CV due to the larger sample sizes and full 51 years of temporal coverage.

CalCOFI Index Selectivity: The most recent version of stock synthesis includes the ability to fit a spawning biomass index directly (Rick Methot, Pers. Comm.). This is an improvement over the previous assessment, which required construction of an artificial selectivity curve to approximate the contribution of age groups to the spawning biomass.

Spawning Output Index: The spawning output index used in the assessment is based on the estimated year effects (Figure 18) from a delta-lognormal GLM (43 years, 7 months, 70 stations; 8247 observations) with at least three positive observations in each effect (allowing jackknife estimates of precision). Year effects include most of the years from 1951 to 2003. The most recent data, collected at sea in February 2003, include Central California coverage and were processed in record time by the NMFS La Jolla Laboratory (Richard Charter, Pers. Comm.).

Recruitment Indexes

Two recruitment indexes were used in the 2002 assessment: the Central California midwater trawl surveys of juvenile rockfish, and an index based on impingement rates at southern California electrical generating stations (power plants). This assessment adds a third recruitment index based on catches of bocaccio from piers. However, the recruitment indexes are not used in the assessment, per STAR Panel recommendation. Descriptions of the recruitment indexes are retained in the assessment because they provide useful auxiliary information regarding bocaccio life history and population structure.

Central California Midwater Trawl Juvenile Survey: A midwater trawl survey of pelagic juvenile rockfish abundances has been conducted at 33 standard stations between Pt. Sur and Pt. Reyes since 1983. Except for four years, sufficient number of bocaccio juveniles were sampled to allow the data to be analyzed by a delta-lognormal GLM based on year, station and temporal effects (average CV of year effect was 0.47 for delta-lognormal, and 0.54 for delta-gamma). The temporal effect reflects the brief period of pelagic juvenile availability to the sampling gear, and consists of five ten-day intervals in the range of 125 to 175 days after January 1. The last two of these intervals (i.e., early- to mid-June) show a progressive reduction in the number of juvenile bocaccio sampled (Figure 19). The year effects show a general decline in recruitment strengths since the 1980s, with a slight increase since the late 1990s (Figure 20). The average coefficient of variation of the year effects is 0.47.

Southern California Power Plant Impingement Index: New data were not available. Data used in the 2002 assessment were re-analyzed using the more thorough jacknife capability now available, but using the same assumptions as in that assessment. A delta-lognormal GLM was used because of the need to weight observations according to source (data from three separately monitored intakes at San Onofre were given a combined weight equivalent to a single site). The time series (Figure 21) shows a general tendency for recruitment to have declined over time. The index is valuable for its 30-year coverage, but even the more precisely estimated years have CVs of about 1.

Recruitment Index Based on MRFSS Pier Sampling: Numerous reports of catches of juvenile bocaccio from fishing piers suggest that bocaccio CPUE from fishing piers could provide an index of recruitment strength. Observed hours fished for all species and catches of bocaccio from man-made structures (i.e. fishing piers) were retrieved from the RecFIN Database for the years 1980 to 2002 (with 1990-92 missing), six bimonthly sampling periods ("waves"), and by coastal county from San Diego County to San Francisco County. Based on these data, San Luis Obispo County is clearly the center of historical bocaccio recruitment, with Santa Barbara to Santa Cruz Counties being the typical geographic range of presumptive recruitment events (Figure 22). In this data set, juveniles were rarely observed at piers in Ventura and Los Angeles Counties, and none at all have been reported from piers in either Orange or San Diego Counties. Juvenile bocaccio are most commonly observed at fishing piers from May to October (waves 3, 4 and 5). Accordingly, the data used to develop the Pier CPUE Recruitment Index were restricted to the four counties from

Santa Barbara to Santa Cruz, and waves 3, 4 and 5. A delta-gamma GLM produced a slightly lower CV of year effects (average CV = 1.03) than did a delta-lognormal GLM (average CV = 1.06). Three years had only a single positive observation and did not allow use of the jackknife. The final index was based on year effects from a delta-gamma GLM including the single observation cases (Figure 23). The index is very imprecise, and at current sampling frequencies, monitoring of catch rate from piers is of doubtful value as an indicator of recruitment.

Assessment Model

The assessment was conducted using the Stock Synthesis length-based maximum likelihood model (Methot 1990). Natural mortality rate is set at M=0.15 except in sensitivity analyses.

STAR and STAT Models: The STAR Panel was concerned about the disagreement between the Triennial Survey data, which showed no increase in abundance, and the rec recreational fishery CPUE, which showed a strong increase in abundance. The Panel adopted two separate and "equally likely" models, both of which exclude the three recruitment indexes (STAR Panel Report). Model STARb1 excludes the Triennial Survey data and uses constant recruitment from 1951-1959. Model STARb2 excludes the recreational CPUE data and uses constant recruitment from 1951-1969. Following the STAR Panel review, the STAT Team developed a third model (STATc) that includes both Triennial Survey and recreational CPUE data, uses constant recruitment from 1951-1959, and also excludes the three recruitment indexes. The two STAR models do not include the goodness of fit to the stock-recruitment relationship (SRR), but the STATc model includes a weak (emphasis = 0.1) SRR component for the purpose of stabilizing estimates of recruitments for years with very little informational basis for estimation.

Tuning: The estimates of precision which are important in determining the likelihood values for each observation present a practical difficulty. Externally estimated precision (multinomial variances for length compositions, or jackknife estimates for abundance indexes) are much more precise than the model is capable of fitting. For example, year effects from a delta-GLM may be quite precise, indicating that the GLM provides a good description of the patterns of variability in the data. However, unlike the independent treatment in the GLM, the year-to-year abundances in the model are very constrained by age structure, so that annual values are not independent. In recent years it has become customary to adjust the precision of the length composition and abundance indexes to approximately match the goodness of fit that can be achieved by the model.

Two initial model runs, corresponding to STATb1 and STATb2 (but also including the three recruitment indexes), was run with length composition sample sizes set to actual values (with a maximum of 300), and with the annual CVs of the abundance indexes set to 0.5. The results of these "tuning models" were used in the following calculations.

Effective Sample Size: An empirical estimate of "effective" sample size (N_{eff})is provided by the synthesis model, based on the ratio of the variance of the expected proportion (p) from a multinomial distribution to the mean squared error of the observed proportion (p'), i.e., N_{eff} = sum[p(1-p)]/sum[(p-p')^2]. Rather than direct use of N_{eff} (e.g., McAllister and Ianelli, 1997), this assessment follows the regression "smoothing" approach developed in the 1999 bocaccio assessment: Actual sample sizes are replaced by nominal effective sample sizes based on the predicted effective sample sizes from a regression of N_{eff} on actual number of fish measured, or actual number of sample clusters, whichever appeared to provide the more consistent relationship. Alternative regressions included zero-intercept, non-zero-intercept, and hockey stick forms according to the pattern of underlying points. The two tuning models produced nearly identical effective sample sizes. The relationships between actual and tuning model effective sample sizes, with fitted regressions, are shown for various sources in Figure 24; details are given in Table 2.

Precision of Abundance Indexes: The root mean squared error (RMSE) was calculated for each abundance index (Table 3). Values of RMSE are approximately equivalent to coefficients of variation (CVs) for purposes of comparison. In subsequent models, the precision of the abundance indexes was set equal to the average RMSE of the two models. Use of a common data set facilitated subsequent comparison of likelihood values. The very high RMSE values for the three recruitment indexes was the basis for excluding their use in further models.

<u>Model Results:</u> Selectivity curves are nearly identical for the three models, and results for the STATc model are shown here (Figure 25). The curves are generally dome-shaped, and are freely estimated. Previous assessments have found that the selectivity curve for the Triennial Survey is poorly determined, and that remains the case in this assessment, despite deletion of the length compositions from 1977-1986. Fits to the surveys (Figure 26) are generally reasonable, except for a poor fit to the Triennial Survey. Although the models tend to show a recent increase in abundance, the magnitude of increase is smaller than suggested by the recreational CPUE indexes. Fits to the length compositions are shown by "bubble plots" (Figure 27). There appear to be periods during which fish are consistently larger of smaller than expected. One likely cause is unmodeled interannual variability in growth rates.

The historical spawning output (Figure 28) and historical total abundance (Figure 29) vary similarly to those in the 2002 bocaccio assessment, except that the low values in the 1990s are not as extreme, and a population increase is beginning to appear in 2000-2003. The STARb2 model shows a different pattern of early abundance because of differences in assumed recruitment (constant through 1969). Recruitment estimates are generally unreliable before 1970, but more recent years show a clear pattern of isolated strong year classes (Figure 30). A comparison of year class strengths estimated by the STARb1 and STARb2 models show that the estimated size of the 1999 year class is one of the main differences between the two models (Figure 31). The STATc estimate is intermediate. The history of exploiutation rates is shown in Figure 32. Fishing intensity greatly exceeded what we now (in hindsight) consider to be an optimal harvest rate (the PFMC uses F50% as a proxy for Fmsy). Overfishing ended in 1998, and under rebuilding, harvest rates have declined to about one-half Fmsy. Numerical values of estimated population parameters are given in Appendix 1.

2003 Stock Status and Harvest Levels for 2004: Relative abundance is substantially higher than was indicated by the 2002 assessment, with estimated spawning outputs in the range of 5.6 to 8.5% of the unfished level (Table 4). Spawning output is expected to increase for several years as the 1999 year class approaches full maturity. Harvest levels for 2004 are shown in Table 5. The ABC is calculated based on F50% applied to the estimated 2004 abundance. Abundance is still below 10% of Bunfished, so "40-10" harvest levels are zero for all three models. Rebuilding harvests are described in the bocaccio rebuilding analysis (MacCall 2003), and are summarized here. Constant F rebuilding policies (70% probability of rebuilding on or before Tmax) from the two STAR models provide 2004 harvest levels of 250 to 625 mtons, and the intermediate STATc model gives a value of 306 mtons. Rebuilding times are much shorter than were seen in the 2002 assessment, mainly because of the much stronger estimated 1999 year class and generally higher productivity rates estimated by the 2003 models. The interaction of alternative management actions with possible "true" models (STARb1, STARb2, STATc) forms a decision table (Table 6). This decision table considers only rebuilding options with 70% probability of success on or before Tmax, and under each management action sets a constant harvest rate corresponding to the catch in the first year. Table 7 shows the level of effort, relative to that in 2002, that will achieve alternative harvest rates, based on model STATc.

Sensitivity Analyses: The STATc model was used to explore alternative emphasis values for individual likelihood components (Table 8). As suggested by the differences between the STARb1 and STARb2 models, the recreational data (both CPUE and length compositions) tend to favor higher estimates of abundance. The Triennial Survey length compositions indicate the presence of the 1999 year class (that component is neutral), but the Triennial Survey abundance component tend to favor lower estimates of current abundance. The STATc model was also used to explore effects of alternative assumed natural mortality rates (Table 9). Estimated current biomass is insensitive to the assumed natural mortality rate, but their effect on estimated unfished abundance (Bunfished) is strong (low M results in a larger unfished biomass per recruit). Estimates of relative abundance vary from 5.4% of Bunfished if M is low, to 9.1% of Bunfished if M is high.

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Table 1a. Historical bocaccio catches (mtons), 1950-1999

Year	Foreign	Trawl	Hook&Line	SetNet	TOT Comm	RECso	RECno	TOT Rec	TOTAL
1950		1287	200		1487	39	86	126	1613
1951		1738	277		2015	35	98	134	2148
1952		1691	276		1966	45	86	131	2097
1953		1921	321		2241	56	72	129	2370
1954		1979	337		2317	122	91	212	2529
1955		2034	290		2324	213	108	321	2646
1956		2383	356		2739	256	121	377	3116
1957		2584	365		2949	138	120	258	3207
1958		2621	649		3270	95	193	289	3559
1959		2236	565		2801	57	160	218	3019
1960		2163	351		2514	63	125	188	2701
1961		1631	354		1985	72	94	166	2151
1962		1316	343		1659	68	109	177	1836
1963		1939	386		2325	67	111	178	2503
1964		1229	259		1488	94	85	179	1667
1965		1417	305		1722	117	132	249	1971
1966	1101	1513	332		2946	170	142	312	3258
1967	2857	1468	328		4653	210	140	350	5003
1968	909	1410	321		2640	223	166	389	3029
1969	48	1388	304		1739	212	154	366	2105
1970		1660	298		1959	289	204	493	2451
1971		1624	424		2047	244	167	411	2458
1972	48	2412	598		3058	339	226	565	3623
1973	1987	4046	1040		7073	401	260	660	7733
1974	3907	3061	778		7746	459	289	748	8494
1975	1070	3142	812		5024	450	276	726	5750
1976	1021	2948	776		4745	417	248	665	5410
1977		2172	581		2754	377	218	595	3348
1978		2785	345	142	3272	350	196	546	3818
1979		2963	387	161	3511	445	242	687	4198
1980		3643	310	151	4104	1755	178	1932	6036
1981		3977	441	296	4714	841	230	1070	5784
1982		4302	748	314	5365	1158	358	1516	6881
1983		4361	380	551	5292	265	301	566	5858
1984		3269	309	398	3976	177	67	244	4220
1985		1268	126	852	2246	321	66	387	2633
1986		1183	328	945	2456	428	171	599	3055
1987		1179	321	1081	2581	90	103	192	2773
1988		1252	463	368	2083	107	44	151	2233
1989		1146	391	971	2508	179	78	256	2764
1990		1124	344	659	2127	233	91	324	2451
1991		706	177	442	1325	200	92	292	1617
1992		488	464	570	1523	167	92	260	1783
1993		559	402	413	1373	109	19	128	1502
1994		526	208	270	1005	215	5	220	1224
1995		377	70	283	730	44	3	47	777
1996		288	97	95	480	67	26	93	573
1997		230	58	36	324	49	107	157	480
1998		73	45	39	157	29	23	51	208
1999		45	21	7	73	71	53	124	197

Table 1b. Historical bocaccio landings and estimated catches (mtons), 2000-2002

Year	Trawl	Hook&Line	SetNet	TOT Comm	RECso	RECno	TOT Rec	TOTAL
Reported Landings								
2000	20	7	1	28	52	60	112	140
2001	14	8	1	23	60	49	109	132
2002	18	3	0	21	76	8	84	105
Estimated Catch								
2000	54	19	2	76	52	60	112	187
2001	37	23	2	62	60	49	109	171
2002	99	17	1	116	76	8	84	200

Table 2. Details of effective sample sizes. To be completed.

Table 3. Precision (RMSE) of abundance indexes from model tuning runs. Values in parentheses receive emphasis of zero, but are reported for comparison.

Component	STARb1	STARb2	Average
North Rec CPUE	0.672	(1.099)	0.67
North DFG CPUE	0.334	0.408	0.37
South Rec CPUE	0.706	(0.903)	0.71
Trawl CPUE	0.377	0.2547	0.32
Triennial Survey	(1.263)	0.808	0.81
CalCOFI	0.659	0.695	0.68
Power Plant Rect	2.154	2.042	2.10
Juvenile Survey Rect	2.118	1.981	2.05
Pier CPUE Rect	3.439	3.139	3.29

Table 4. Estimated spawning abundance and related reference points.

					2003		
MODEL	SPR(F=0)	AvgR51-86	Bunfished	Brebuild	Spawn Out	% of Bunf	% of Brebuild
STARb1	2.500	5364	13412	5365	1136	8.5%	21.2%
STARb2	2.498	5230	13064	5226	733	5.6%	14.0%
STATc	2.499	5358	13387	5355	984	7.4%	18.4%

Table 5. Reference harvest levels and associated rebuilding statistics for 2004.

	2004		REBUILDING SUMMARY				
MODEL	ABC(MT)	C(40-10)	TARGET	OY(70%)	Tmed(70%)	Tmax	Tmin
STARb1	660	0	5365	625	20	26	12
STARb2	400	0	5226	250	25	31	17
STATc	501	0	5355	306	23	30	16

Table 6. Decision table treating three alternative models as true states of nature. Four management decisions are given, corresponding to the correct decision under the three models, and a fourth decision based on average catch from the STARb1 and STARb2 models. Values in bold indicate the correct decision for the associated model if it is true.

	True Model (State of Nature)		
	STARb1	STATc	STARb2
Management Decision:			
STARb1			
C2004	**624.8**	624.7	624.8
F	**0.0801**	0.1039	0.1403
medianTreb(years)	**20.1**	41.6	81.1
Prob Rebuild by Tmax	**70%**	19%	3%
STATc			
C2004	307.2	**306.3**	307
F	0.0387	**0.0498**	0.0669
medianTreb(years)	14.7	**22.7**	28.1
Prob Rebuild by Tmax	94%	**70%**	58%
STARb2			
C2004	250	248.8	**249.6**
F	0.0314	0.0403	**0.0541**
medianTreb(years)	13.9	20.7	**25.2**
Prob Rebuild by Tmax	96%	79%	**70%**
GMT: avg(b1,b2)			
C2004	438.3	436.9	438
F	0.0556	0.0717	0.0966
medianTreb(years)	16.5	27.9	25.5
Prob Rebuild by Tmax	88%	50%	39%

Table 7. Future catches and levels of fishing effort relative to 2002 for alternative constant harvest rates beginning in 2004 (based on STATc model).

C2004(MT)	200	300	400	500	200	300	400	500
F	0.035	0.055	0.0774	0.103*	0.035	0.055	0.0774	0.103*
Year	Catch				Effort rel to 2002 level			
2004	200	300	400	501	84%	131%	182%	240%
2005	199	294	386	475	80%	125%	174%	229%
2006	192	280	363	439	76%	118%	164%	216%
2007	185	267	342	409	72%	112%	156%	206%
2008	182	260	329	389	69%	108%	152%	200%
2009	183	258	324	377	68%	107%	150%	198%
2010	186	260	322	370	68%	107%	150%	198%

* Fmsy

Table 8. Sensitivity of STATc model to alternative emphases on individual components.

	2003 Biomass(age1+) (mtons)		2003 Spawning Output (as percent of unfished)		1999 Year Class Size	
Base Model (STATc)	7133		7.4%		5071	
	EMPH=10	EMPH=0.1	EMPH=10	EMPH=0.1	EMPH=10	EMPH=0.1
Length Compositions						
Trawl	5039	7681	5.2%	7.9%	3674	5216
Hook & Line	6556	7347	6.4%	7.7%	4992	5073
Set Net	5476	7345	5.7%	7.6%	3674	5162
Recreational--South	11994	7391	13.9%	7.4%	6161	5418
Recreational--North	15682	7043	15.3%	7.4%	7344	4955
Triennial Survey	7369	7293	7.8%	7.5%	4887	5190
Abundance Indexes						
RecFIN CPUE--North	18993	5170	17.9%	5.5%	14689	3675
CDF&G CPUE--North	7909	7072	8.2%	7.3%	5490	5006
RecFIN CPUE--South	10596	6470	10.6%	6.7%	7731	4560
Trawl Logbook CPUE	3953	9147	4.0%	9.5%	3051	6263
Triennial Survey	2924	8217	3.1%	8.5%	2232	5776
CalCOFI Larvae	6923	7507	7.0%	7.7%	4887	5190
Group Emphasis:						
Length Compositions	4446		4.7%		3164	
Abundance indexes	9672		8.9%		7985	

Table 9. Sensitivity of STATc model to alternative assumed natural mortality rates.

Model STATc	2003 Biomass(age1+) (mtons)	2003 Spawning Output (as percent of unfished)	1999 Year Class Size
M=0.10	7454	5.4%	4567
M=0.15 (base)	7133	7.4%	5071
M=0.20	7523	9.1%	6099

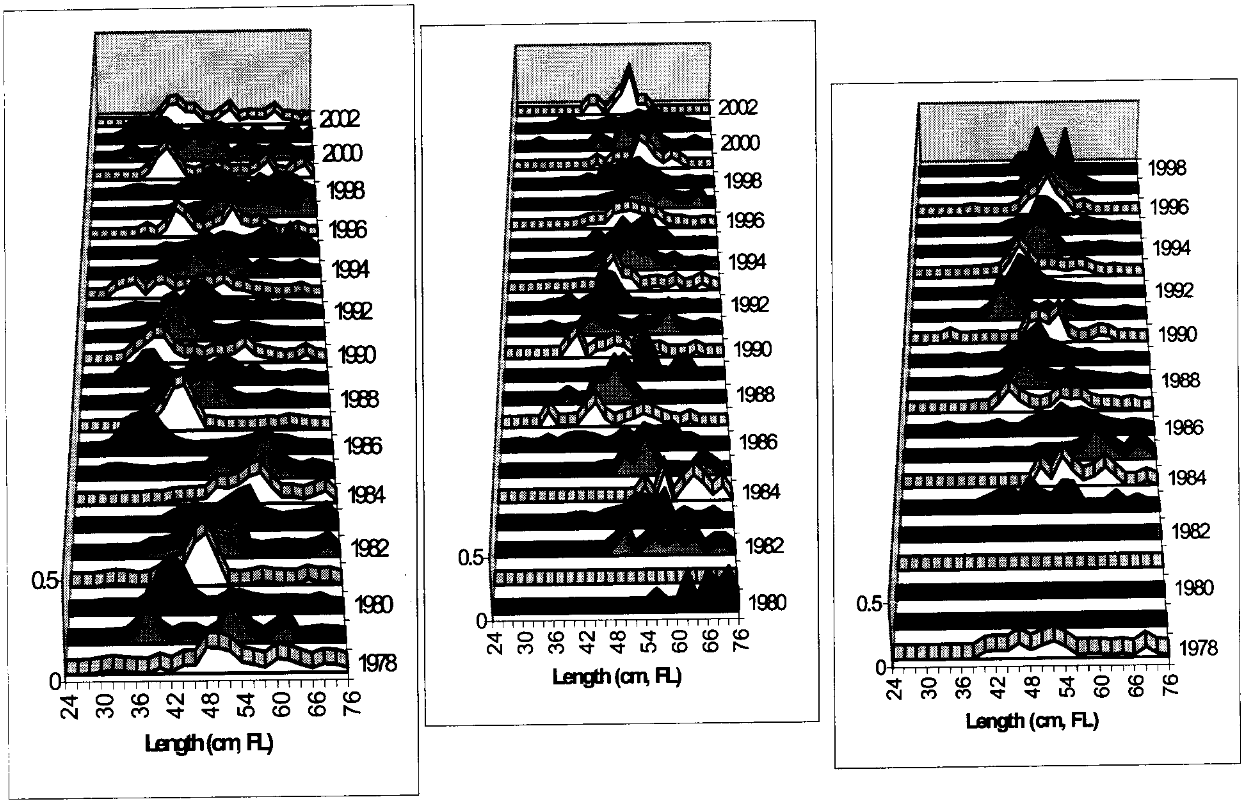


Figure 1. Historical length compositions of female bocaccio landed by commercial fisheries. Left: trawl; Middle: hook and line; Right: setnet.

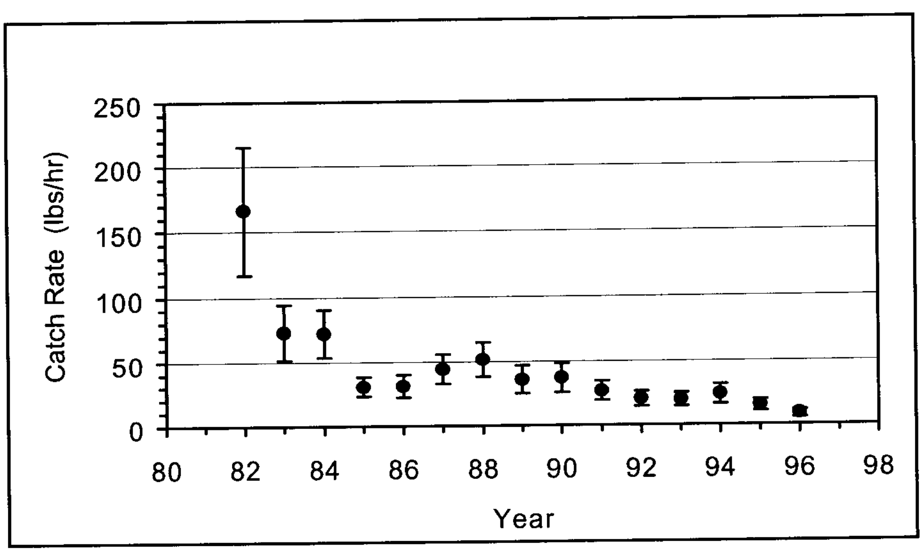


Figure 2. CPUE index of bocaccio abundance from California trawl fishery logbooks (Ralston 1999). Error bars are ±1SE.

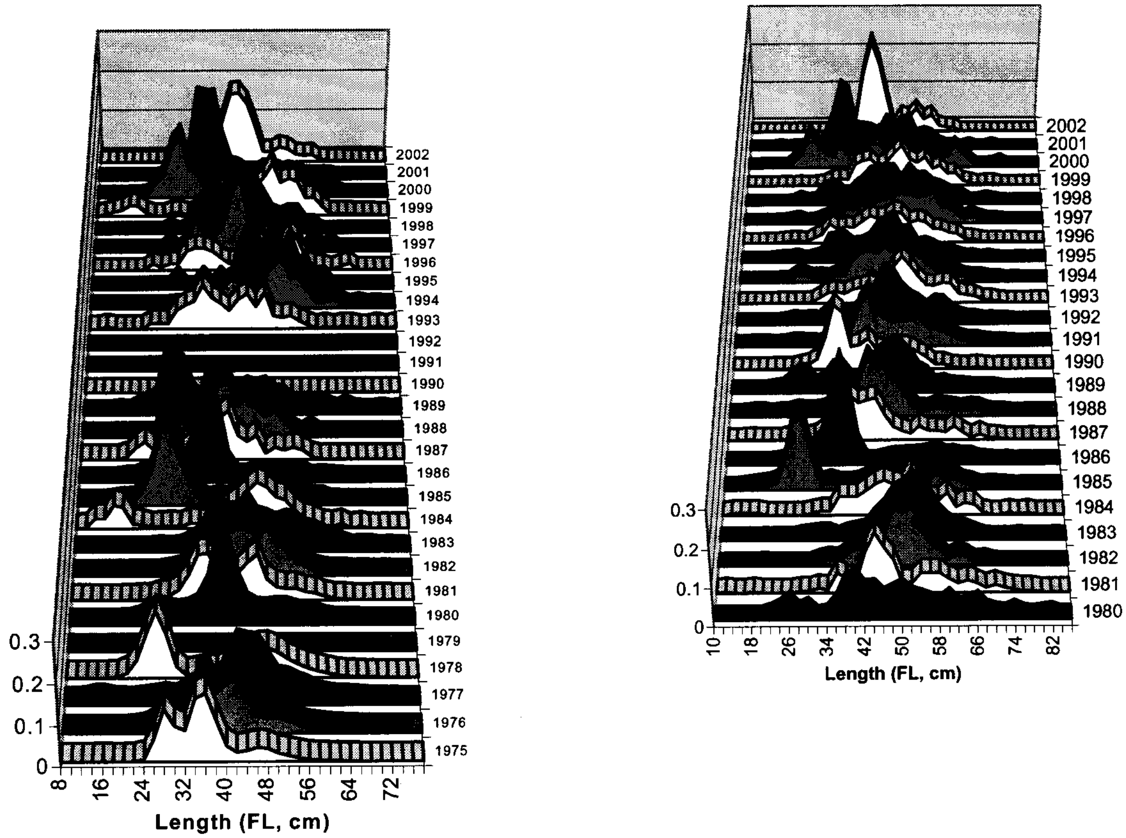


Figure 3. Left is Southern California, right is northern California bocaccio length composition from recreational fisheries, combined sexes.

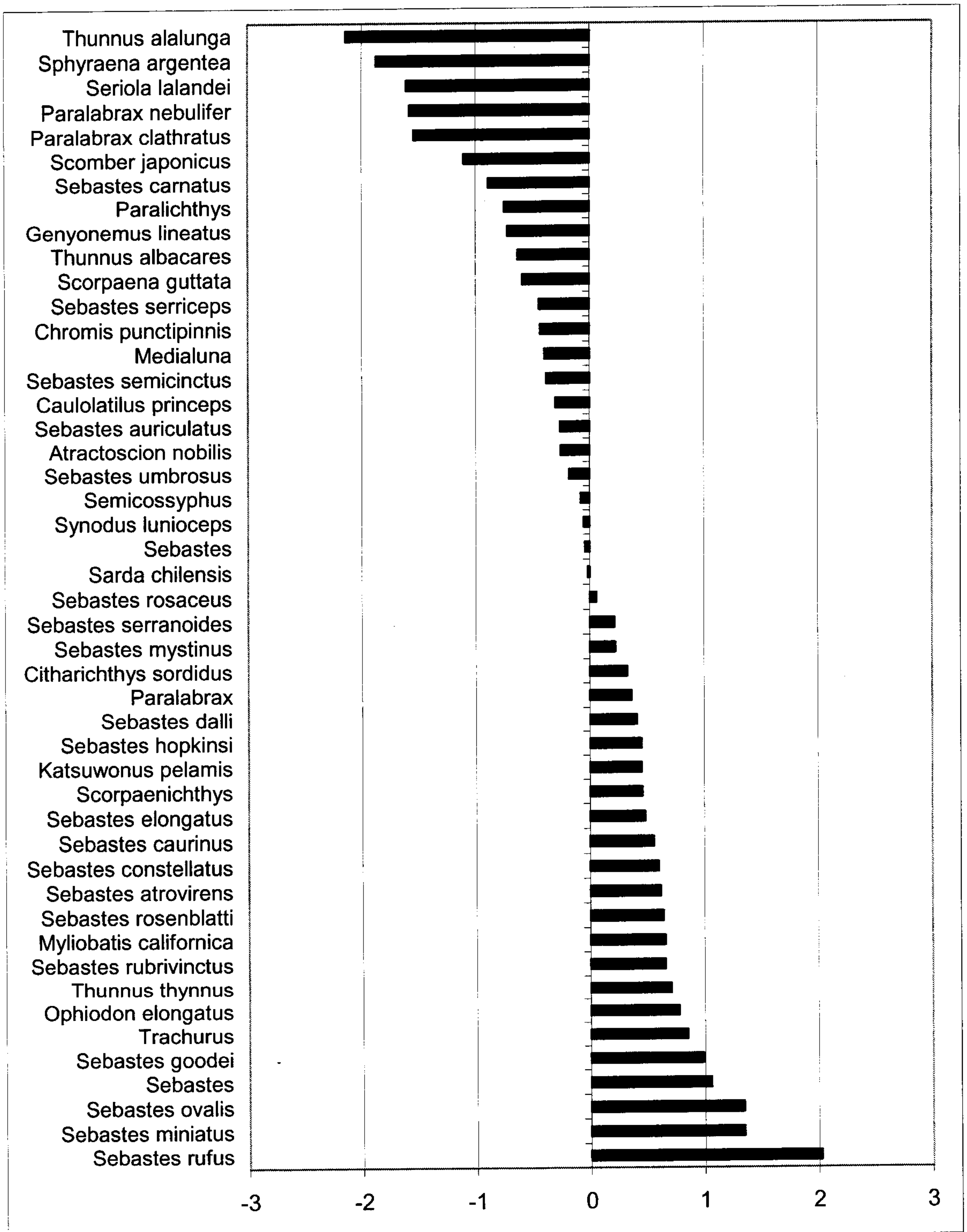


Figure 4. Species coefficients for presence of bocaccio in southern California partyboat catches.

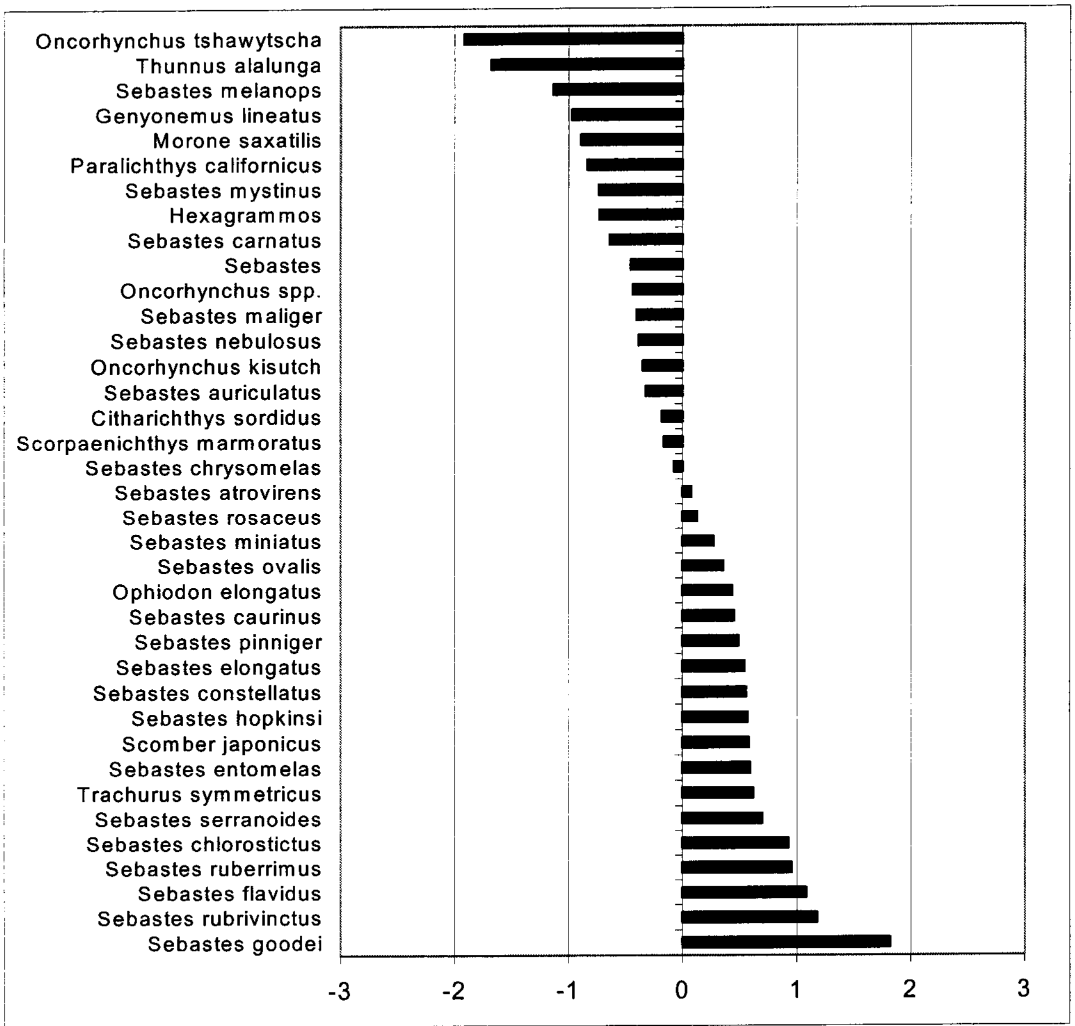


Figure 5. Species coefficients for presence of bocaccio in northern California partyboat catches.

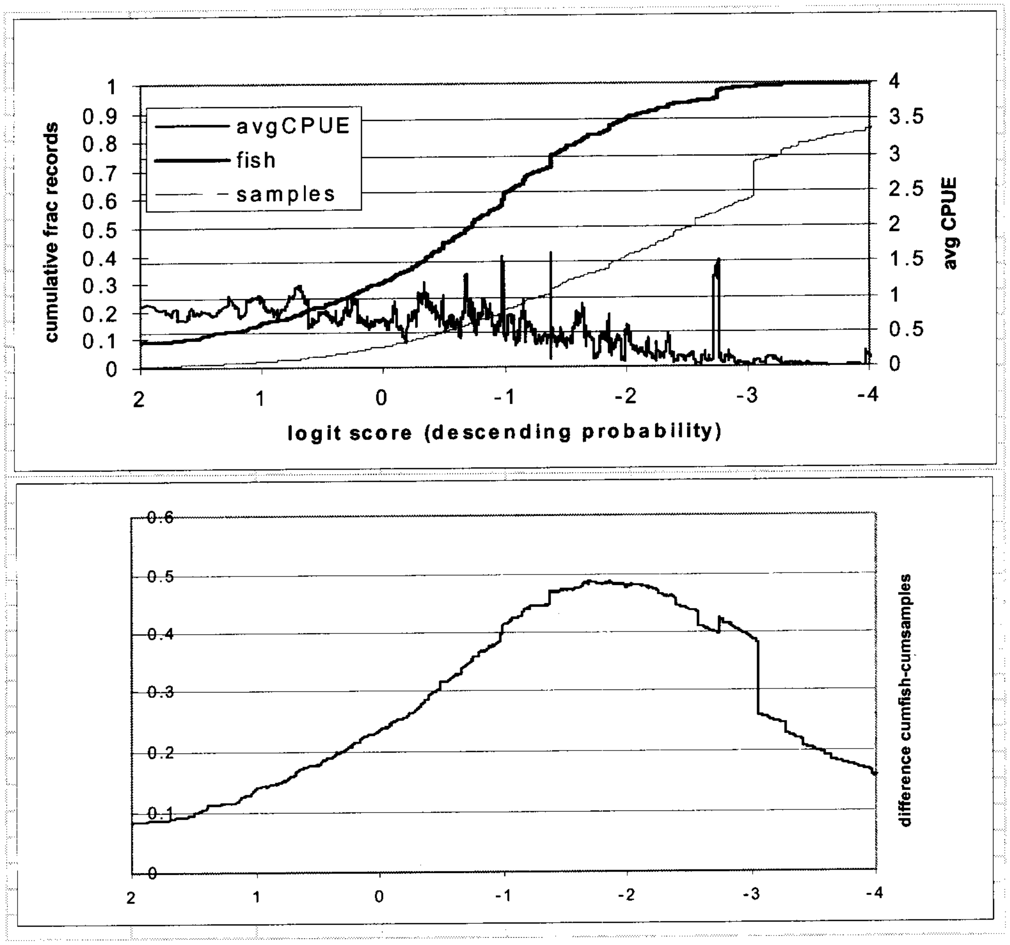


Figure 6. Relationship between northern California bocaccio CPUE (moving average) and logit score based on presence/absence of other species.

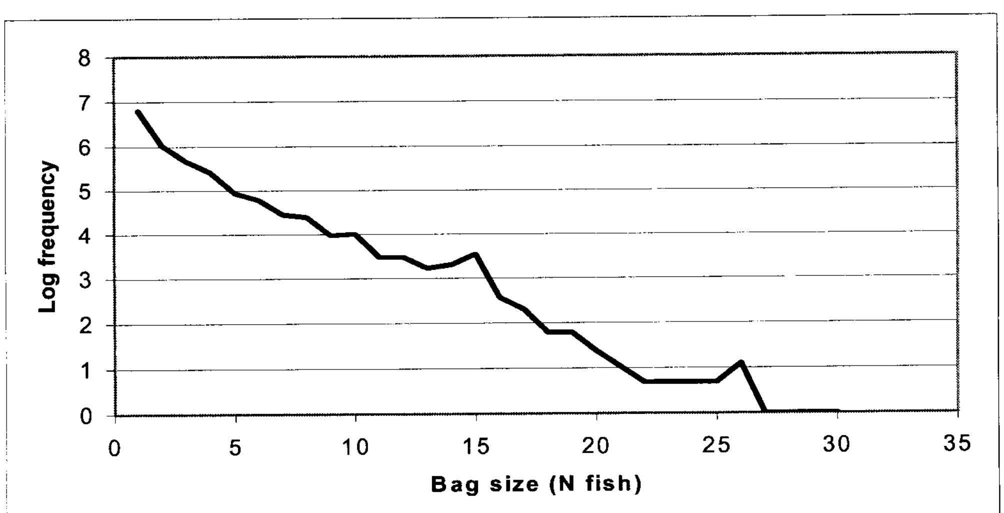
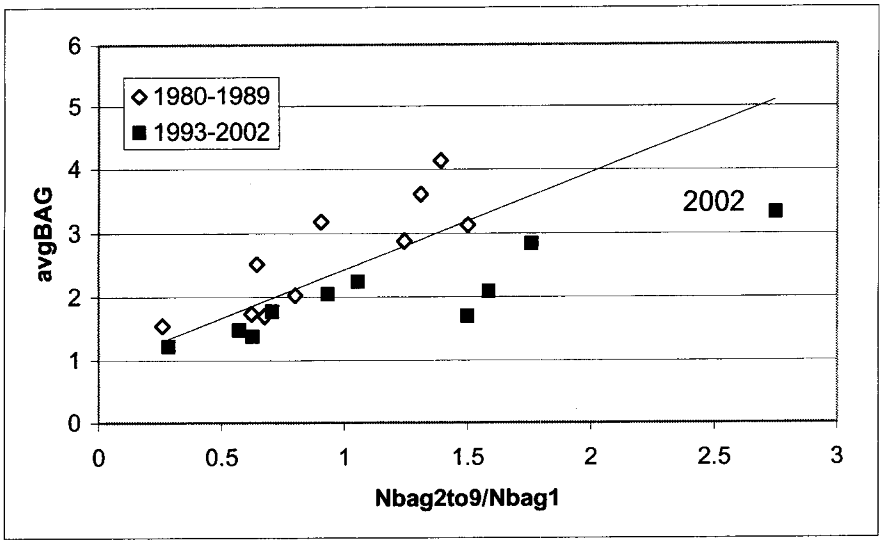


Figure 7. Recreational bag sizes are exponentially distributed. for bocaccio.



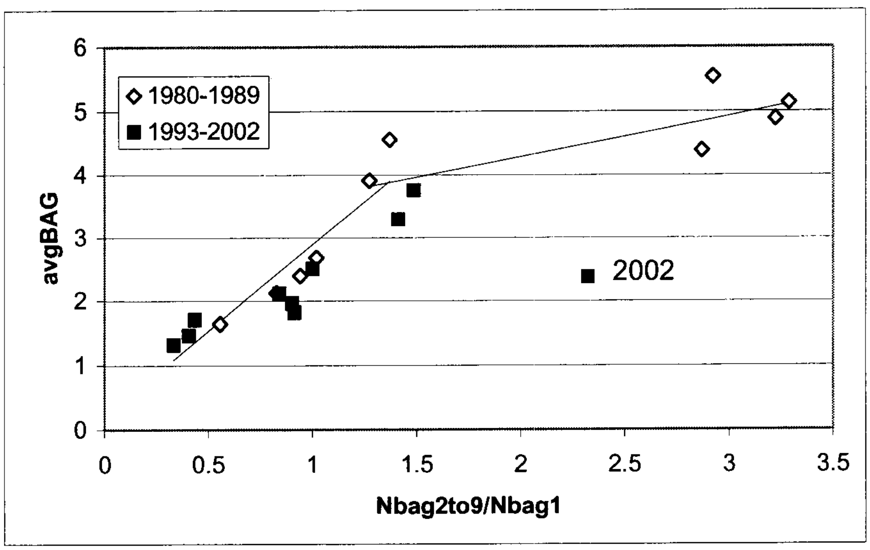


Figure 8. Correction for effects of bocaccio avoidance and reduced bag limits on bocaccio CPUE. Upper is Northern California, lower is Southern California.

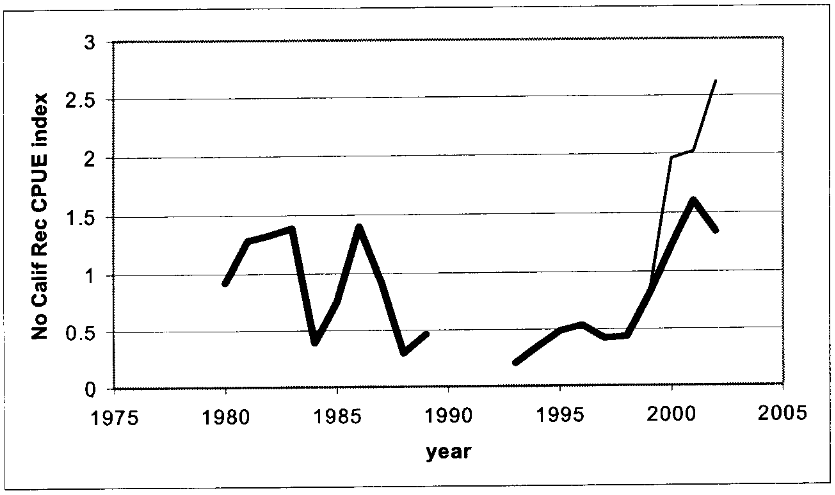


Figure 9. RecFIN-based partyboat CPUE in Northern California. Thin line is value corrected for effect of avoidance and bag limit.

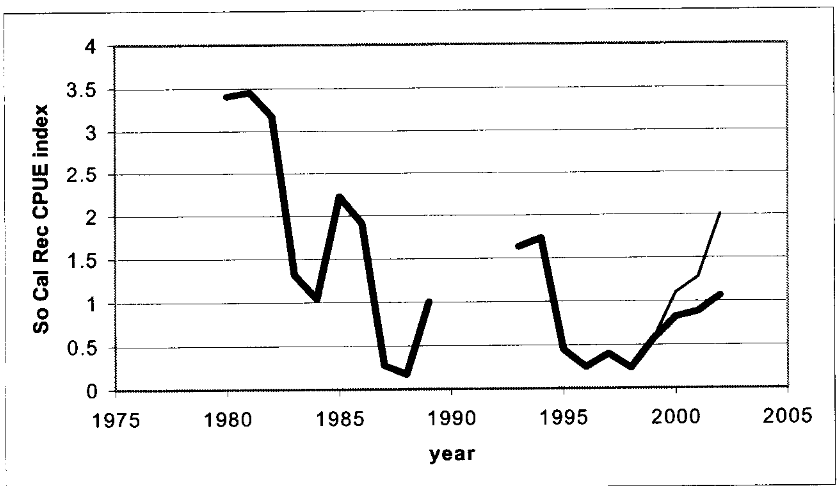


Figure 10. RecFIN-based partyboat CPUE in Southern California. Thin line is value corrected for effect of avoidance and bag limit.

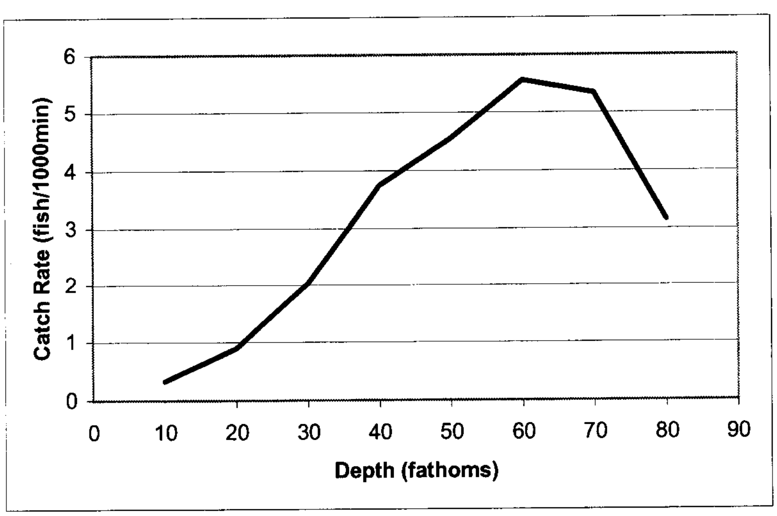


Figure11. Depth effects on recreational catch rate of bocaccio in northern California, as estimated by delta-lognormal GLM

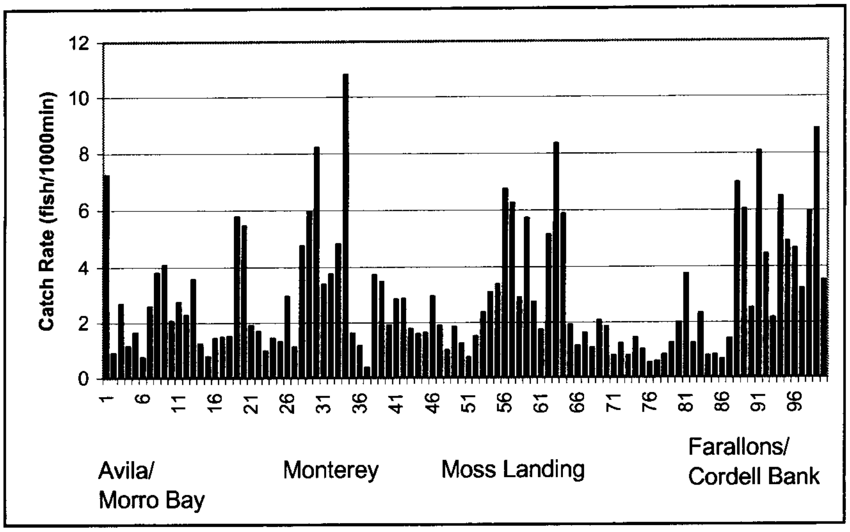


Figure 12. Site effects on recreational catch rate of bocaccio in northern California, as estimated by delta-lognormal GLM

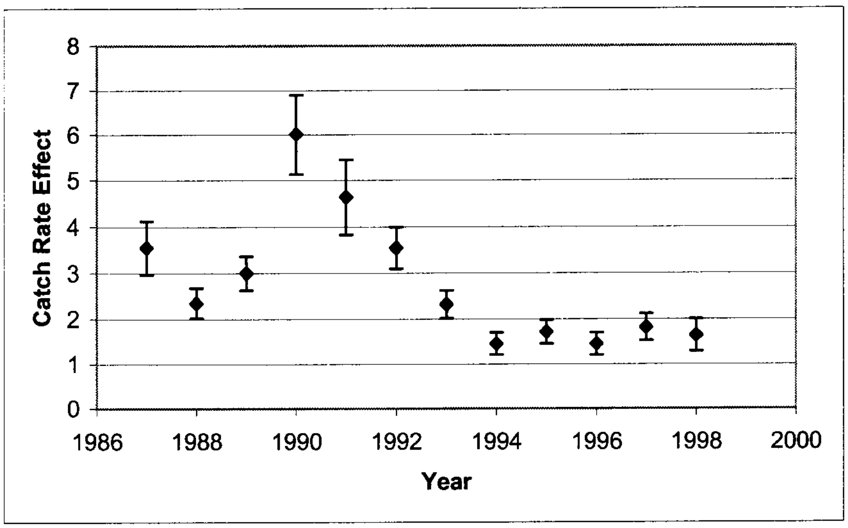


Figure 13. CPUE index from Northern California recreational fishery monitored by CDF&G. Error bars are ±1SE.

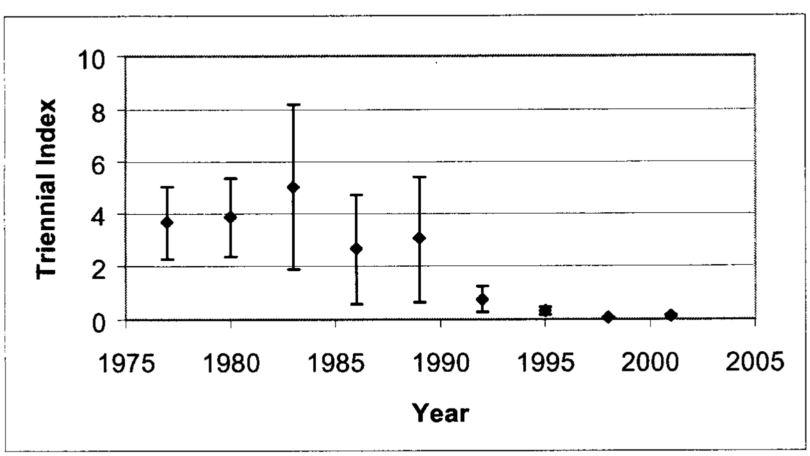


Figure 14. Triennial Trawl Survey GLM index of abundance for Central California (Monterey and Conception INPFC areas). Error bars are ±1SE.

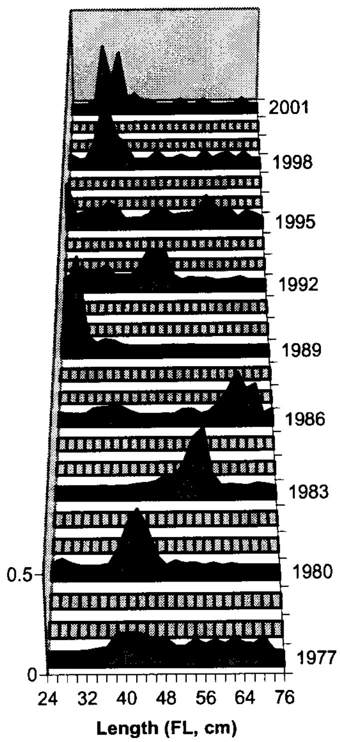


Figure 15. Length composition of female bocaccio sampled by Triennial Surveys. Data from before 1989 were not used in the analysis.

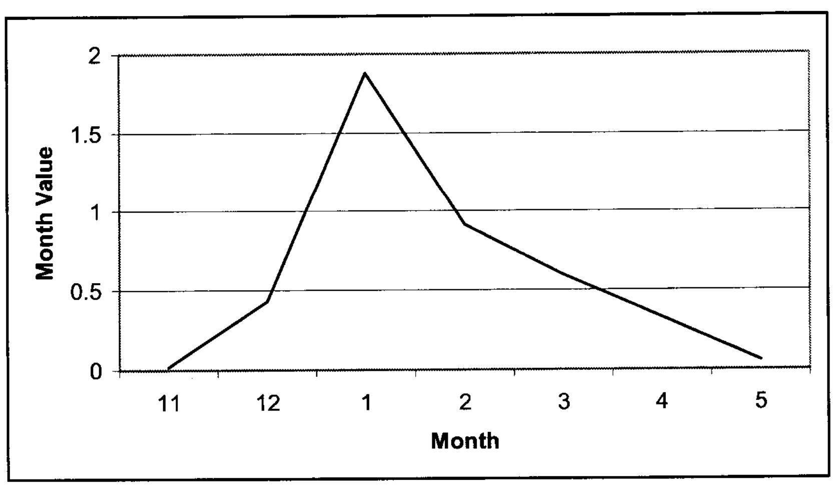


Figure 16. Monthly pattern of bocaccio larval abundance, based on delta-lognormal GLM of CalCOFI samples.

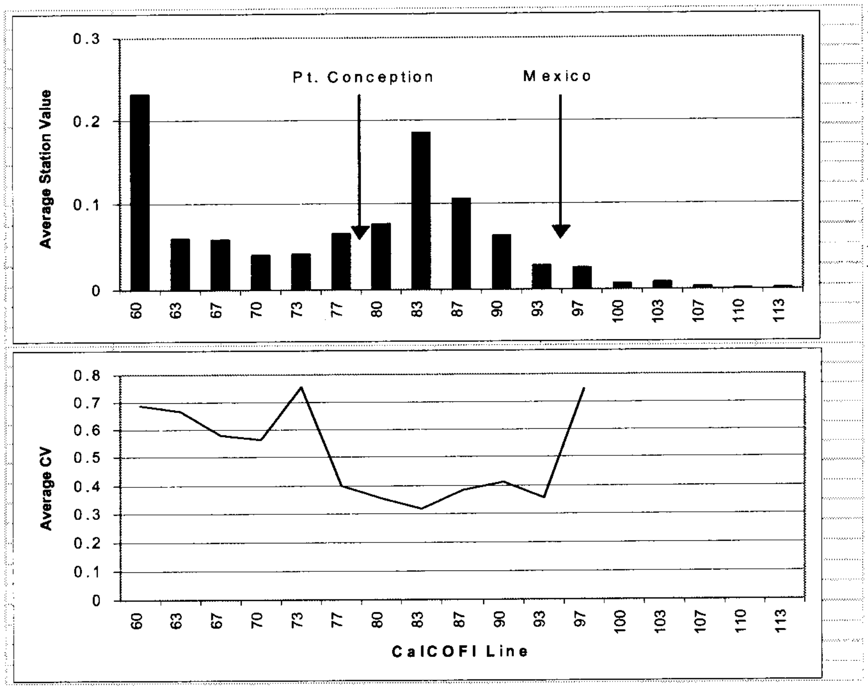


Figure 17. Geographic distribution of bocaccio spawning biomass. Upper: Abundances by CalCOFI line as fraction of total population size. Lower: Relative precision of line-specific estimates

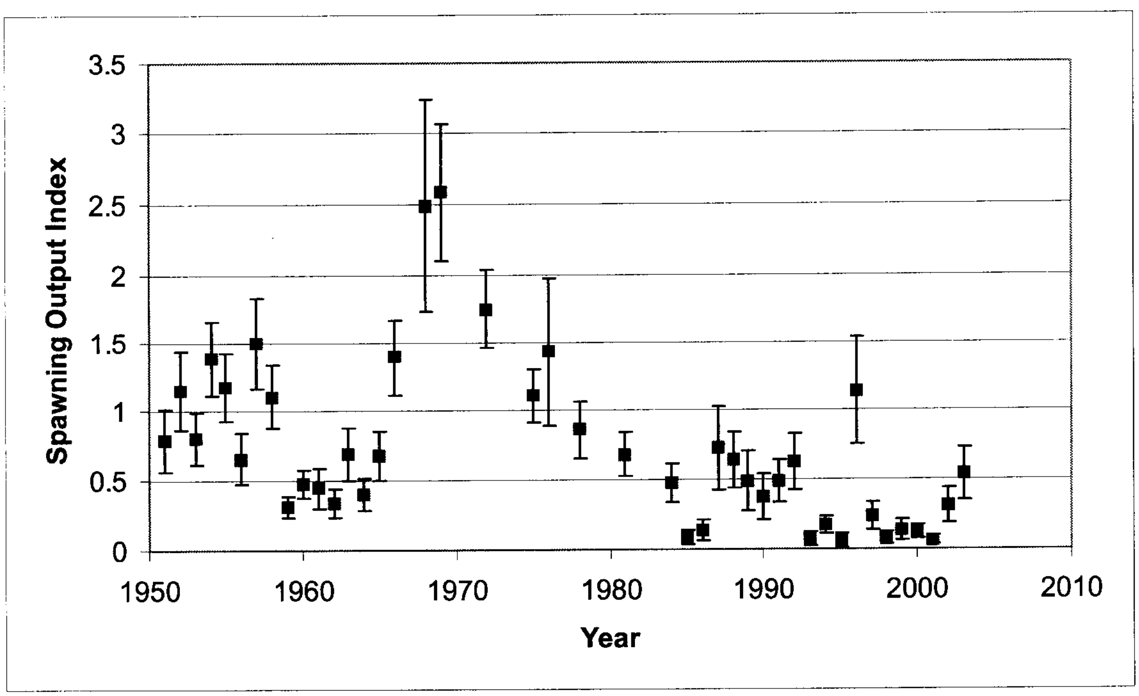


Figure 18. Index of spawning output, based on delta-lognormal GLM of larval abundance obervations from CalCOFI surveys. Error bars are ± 1SE, as estimated by jacknife statistic.

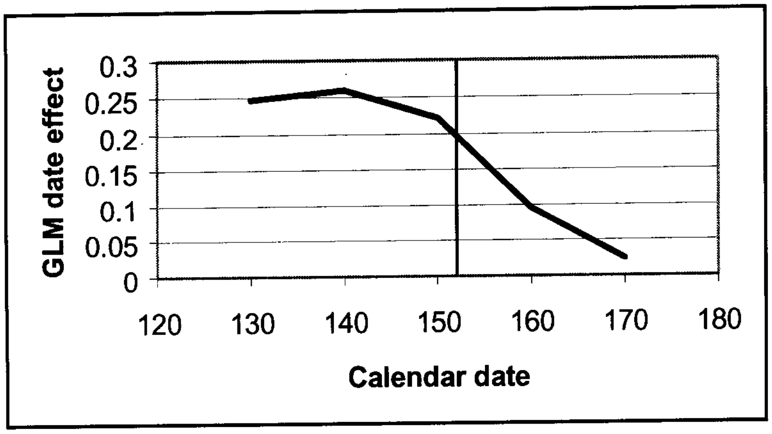


Figure 19. Effect of calendar date on abundance of bocaccio sampled in Central California juvenile rockfish surveys. Vertical line is June 1.

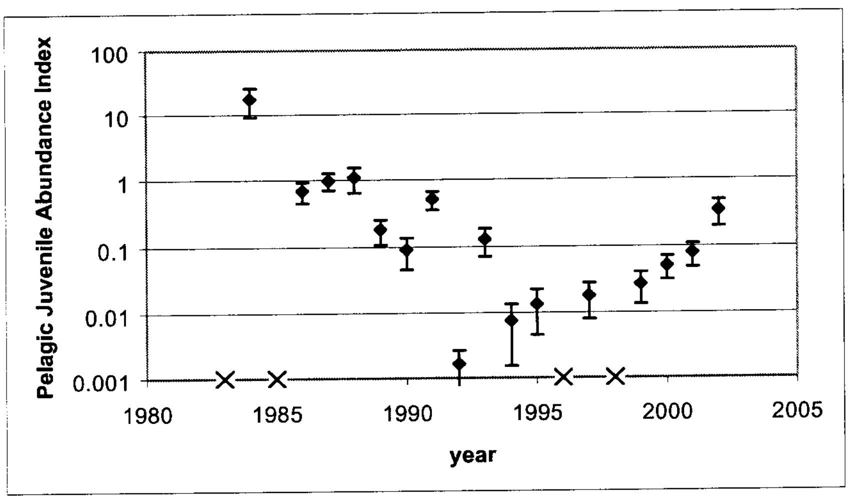


Figure 20. Recruitment strength index based on midwater trawl survey of juvenile rockfish off Central California (error bars are ± 1SE, X denotes years with no catch of juvenile bocaccio).

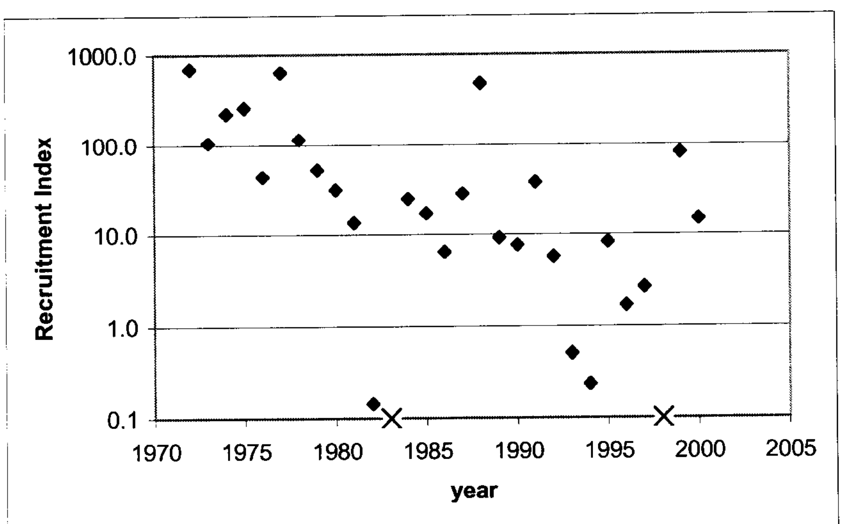


Figure 21. Time series of bocaccio recruitment indexes based on impingement rates at five southern California power plants (data provided by K. Herbinson, Southern California Edison).

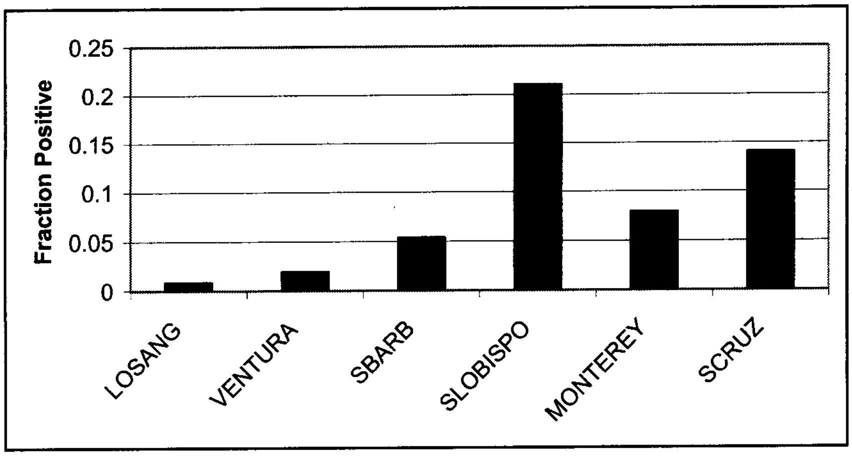


Figure 22. Geographic pattern of occurrence of juvenile bocaccio at fishing piers by California county. Values are zero for Orange and San Diego Counties.

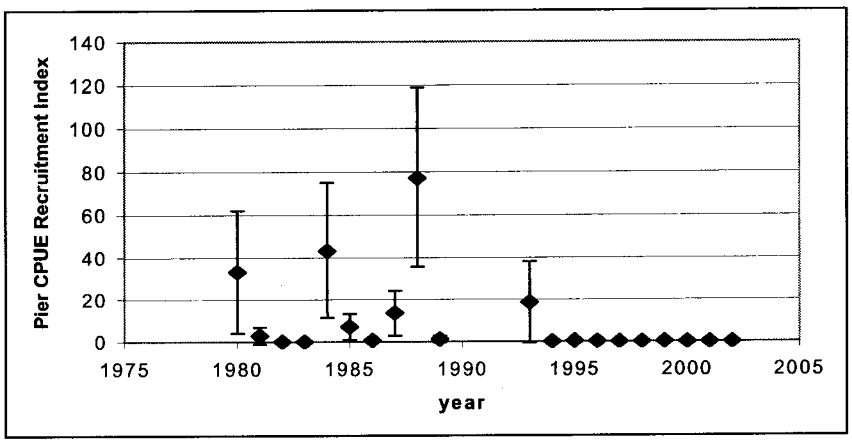


Figure 23. Index of recruitment strength, based on GLM of catch rate of bocaccio from piers. Error bars are ±1SE.

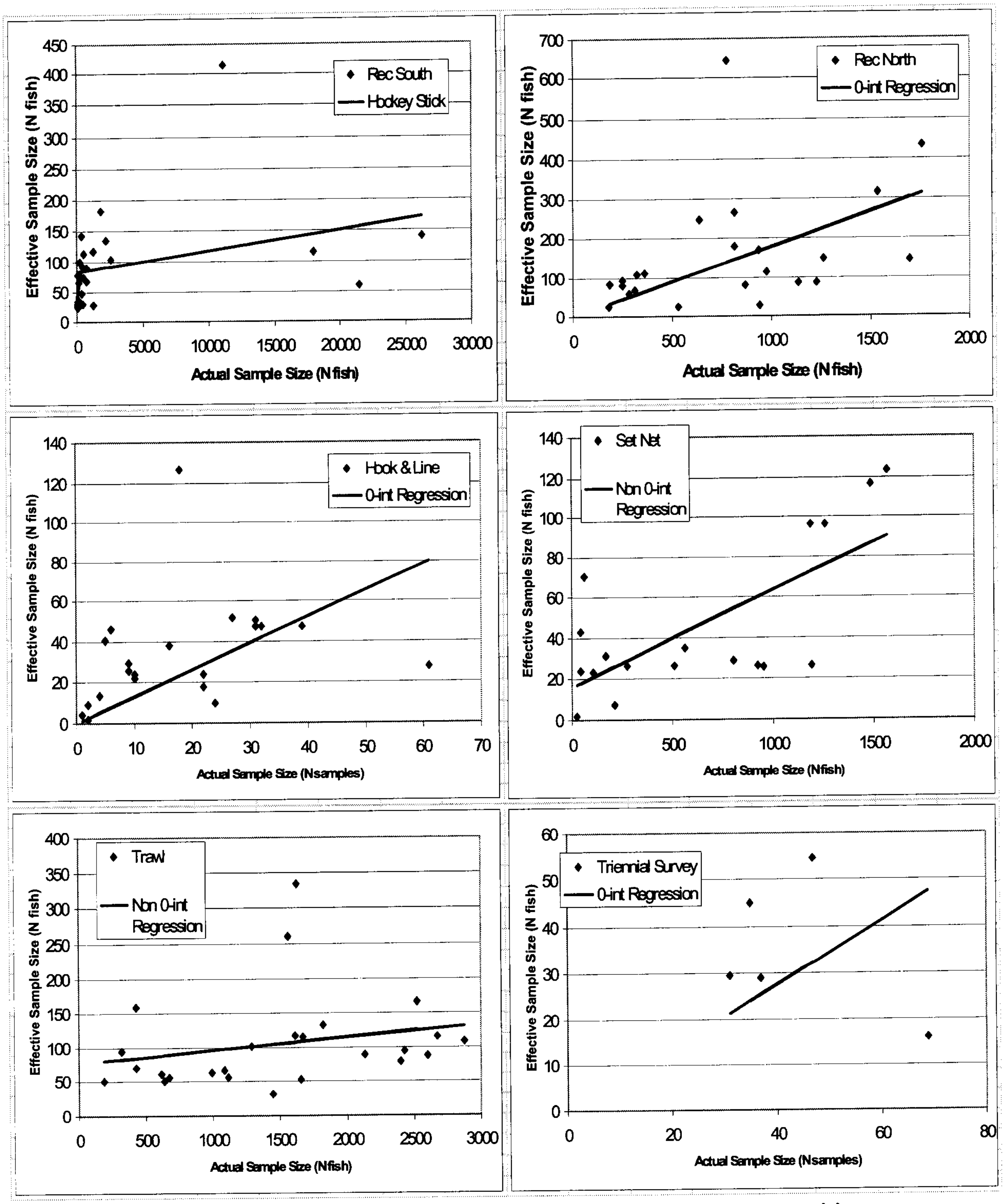


Figure 24. Regression calculations of effective sample sizes for length compositions.

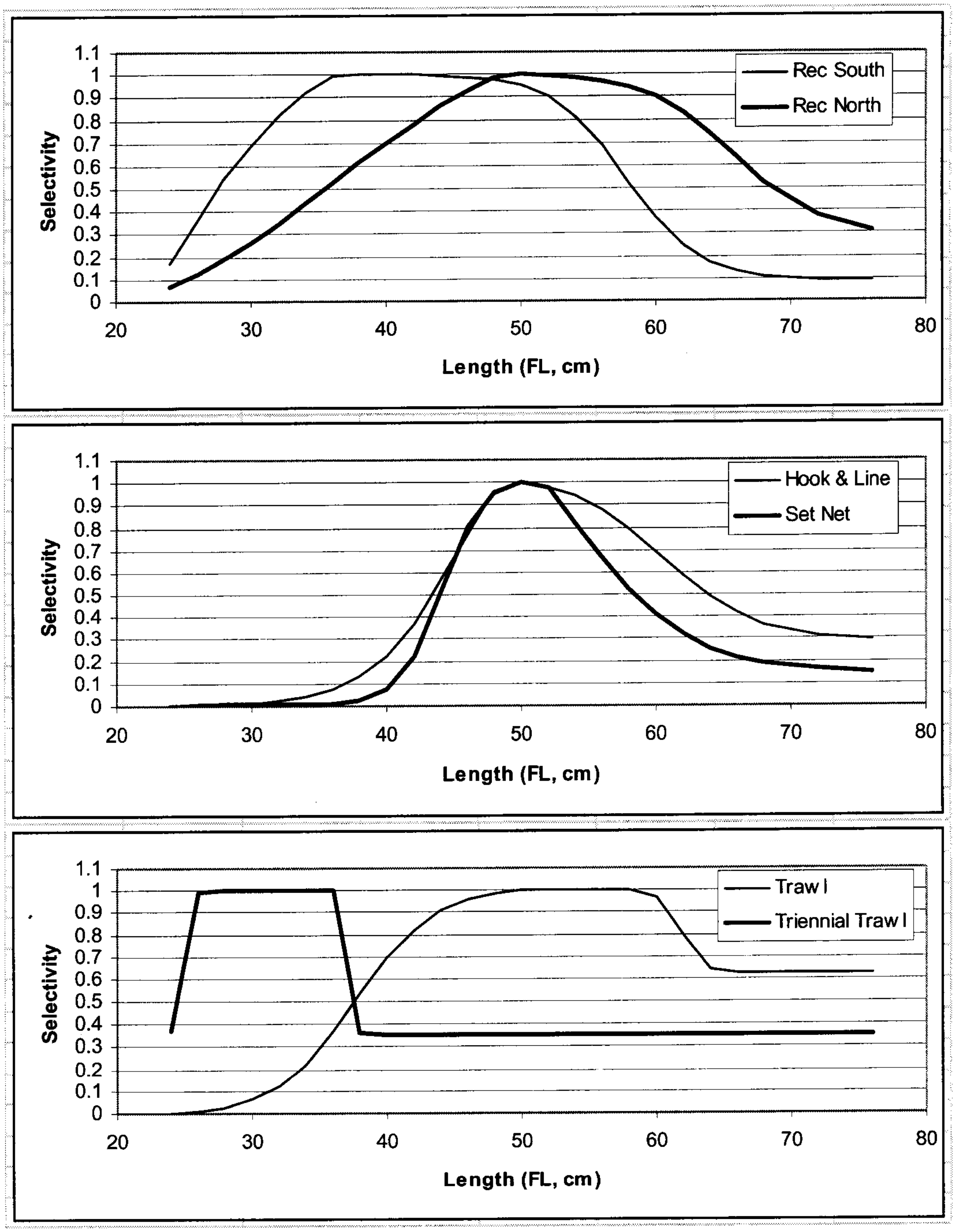


Figure 25. Selectivity curves estimated by the STATc model.

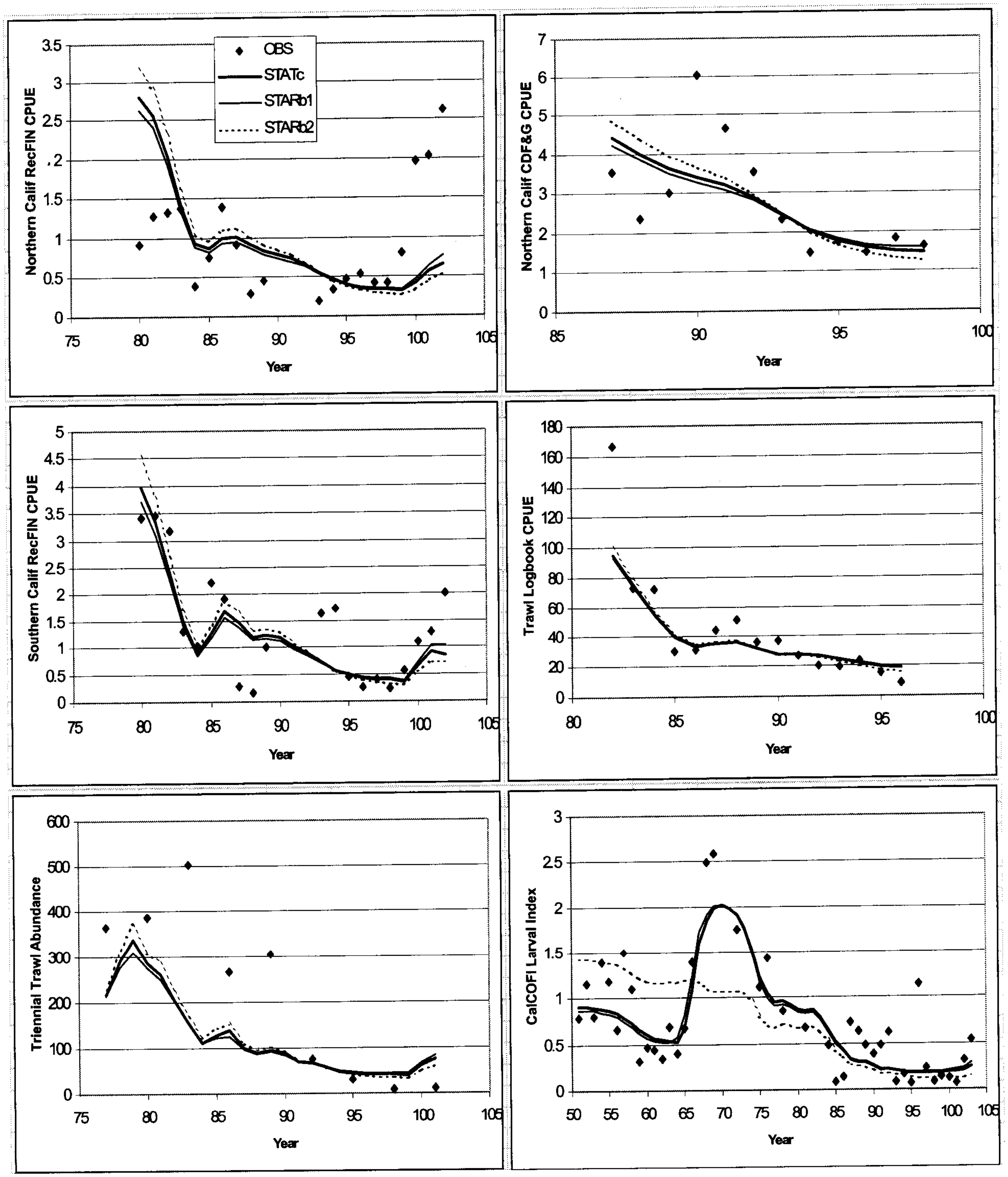


Figure 26. Model fits to abundance indexes.

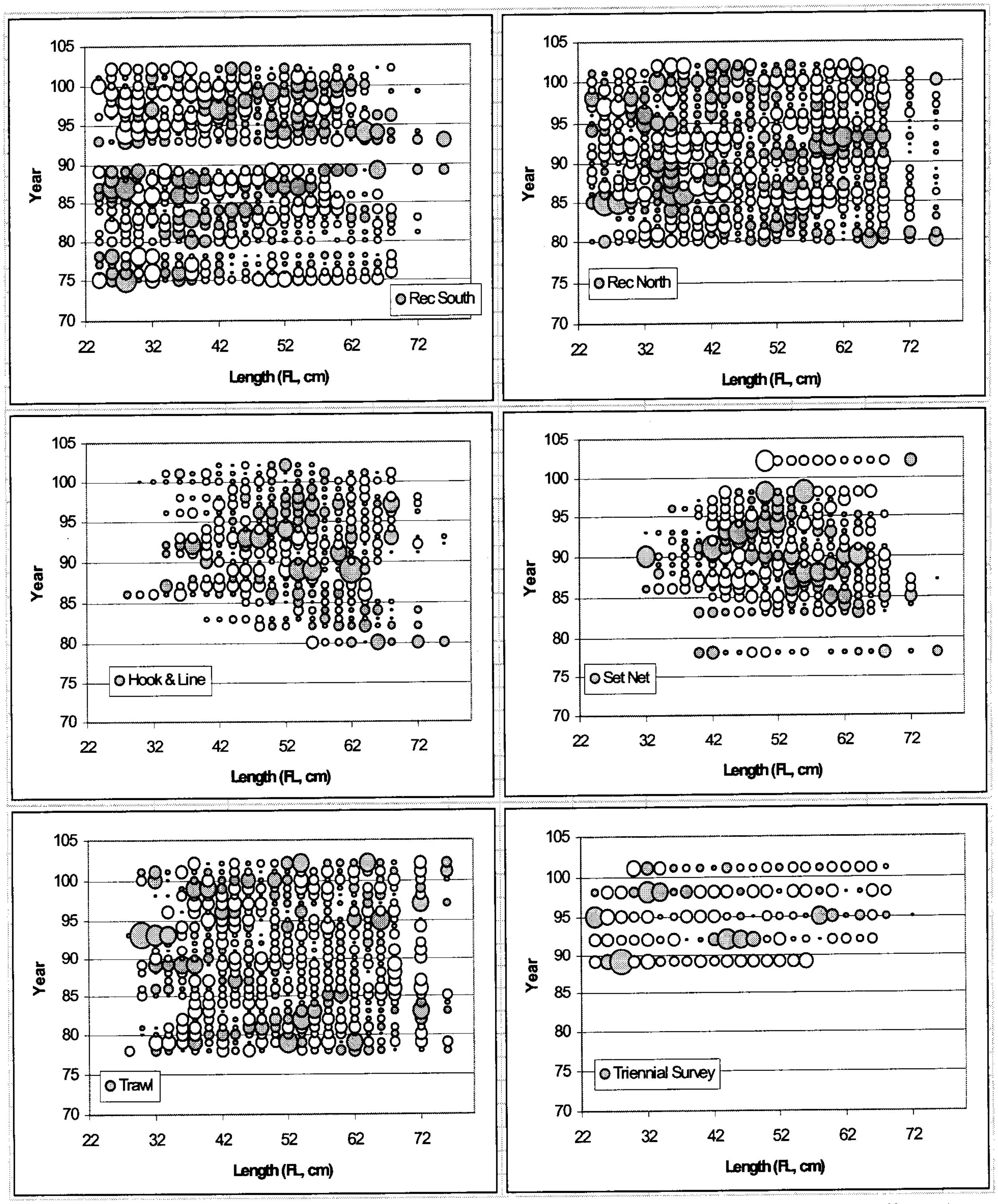


Figure 27. Goodness of fit to length compositions, represented as standardized anomalies. Area of circle is proportional to size of anomaly, colored circles are positive, white circles are negative.

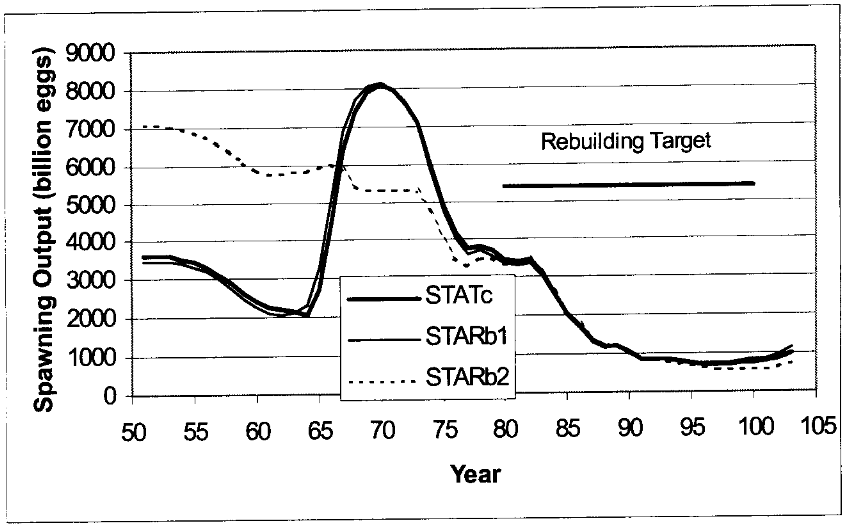


Figure 28. Historical values of spawning output estimated by the three bocaccio models. Rebuilding target is shown for STATc, but others are nearly indistinguishable.

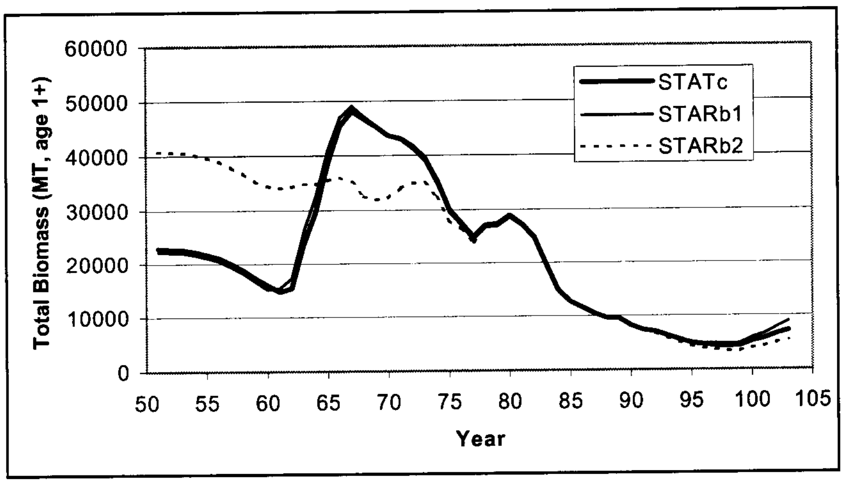


Figure 29. Historical values of total biomass (age 1+) from the three bocaccio models.

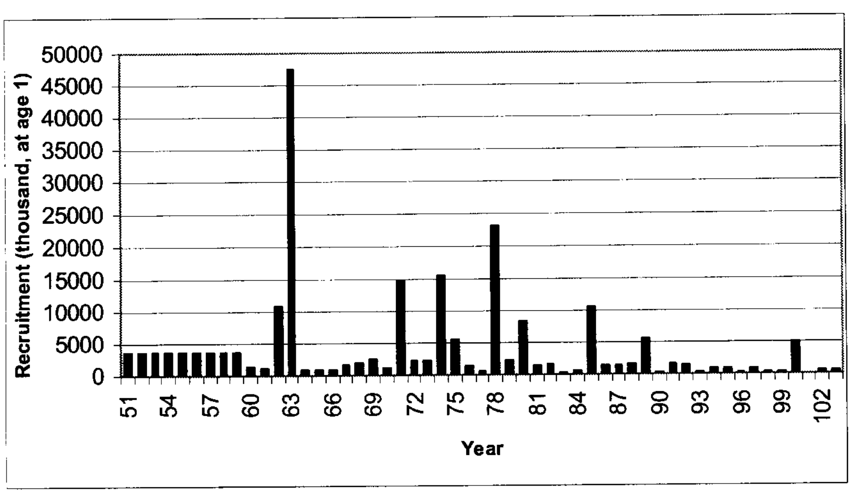


Figure 30. Historical values of recruitment (at age 1) from the STATc model.

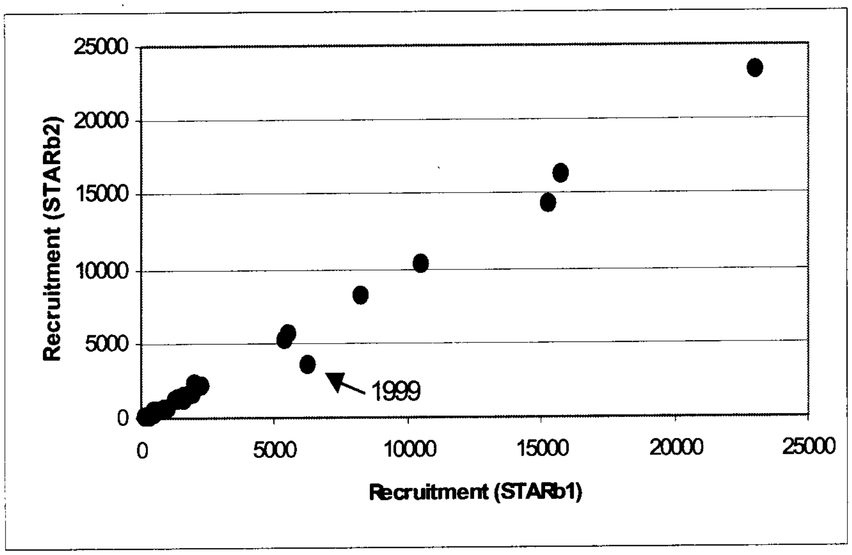


Figure 31. Comparison of recruitments estimated by STARb1 and STARb2 for the years 1971-2000.

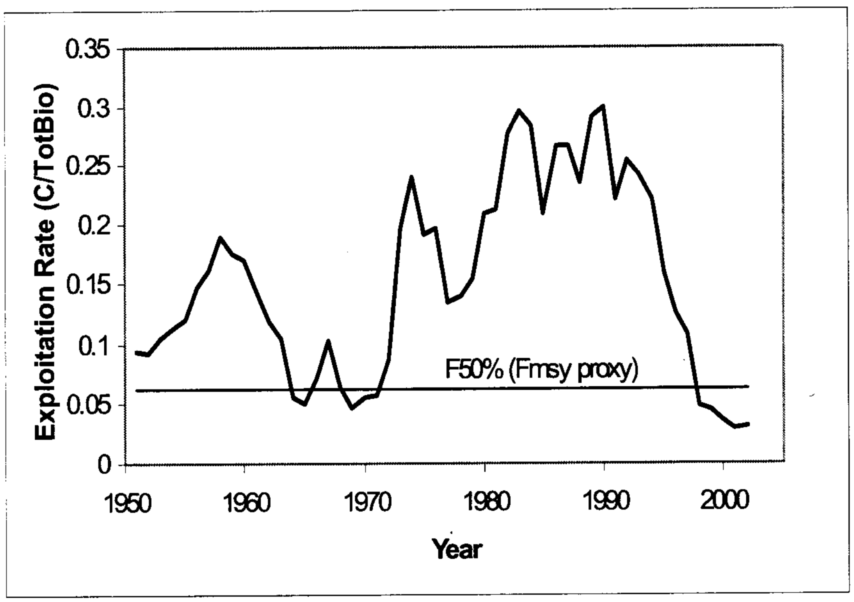


Figure 32. Historical bocaccio exploitation rates (catch/total biomass) relative to the Fmsy proxy of 50% SPR.

Exhibit B.3
Attachment 8
June 2003

Bocaccio Rebuilding Analysis for 2003 (Draft 2, May 2003)

Alec D. MacCall
NMFS Santa Cruz Laboratory
110 Shaffer Rd.
Santa Cruz, CA 95060
email: Alec.MacCall@noaa.gov

Introduction

In 1998, the PFMC adopted Amendment 11 of the Groundfish Management Plan, which established a minimum stock size threshold of 25% of unfished biomass. Based on the stock assessment by Ralston et al. (1996), bocaccio was declared formally to be overfished, thereby requiring development of a rebuilding plan for consideration by the Council in the fall of 1999. Rebuilding was initiated by catch restrictions beginning in 2000. A new stock assessment (MacCall et al. 1999) found that under weak recruitment, the index of bocaccio spawning output was about half the the estimate made in 1996, but at that time preliminary indications of a strong 1999 year class allowed some optimism. Under the assumption that the 1999 yearclass was similar in size to the 1984 yearclass (the "Medium 1999 Year Class" scenario in MacCall 1999), the rebuilding OY for the bocaccio fishery was set at 100mt for 2000-2002.

A bocaccio assessment conducted in 2002 (MacCall 2002a) indicated that the 1999 year class was weaker than had been assumed, and was at or below the low end of the range considered in the 1999 analyses. The low estimated abundance was partially due to the effect of a very low 2001 abundance index from the Triennial Trawl Survey. A rebuilding analysis (MacCall and He 2002a, using SSC Rebuilding Analysis V2.1) indicated that the stock could not be rebuilt with 50% probability within the time limit specified by the National Standard Guidelines. This was due to a combination of very little average surplus production and the "deficit" imposed by the catches that had been taken in 2000-2002. The 2003 fishery management approach was to keep the mortality rate as low as possible (catch not to exceed 20mt) while providing limited opportunities to fish in times and areas that had low likelihood of impacting bocaccio. A "sustainability analysis" indicated that this rate of fishing would have a low probability of driving abundance to such a low level that Endangered Species Act listing would be warranted (MacCall and He 2002b).

Knowing that the 2002 fishery would provide the first reliable information on the strength of the important 1999 yearclass, the stock assessment author agreed with the Pacific Fishery Management Council that a re-assessment in 2003 would be worthwhile. This re-assessment would also provide an opportunity to address a number of technical issues (such as the assumed natural mortality rate of bocaccio) that could not be considered in 2002 because of scheduling constraints.

The re-assessment (MacCall 2003) included new CPUE and length composition information from recreational fisheries in 2002, and CalCOFI larval abundances up to early 2003, all of which indicated an increase in abundance. The assumed natural mortality rate was reduced to 0.15 which is more consistent with information on longevity of bocaccio. The assessment indicated a strong 1999 yearclass, and a clear increase in abundance since 1999. This rebuilding analysis is primarily based on the STATc model described in MacCall (2003).

Management Reference Points

$B_{unfished}$. Unfished biomass is estimated by multiplying average recruitment (R) by the spawning output per recruit achieved when the fishing mortality rate is zero ($SPR_{F=0}$ = 2.499, spawning output in billion eggs, recruitment in thousand fish at age 1). The estimated unfished spawning output (S) is 13387 billion eggs, based on the average recruitment from spawning years between 1950 and 1985. This time period was chosen as representing a presumably "natural" range of stock abundance. Because recruitment is highly variable, this calculation of unfished abundance is imprecise (CV ≥ 10%, variability is underestimated because estimated recruitment in the first ten years is held constant).

B_{msy}. The rebuilding target is the spawning abundance level that produces MSY. This value cannot be determined directly for bocaccio, so this analysis uses the proxy value of 40% of estimated unfished spawning abundance. Estimated B_{msy} is 5355 billion eggs.

Current status: Current (2003) spawning output is 984 billion eggs, which is 7.4% of the estimated unfished abundance, and 18% of estimated $\mathbf{B_{msy}}$. Historical abundance relative to the rebuilding target is shown in Figure 1.

Mean generation time. Mean generation time of bocaccio is estimated from the net maternity function, and is 14 years. This value reflects the lower natural mortality rate assumed in 2003.

Simulation Model

The rebuilding model (SSC Rebuilding Analysis software V2.6) simulates population abundance for 500 years, and 2000 replicate simulations were used in this analysis. The model tracks male and female abundances at age, with an accumulator at age 21+. Values of weights at age, composite selectivity and fecundity are taken from MacCall (2003), and are given in the input data for the rebuilding model (Appendix 1). Population simulations begin with the 2002 age composition. Subsequent recruitments (R) are generated by a random draw of one of the historical values of R/S (from spawning years1970 to 2000, during which recruitment was relatively well estimated), which is multiplied by current spawning output (S) to obtain the following year's recruitment at age 1. Resampling R/S is supported by the nearly constant pattern of historical R/S values (Figure 2), whereas the strong historical decline in recruitment strengths argues against resampling recruitments directly (Figure 3). Values of R/S are also unrelated to S (Figure 4), indicating no value in use of the stock-recruitment relationship as the basis for simulated recruitments.

Rebuilding is assumed to have begun in 2000, the first year in which catches are set to zero for calculation of $\mathbf{T}_{min}$, the length of time it would take to rebuild in the absence of fishing. The distribution of simulated $\mathbf{T}_{min}$ ranges from about 10 to 40 years (Figure 5). The median (50% probability) rebuilding time is 18 yr. The maximum allowable length of time to rebuild ($\mathbf{T}_{max}$) is this value plus one generation time (14 yr), or 32 yr from the first year of rebuilding, which is 2032. The maximum allowable fishing mortality rate is that which would allow the stock to achieve the target abundance in calendar year 2032, with a probability of 50%. This fishing rate is 0.0709 (peak F), and the associated maximum rebuilding catch is 423mt in 2004. Options with higher probabilities of success and/or earlier rebuilding times are usually adopted by the PFMC, and are given in Table 1.

Simulated individual rebuilding trajectories are erratic (Figure 6). The time series of percentiles of simulated trajectories (Figure 7) is more informative. Note that the fishing rate is reset to $\mathbf{F}_{msy}$ upon rebuilding.

Consideration of Alternative STAR Models

The STATc model that serves as the basis of this rebuilding analysis is intermediate between two models (STARb1 and STARb2) developed by the STAR Panel for the purposes of bracketing the uncertainty in the bocaccio assessment. Model STARb1 omits data from the Triennial Surveys, and holds estimated recruitment constant to 1959, whereas model STARb2 omits the recreational CPUE data and holds estimated recruitment constant to 1969. Model STATc omits neither data source, holds estimated recruitment constant to 1959, and places a low emphasis on the stock-recruitment relationship to stabilize estimates of recent (post-1999) recruitment. Comparative results for the two alternative STAR models are shown in Table 2.

Decision Analysis

The three models (STARb1, STARb2 and STATc) correspond to alternative "true" states of nature, and management is faced with establishing a harvest policy. Table 3 is a decision table that considers four alternative 70% probability constant mortality rate harvest policies: three corresponding to the respective models, and a fourth policy proposed by the GMT that sets 2004 catch equal to the average of the STARb1 and STARb2 values. Table 4 shows the approximate level of fishing effort (scaled relative to 2002) that would be necessary to achieve constant harvest rate policies corresponding to 2004 catches of 200 through 500 Mtons. The effort level changes because selectivity varies as fish from strong year classes grow in length.

Analysis of Sustainability

The 2002 rebuilding analysis was based on a very low productivity scenario, and management was constrained by the risk of driving the stock to very low abundances. This risk was addressed by a "sustainability analysis" that estimated fishing rates which would associated with no further decline in abundance. This analysis indicates that a fishing rate of 0.17 (2004 catch of 959mt) would have a 50% chance of no further decline, and a fishing rate of 0.15 (2004 catch of 864mt) would have an 80% probability of no further decline. The fishing rates given by this rebuilding analysis are less than half these sustainable rates, and the probability of further decline is negligibly small.

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Table 1. Results of bocaccio rebuilding analysis (model STATc).

Fishing rate	0.0721	0.0615	0.0498	0.0383	0
OY	439.1	376.5	306.3	236.5	0
Prob to rebuild by Tmax	50	60	70	80	96.5
Median time to rebuild	28	25.1	22.7	20.4	15.5
Prob overfished after rebuild	0	0	0	0	0
Median time to rebuild (yrs)	28	25.1	22.7	20.4	15.5

Table 2. Sensitivity analysis: alternative STAR Panel models.

STARb1					
Fishing rate	0.1014	0.0914	0.0801	0.067	0
OY	784.1	709.8	624.8	525.6	0
Prob to rebuild by Tmax	50	60	70	81	99.9
Median time to rebuild	25	22.5	20.1	18.1	11.6
Prob overfished after rebuild	0	0	0	0	0
Median time to rebuild (yrs)	25	22.5	20.1	18.1	11.6

STARb2					
Fishing rate	0.0729	0.0643	0.0541	0.043	0
OY	333.5	295.2	249.6	199.2	0
Prob to rebuild by Tmax	50	60	70	80	97.6
Median time to rebuild	30	27.4	25.2	23.1	17.2
Prob overfished after rebuild	0	0	0	0	0
Median time to rebuild (yrs)	30	27.4	25.2	23.1	17.2

Table 3. Decision table treating three alternative models as true states of nature. Four management decisions are given, corresponding to the correct decision under the three models, and a fourth decision based on average catch from the STARb1 and STARb2 models. Values in bold indicate the correct decision for the associated model if it is true.

	True Model (State of Nature)		
	STARb1	STATc	STARb2
Management Decision:			
STARb1			
C2004	**624.8**	624.7	624.8
F	**0.0801**	0.1039	0.1403
medianTreb(years)	**20.1**	41.6	81.1
Prob Rebuild by Tmax	**70%**	19%	3%
STATc			
C2004	307.2	**306.3**	307
F	0.0387	**0.0498**	0.0669
medianTreb(years)	14.7	**22.7**	28.1
Prob Rebuild by Tmax	94%	**70%**	58%
STARb2			
C2004	250	248.8	**249.6**
F	0.0314	0.0403	**0.0541**
medianTreb(years)	13.9	20.7	**25.2**
Prob Rebuild by Tmax	96%	79%	**70%**
GMT: avg(b1,b2)			
C2004	438.3	436.9	438
F	0.0556	0.0717	0.0966
medianTreb(years)	16.5	27.9	25.5
Prob Rebuild by Tmax	88%	50%	39%

Table 4. Future catches and levels of fishing effort relative to 2002 for alternative constant harvest rates beginning in 2004 (based on STATc model).

C2004(MT)	200	300	400	500	200	300	400	500
F	0.035	0.055	0.0774	0.103*	0.035	0.055	0.0774	0.103*
Year	Catch				Effort rel to 2002 level			
2004	200	300	400	501	84%	131%	182%	240%
2005	199	294	386	475	80%	125%	174%	229%
2006	192	280	363	439	76%	118%	164%	216%
2007	185	267	342	409	72%	112%	156%	206%
2008	182	260	329	389	69%	108%	152%	200%
2009	183	258	324	377	68%	107%	150%	198%
2010	186	260	322	370	68%	107%	150%	198%

* Fmsy

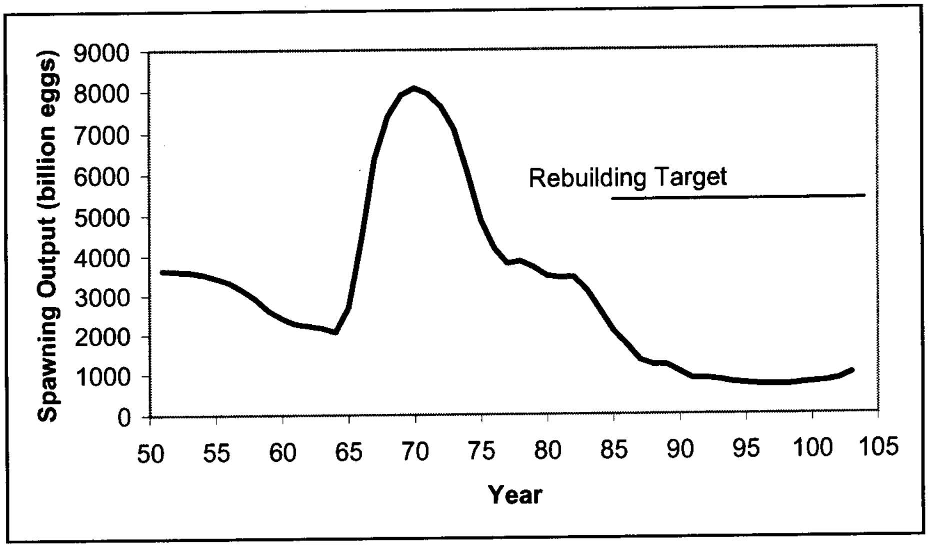


Figure 1. Historical bocaccio abundance (measured as spawning output). Rebuilding target is 40% of estimated unfished abundance.

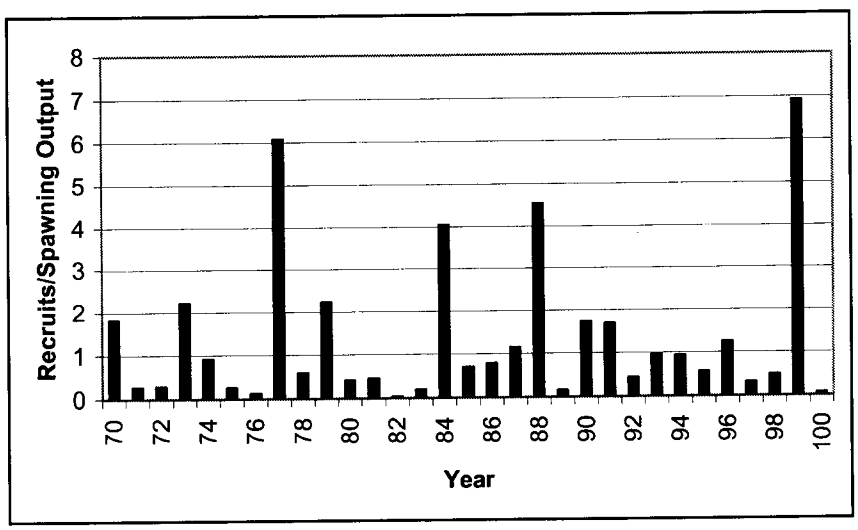


Figure 2. History of estimated bocaccio reproductive successes, plotted by birth year.

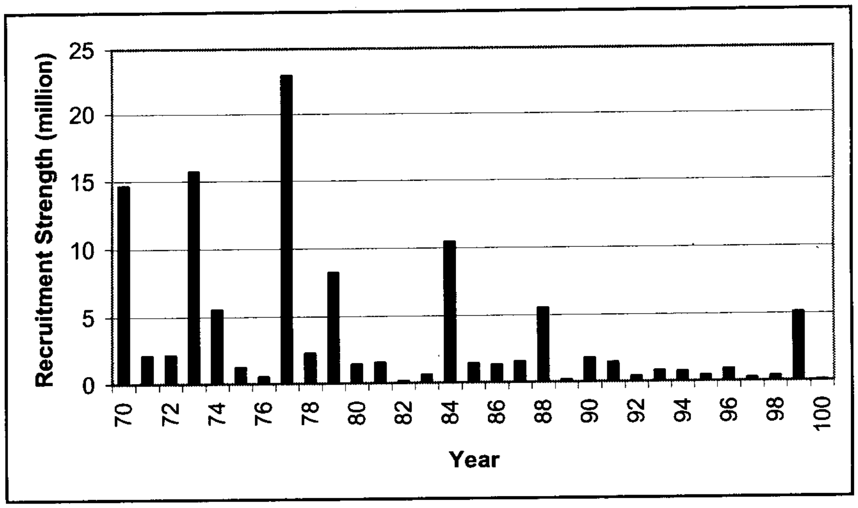


Figure 3. History of estimated bocaccio recruitments, plotted by birth year.

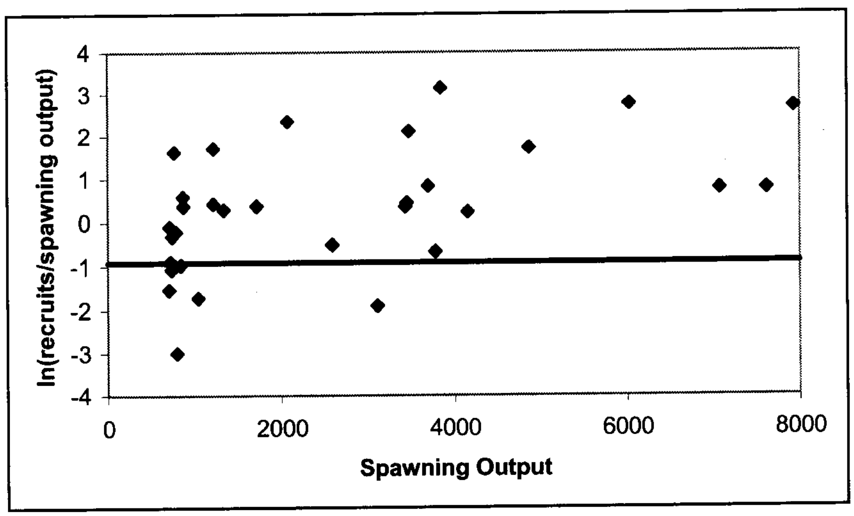


Figure 4. Relationship of log spawning success to parental abundance. Horizontal line is replacement level at F=0.

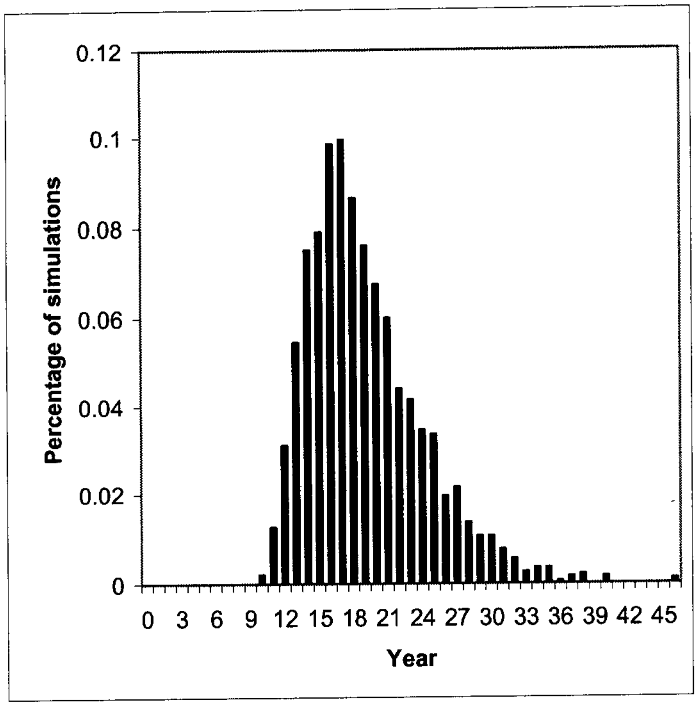


Figure 5. Distribution of simulated rebuilding times in the absence of fishing.

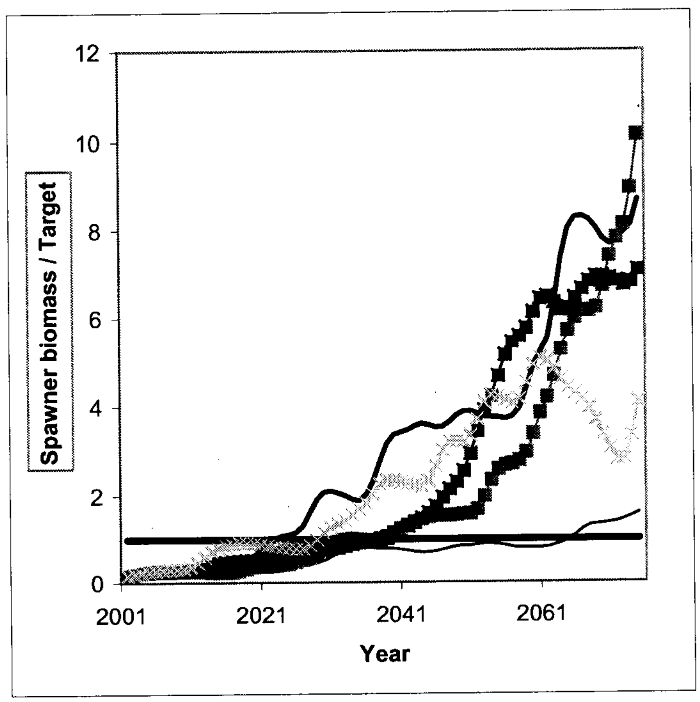


Figure 6. Example individual rebuilding trajectories.

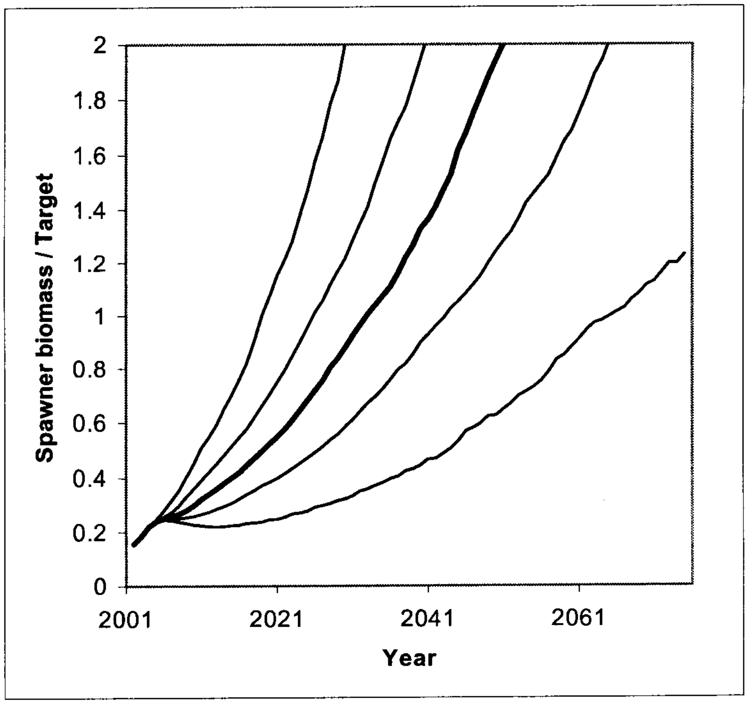


Figure 7. Envelope of bocaccio rebuilding trajectories, based on STATc model (lines are 5, 25, **50**, 75 and 95 percentiles of simulations).

Appendix 1. Input file for SSC Rebuilding Analysis based on STSTc assessment model.

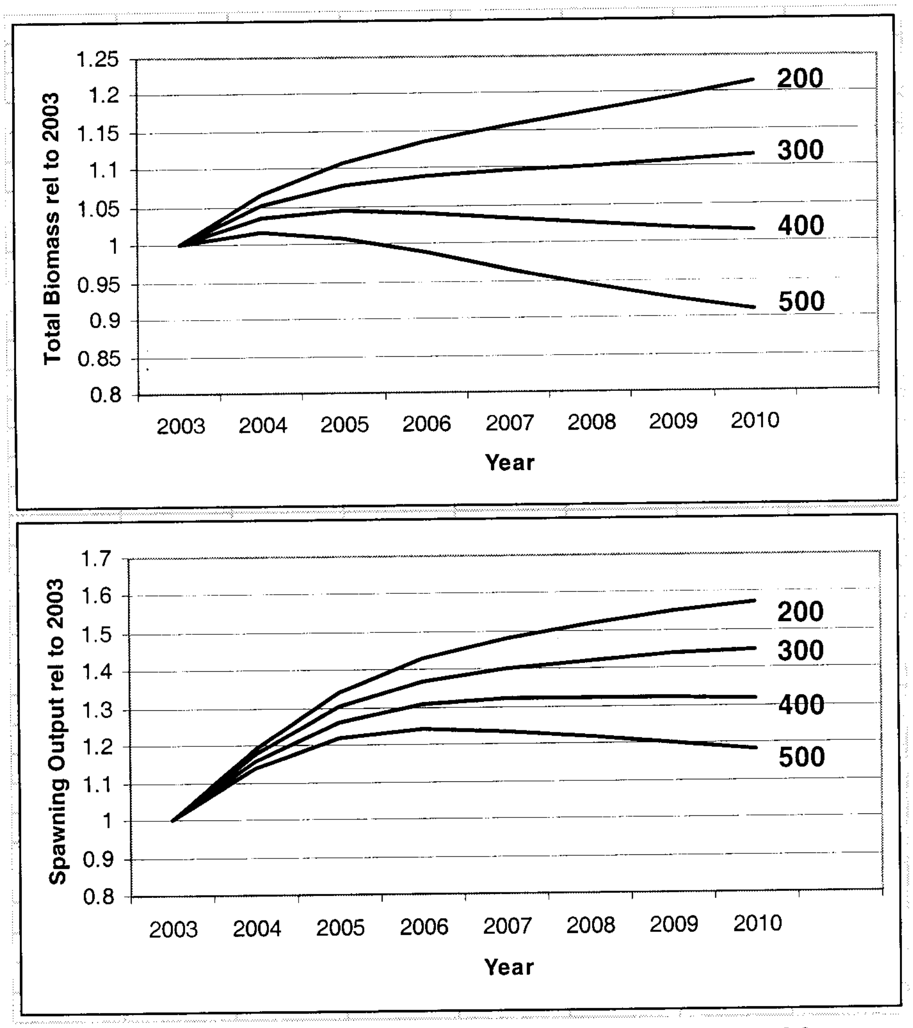
```
# Title
bocaccio 2003 model POSTSTAR.P03 (STATC) resample to 2001
# Number of sexes
2
# Age range to consider (minimum age; maximum age)
1 21
# Number of fleets to consider
1
# First year of the projection
2002
# Year declared overfished
2000
# Is the maximum age a plus-group (1=Yes;2=No)
1
# Generate future recruitments using historical recruitments (1), historical recruits/spawner (2), or a stock-recruitment (3)
2
# Constant fishing mortality (1) or constant Catch (2) projections
1
# Pre-specify the year of recovery (or -1) to ignore
-1
# Fecundity-at-age
# 1 2 3 4 5 6 7 8 9... 21+
0.000   0.002   0.026   0.131   0.325   0.547   0.762   0.965   1.160   1.345   1.513   1.659   1.781
        1.882   1.965   2.032   2.086   2.129   2.163   2.191   2.265
# Age specific information (Females then males) weight and selectivit
# Females
0.223   0.499   0.878   1.313   1.771   2.227   2.663   3.071   3.446   3.783   4.074   4.319   4.522
        4.690   4.828   4.939   5.028   5.100   5.157   5.203   5.328
0.166   0.501   0.792   0.965   0.987   0.903   0.775   0.647   0.545   0.477   0.436   0.411   0.396
        0.386   0.379   0.373   0.369   0.366   0.364   0.362   0.357
# Males
0.223   0.463   0.770   1.101   1.430   1.742   2.025   2.276   2.495   2.681   2.839   2.972   3.082
        3.174   3.250   3.313   3.365   3.408   3.442   3.471   3.560
0.167   0.466   0.725   0.906   0.995   1.000   0.958   0.898   0.833   0.772   0.717   0.671   0.633
        0.602   0.578   0.559   0.545   0.533   0.524   0.517   0.501
# Age specific information (Females then males), natural mortality and numbers at age
# Females
0.15    0.15    0.15    0.15    0.15    0.15    0.15    0.15    0.15    0.15    0.15    0.15    0.15
        0.15    0.15    0.15    0.15    0.15    0.15    0.15    0.15
259     21      1819    101     52      176     64      87      72      24      62      50      3
        60      11      6       4       21      1       0       17
# Males
0.15    0.15    0.15    0.15    0.15    0.15    0.15    0.15    0.15    0.15    0.15    0.15    0.15
        0.15    0.15    0.15    0.15    0.15    0.15    0.15    0.15
259     21      1822    101     52      178     64      88      72      24      62      49      3
        54      9       4       3       12      0       0       5
# Initial age-structure (for Tmin)
2535    145     77      263     95      128     104     34      88      70      4       85      15
        8       6       29      1       0       1       1       22
2535    145     77      265     96      132     108     36      91      72      4       78      12
        6       4       17      1       0       0       0       6
# Year for Tmin Age-structure
2000
# Number of simulations
2000
# Recruitment and Spanwer biomasses
```

Number of historical assessment years
52
Historical data: Year, Recruitment, Spawner biomass, Used to compute B0, Used to project based
on R, Used to project based on R/S

1951	3523	3630	1	0	0
1952	3523	3611	1	0	0
1953	3523	3597	1	0	0
1954	3523	3536	1	0	0
1955	3523	3446	1	0	0
1956	3523	3335	1	0	0
1957	3523	3138	1	0	0
1958	3523	2909	1	0	0
1959	3523	2617	1	0	0
1960	1259	2413	1	0	0
1961	1135	2273	1	0	0
1962	10756	2217	1	0	0
1963	47503	2165	1	0	0
1964	785	2066	1	0	0
1965	711	2690	1	0	0
1966	898	4404	1	0	0
1967	1574	6368	1	0	0
1968	2059	7382	1	0	0
1969	2432	7892	1	0	0
1970	1161	8073	1	0	1
1971	14610	7928	1	0	1
1972	2134	7617	1	0	1
1973	2143	7073	1	0	1
1974	15665	6026	1	0	1
1975	5527	4864	1	0	1
1976	1252	4153	1	0	1
1977	507	3780	1	0	1
1978	22964	3845	1	0	1
1979	2278	3696	1	0	1
1980	8213	3477	1	0	1
1981	1423	3433	1	0	1
1982	1549	3449	1	0	1
1983	149	3109	1	0	1
1984	597	2587	1	0	1
1985	10436	2074	1	0	1
1986	1450	1718	1	0	1
1987	1333	1337	0	0	1
1988	1529	1216	0	0	1
1989	5501	1217	0	0	1
1990	179	1040	0	0	1
1991	1799	866	0	0	1
1992	1455	870	0	0	1
1993	380	838	0	0	1
1994	804	780	0	0	1
1995	728	738	0	0	1
1996	408	721	0	0	1
1997	901	711	0	0	1
1998	216	704	0	0	1
1999	342	734	0	0	1
2000	5071	764	0	0	1
2001	50	790	0	0	1
2002	517	843	0	0	0

Number of years with pre-specified catches
2

```
# Catches for years with pre-specified catches
2002 200
2003 100
# Number of future recruitments to override
1
# Process for overiding (-1 for average otherwise index in data list)
2003	0	0
# Which probability to product detailed results for (1=0.5,2=0.6,etc.)
1
# Steepness and sigma-R  and auto-correlations
 0.39  1.000000 0.0
# Target SPR rate (FMSY Proxy)
0.500000
# Target SPR information: Use (1=Yes) and power
0 20
# Discount rate (for cumulative catch)
0.100000
# Truncate the series when 0.4B0 is reached (1=Yes)
0
# Set F to FMSY once 0.4B0 is reached (1=Yes; 2=Apply 40:10 rule after recovery)
2
# Percentage of FMSY which defines Ftarget
0.900000
# Maximum possible F for projection (-1 to set to FMSY)
2
# Conduct MacCall transition policy (1=Yes)
0
# Defintion of recovery (1=now only;2=now or before)
2
# Results for rec probs by Tmax (1) or 0.5 prob for various Ttargets
1
# Produce the risk-reward plots (1=Yes)
0
# Calculate coefficients of variation (1=Yes)
0
# Number of replicates to use
20
# First Random number seed
-89102
# Conduct projections for multiple starting values (0=No;else yes)
0
# File with multiple parameter vectors
MCMC.PRJ
# Number of parameter vectors
100
# User-specific projection (1=Yes); Output replaced (1->6)
0 5
# Catches and Fs (Year; 1/2 (F or C); value); Final row is -1
2004 2 20.0
-1 -1 -1
# Split of Fs
2002 1
-1 1
# Proportion of target B0
0.400000
```



Bocaccio Supplemental Figure: STATc model projections of future total biomass and spawning output relative to 2003 for alternative constant harvesting rates, expressed as 2004 catch in MT. Future recruitment is assumed to be average R/S from stock-recruit curve. The increase in spawning output is mainly due to maturation of the 1999 year class.

BOCACCIO

STAR Panel Report
Southwest Fisheries Science Center
Santa Cruz, California
April 20-25, 2003

STAR Panel Members

Thomas Helser, NMFS Northwest Fisheries Science Center, STAR Chair
Farron Wallace, Washington Department of Fish and Wildlife
Martin Dorn, NMFS Alaska Fisheries Science Center, SSC Representative, Rapporteur
David Sampson, Oregon State University
Patrick Cordue, Center for Independent Experts, University of Miami
Peter Leipzig, Fisherman's Marketing Association, GAP Representative
David Thomas, California Department of Fish and Game, GMT Representative

STAT Team Members Present:

Alec MacCall, NMFS Southwest Fisheries Science Center

Overview

The STAR Panel met to review the 2003 draft bocaccio assessment during the week of April 21-25, 2003, at the Santa Cruz Laboratory of the Southwest Fisheries Science Center. The STAT team (Alec MacCall sole constituent) presented the draft assessment, and assisted the review by conducting analyses and doing additional model runs. The draft prepared for the STAR Panel meeting had many changes from the 2002 bocaccio assessment. These changes included; a lower assumed natural mortality coefficient (reduced from 0.2 to 0.1 per year), recalculated recreational fishery CPUE indices with new data selection criteria, new GLM models for CPUE in numbers rather than weights, and a correction in 2000-2002 to account for the two fish bag limit in 2002 and avoidance of bocaccio in 2000-2001. A new maturity at length relationship was also proposed. Catch in 2000-2002 was adjusted using observer estimates of discard. Length-frequency data sets were adjusted to reflect middle-of-year size as required by the Synthesis model, and the lower two size bins were truncated (<24 cm). Finally, this assessment departed from the catch histories in the 2002 assessment, such that catch histories were used as reported by Ralston et al. (1996) with the addition of the foreign catches of bocaccio from Rogers (2002).

Effects of these changes from the 2002 model on the new model results were not systematically evaluated in the draft document. Accordingly, a major effort of the Panel was to establish an "audit trail" between the model configuration and data in the 2002 assessment and a base run model in the current assessment. Due to the fact that the Stock Synthesis model required approximately 3 hours to converge, time during the meeting was insufficient for the STAT team to step through the four models the Panel deemed necessary to produce such an audit trail. However, after reviewing intermediate model runs with essentially the same data as in the 2002 assessment but with newly modified CPUE indices for the period covered in the 2002 assessment, the Panel was satisfied that the data and methods employed in the updated assessment were relatively consistent. Additionally, the Panel also dedicated major effort to evaluating the new data and different methods (Delta-GLM) used to standardized the fishery-dependent CPUE indices used to track stock abundance.

The bocaccio assessment is complex, reflecting the complexity of the fishery and the diversity of data sources. Notwithstanding the quantity of data used in the assessment, the Panel considered the assessment results to be highly uncertain. While it is clear there has been a significant decline in bocaccio abundance in the past few decades, the estimates of unfished stock abundance as well as the estimates of recent stock depletion are problematic. The lack of reliable fishery-independent indices of stock abundance is a severe limitation for the bocaccio assessment, but this is true for virtually every other West Coast rockfish assessment. While the goal of the stock assessment is to arrive at a risk neutral estimate of stock abundance and trend, extensive use of indices whose properties are not well understood makes it impossible to come to any objective conclusion whether this goal has been attained. Despite these limitations, the Panel concluded that the bocaccio assessment represents the best available scientific information on stock abundance trends and current stock depletion. However, because of insufficient data prior to 1969 to resolve year-class magnitudes, the Panel recommends against using in rebuilding analyses the Stock Synthesis estimates of steepness or recruitment strength prior to 1970.

Fisheries-independent time series evaluated in the assessment include recruitment indices (midwater trawl, power plant impingement, and recreational pier CPUE) and stock biomass indices (CALCOFI larval index of spawning stock biomass, and NMFS triennial survey). Fisheries-dependent time series include CPUE indices from RecFIN for northern and southern California, CDF&G partyboat CPUE, and commercial trawl CPUE from California logbooks. Length composition data are available for commercial and recreational fisheries and the NMFS triennial survey. The strengths and weaknesses of these data sets are discussed in later sections of the report.

Analyses Requested by the STAR Panel:

1) Compare length composition by year for the Northern California RECFIN and CDFG length composition data.

These data sets were combined in the initial model runs. The Panel was concerned that there might be systematic differences between these data sets. There was apparent contamination of RecFIN length data with CDF&G data. This needs to be investigated further, but is likely to have minimal impact on the assessment results.

2) Compare model runs for unadjusted length composition and length composition adjusted to the middle of the year.

This analysis was not performed due to insufficient time during the STAR Panel meeting.

3) Requests for new analyses of methods used to develop selection criteria of bocaccio trips in the RecFIN data base and subsequent standardizing RecFIN CPUE data.

3a) Calculate species coefficients for pre- and post-1990 periods to evaluate the temporal consistency of the pattern of species association.

3b) Calculate CPUE indices using the GLM model for the Southern California RECFIN data using the two sets of coefficients (pre- and post-1990).

The new method relied on the use of species composition information to identify trips that are more highly associated with catches of bocaccio. In the statistical model, a linear combination of species-specific coefficients (effects) predicted the probability of observing bocaccio in the trip's catch, and a "threshold" probability level was chosen as a means to include trips in the subsequent Delta-GLM analysis. Panel members expressed concerns that the RecFIN index generated by applying the new statistical methodology for trip selection and subsequent Delta-GLM standardization may be sensitive to changes in species composition. The Panel noted that depending on the selection criterion used (the estimated probability that the trip would catch bocaccio) CPUE at the very beginning and end of the time series varied, although the trends over the entire time series were largely the same.

4) Report sample sizes for the bag limit correction analysis.

The frequency distribution of bag sizes showed a peak at 10 fish (the previous bag limit) but no attempt was made to adjust for possible effects of this earlier bag limit.

5) Calculate the bag adjustment using the ratio of bags from two to nine to one bags rather than bags two or larger to remove the effect of previous 10 fish bag limit.

A bag limit of two fish for bocaccio was imposed in 2002. A regression of mean bag size against the ratio of bags two or larger to one fish bags was used to obtain a correction for CPUE data in 2000-2002. Although the two fish bag limit was not imposed until 2002, the regression analysis suggested avoidance of bocaccio in 2000 and 2001 (in fact a bag adjustment between 2000-2002 was applied to the RecFIN CPUE data).

The bag limit correction has a large impact on the CPUE index values for 2000-2002 (increasing the raw CPUE index by almost a factor of two). The Panel agreed that if CPUE were accepted as an unbiased abundance index, then some adjustment was required to account for changes in fishing behavior due to the change in regulations. Still, any attempt to correct CPUE indices for avoidance of bocaccio is problematic.

6) Provide the estimated trend for a GLM analysis that uses only presence/absence information.

This index would not be affected by the bag limit instituted in 2002. The prevalence of positive catches showed less of an increase in 2000-2002 relative to the CPUE index produced by the full GLM analysis.

7) The Panel requested further information about the derivation of the new maturity schedule.

A new maturity schedule, proposed in the new draft assessment, showed a decrease in the age at 50% maturity from 5 years of age based on the Wyllie Echeverria (1987) results used in the 2002 assessment to 3 years based on new port sampled data. The STAR Panel, recognizing the potential impact on the new assessment results, requested more information on the data and protocols used to determine the new maturity schedule. The STAR Panel was informed by the STAT team that the previous maturity schedule from Wyllie Echeverria (1987) was consistent with the port sampler maturity data after recalculation of maturity at length using appropriate staging codes.

8) It was requested that figures of recreational CPUE indices include both bag limit adjusted and unadjusted indices.

This was not done at the meeting, but the Panel expects the request to be completed in the final draft stock assessment report.

9) Conduct exploratory GLMs using CalCOFI data with a) line-month interaction, b) line-year interaction. Provide the interaction coefficients, and residual deviance.

The Panel was concerned that if there were significant line-month or line-year interactions, then methods used to calculate year coefficients to track abundance could be biased. However preliminary analysis did not suggest significant interaction terms.

10) Document a stepwise transition between last year's assessment (data and model assumptions) and this year's base model runs. Four runs were requested.

The Panel was greatly concerned that there was no audit trail to document the effect of changes from the 2002 assessment specifications and data on model results. This was important since the draft assessment presented at the meeting contained numerous model and data changes. The STAT team showed results of runs that suggested that there was little effect from moving to the recalculated indices over the time period covered by the 2002 assessment. Changes in stock status can therefore be attributed to new indices not included in the 2002 assessment (particularly the adjustment for bag limits in recent years), not to changes in model structure or assumptions.

11) Two base run models were suggested.

The triennial trawl survey biomass index appears to be contradictory to the RecFIN CPUE indices in recent years. While both indices show a strong decline since the mid-1980s, the RecFIN CPUE index has increased substantially over the last three years but the triennial survey index remains flat. On one hand, fishery dependent CPUE indices can mask real declines in abundance if fishers are able to redirect effort to areas of high density. On the other hand, the triennial trawl survey may be less efficient at low stock abundance because bocaccio preferentially occupy untrawlable habitat (varying q with stock abundance). Because of these concerns, the Panel sought to bracket the uncertainty with two base run models. Both models have the following features in common:

Catch history as in Ralston et al. (1996) with the addition of foreign catches of bocaccio reported in Rogers (2002), and 2000 t annually of historical catch prior to 1950.

Updated length composition data and abundance indices with revised methods for calculation, but remove the recruitment indices. The Panel was concerned the recruitment indices were not sufficiently comprehensive spatially to provide a reliable index of year-class strength.

Maturity schedule as in the 2002 assessment, based on Wyllie Echeverria (1987).

Set the natural mortality coefficient equal to 0.15 (with sensitivity analyses for $M = 0.1$-0.2). The Panel did not consider the rationale presented in the draft assessment for $M=0.1$ to be convincing, and opted instead for the value in Ralston et al. (1996) as a more reasonable choice. There wasn't sufficient time during the STAR Panel meeting to do a thorough sensitivity analysis on natural mortality.

Estimate selectivity patterns as in the 2002 assessment.

Estimate recruitment freely from 1960-2001, but use constant background recruitment in 1950-1959.

Base model 1: RecFIN CPUE indices with bag limit adjustment, but remove the triennial trawl survey (biomass index and length composition data).

Base model 2: Use triennial trawl survey data, but remove the RecFIN CPUE indices. Remove the triennial trawl survey length frequency data from before 1989 because of irregular survey coverage for earlier years.

12) Do an additional pair of model runs to evaluate the influence of estimated recruitments during the early time period (1951-69).

These models were similar to base models 1 and 2 but extended background recruitment to 1969 so that annual recruitment strengths would only be based on years for which length composition data were available. The only major effect of extending the backgound recruitment was on the level of stock depletion estimated for the early years of the modeled period.

13) Do an additional model run with the S/R steepness parameter fixed at 1.0, rather than 0.39.

The Panel was concerned that essentially fixing the steepness parameter at a low value was causing Stock Synthesis to estimate a ridiculously high level for unfished stock biomass. The model run with steepness = 1 still resulted in high stock depletion in the first year (4% of unfished in 1951). Later it was discovered that when "background" recruitment is used for the initial recruitment the Stock Synthesis model ignores the reported unfished level (R. Methot pers. commun. April 28, 2003).

14) Prepare bubble plots of length composition residuals and overlays of predicted and observed length frequency.

A pattern of large positive residuals was observed for the main modes in the series of length frequency data, suggesting that the CVs in the growth model were too large, at least for the younger fish. Variable growth by cohort could be responsible to producing such large CVs. This could be affecting the estimates of recruitment strength and variability.

15) Produce a table showing average recruitment, B_0, Spawning biomass per recruit at F=0, stock depletion in 1951 and 2003 for the initial base runs and with modifications for extended background recruitment.

The STAT team produced a table with the following results:

Model	R 1951-1986	SPR(F=0)	B_0	B_{2003}/B_0	B_{1951}/B_0
B1-base	5364	2.500	13412	8.5%	26%
B1-constant recr. to 1969	4729	2.787	13180	10.0%	59%
B2-base	5269	2.648	13952	3.9%	22%
B2-constant recr. to 1969	5230	2.498	13063	5.6 %	54%

Estimates of average recruitment were similar for all models runs, and estimates of unfished spawning output (B0) obtained by multiplying SPR (F=0) by average recruitment during 1951-1986 were more plausible than the estimates of B0 from the Stock Synthesis model. (Note: it was determined after the meeting that when Synthesis is configured to use background recruitment in the initial age composition, as had been done in the bocaccio model, the parameter value for virgin recruitment must be manually set equal to the background recruitment for Stock Synthesis to calculate a value of B0 consistent with the background level of recruitment.). Base runs showed higher initial depletion than the new runs, implying that the base model required a higher initial depletion in order to match the large increase in the CalCOFI time series in the late 1960s.

To bracket uncertainty, the Panel decided to use only two runs for ease of interpretation. Three factors were considered: depletion in the first year of the model, depletion in the last year of the model, and early recruitment strength. The third factor was included because of concern that estimating relative year-class magnitude using only the CalCOFI spawning biomass index gives implausible results, namely, a spike in recruitment in 1962 more than twice as large as than any year-class for which adequate length composition data are available. The Panel chose the B1-base and B2 with constant recruitment to 1969 as models that most reasonably incorporated these three major sources of uncertainty. However the true level of uncertainty is unknown, but very likely of larger magnitude.

Technical merits and/or deficiencies of the assessment

The STAR Panel commends the STAT team for their extraordinary effort during the STAR Panel meeting. It was also clear that considerable effort has been devoted to assembling diverse sources of information on trends in bocaccio abundance. The Panel considered the new CPUE analysis based on species associations an innovative approach, but concludes that more work should be done to evaluate whether such a fishery-dependent index is appropriate for tracking stock abundance. The approach may have wide applicability for numerous west coast rockfishes and the Panel suggests further investigation and possible submission to a peer-reviewed journal. Species associations in the catch could be corroborated by applying the method to data sets with additional information (location, time of day, number of anglers) and the robustness of the approach could be tested using simulation.

Long run times (3 hrs) for the bocaccio Stock Synthesis model hampered a more thorough investigation of model(s) during the STAR Panel meeting. Slow convergence could be indicative of a poorly parameterized model, such as freely estimated parameters without adequate information, or sets of parameters that are highly correlated. It is difficult when using Stock Synthesis to develop a well-supported population model when the data begin very sparsely and then become abundant in later years. Model complexity should depend on the availability of information, but Stock Synthesis was unable to handle this transition smoothly. Consideration should be given to moving to a more flexible modeling environment.

The Panel had many questions relating to how the data and results changed since last year. Basic exploratory data analyses, such as comparison of survey indices, CPUE indices, catch time series, selectivity patterns, year class abundance, biomass trends, etc. would have greatly assisted the work of the STAR Panel. There was also a general lack of description of data sources, sample size information, etc., which should be a required component of any stock assessment document. A pre-assessment meeting could have addressed many of the issues that the Panel was forced to deal with.

Generalized linear models (GLMs) with mixture error distributions (binomial-lognormal, or binomial-gamma) were extensively used in the bocaccio assessment to estimate annual biomass indices. The STAR Panel wishes to emphasize that GLMs are MODELS. Accordingly, diagnostics should be employed as a matter of course to evaluate the adequacy of model fits, error assumptions, and model structure. The STAT team typically fit both delta-lognormal and delta-gamma models and selected the model with the lowest CV for the year effects. The STAR Panel is uncomfortable with this approach and recommends that more formal goodness of fit tests be used for model selection. Systematic and thorough exploration of main effects and interactions is another essential part of fitting GLMs that was not reported in the draft assessment.

The STAR Panel is concerned about the unstated and unevaluated assumptions needed to consider CalCOFI larval counts as an index of spawning biomass. Ralston et al. (2003) notes that changes in the timing of spawning can have a large influence on a biomass index based on larval abundance. A GLM model consisting of only main effects could either overestimate or underestimate stock decline if the stock contracts into more favorable habitat at low stock size (MacCall 1990). The CalCOFI survey is a highly unbalanced design. There is an extensive time series of surveys in southern California, but the area north of Point Conception was surveyed primarily in the early years of the time series, and only infrequently in later years. A more troubling concern is the potential for bocaccio egg production to be influenced by adverse environmental conditions as has been shown for other rockfish during El Nino episodes (Eldridge and

Jarvis 1994). One potential explanation for the low values of the CalCOFI index in the 1990s is that bocaccio egg production was adversely affected by the anomalously warm water temperatures during this decade. Because of these concerns the STAR Panel recommends that the CalCOFI index be used with caution and only to indicate general trends in abundance. Unfortunately, the CalCOFI index is the only information prior to the 1970s, and so the estimated population trends in this early period follow the CalCOFI index very closely. The STAR Panel was unconvinced that the CalCOFI index is so closely associated with bocaccio spawning stock biomass.

The Panel was concerned about the initial equilibrium assumptions in the model. Before 1951, the model assumes that a constant annual "historical catch" has caused the population to reach an equilibrium age structure in 1951. This creates two problems. First, there may not have been sufficient time, since the beginning of the fisheries, for the population to have reached "equilibrium". Second, the appropriate level of "historical catch" is unknown.

Model estimates of historic depletion are very sensitive to the assumed level of historical catch. The Panel recognized the early catch history was highly uncertain due to lack of information (little or no species composition samples). In the black rockfish assessment, the Panel worked with the STAT team to develop a plausible catch history, which avoided the need to assume historical catch and equilibrium conditions in the first year of the assessment. Also, when age or length data were unavailable, recruitment was based on a stock-recruit curve with fixed steepness and a profile on the steepness parameter was conducted to obtain the most plausible value. If this approach had been used in the bocaccio assessment the logical contradictions in the current assessment would have been avoided. However, for the bocaccio assessment there was insufficient time to do this during the meeting.

STAR Panel did not have an opportunity to review a bocaccio rebuilding analysis. We offer the following comments on the use of assessment results in rebuilding analyses. Sampling from recruitments (or R/S) should be confined to years with reliable recruitment estimates, i.e., after 1969 when length composition data are available. Of particular concern is the estimate of recruitment in 1962 that is more than twice as large as any other year class. This recruitment estimate is based solely on an apparent increase in the CalCOFI index (which indexes stock spawning output). Also, we recommend that rebuilding analyses not be based on the Stock Synthesis estimate of steepness. In the Stock Synthesis runs there was almost nil emphasis on the stock-recruit likelihood components, hence the estimated value for the steepness parameter is not reliable. Steepness for bocaccio must be higher for the stock to have been at the levels seen during the 1950s to 1970s.

Base model 1 vs. Base model 2 with constant recruitment to 1969.

Comparison of the likelihood components from both models do not indicate that one model provides a significantly better fit to the data than the other model. The only basis for evaluating uncertainty is by comparison of point estimates between alternative model runs. This method of bracketing uncertainty doesn't capture the true level of uncertainty

Explanation of Areas of Disagreement Regarding STAR Panel Recommendations

Since the assessment was not completed at the end of the meeting, the Panel is unsure whether there will be significant areas of disagreement concerning the final version of the assessment. Based on our discussions with the STAT team on the last day, it appeared that the STAT team did not agree with the two final models proposed by the STAR Panel to bracket uncertainty. The STAT team placed greater weight on the RecFIN CPUE indices and gave more credence to the CalCOFI index than the Panel considered justifiable. It appeared that the STAT team intended to complete a Stock Synthesis run which included both the RecFIN and the triennial survey indices, an approach which the Panel rejected because the two sources of information were contradictory. Further, it appeared there would be disagreement concerning the time period over which the STAT team intended to resample recruits (or R/SSB) for use in the rebuilding analysis (i.e., recruitment prior to 1969).

Unresolved Problems and Major Uncertainties

Triennial survey selectivity is implausible. The selectivity curve of the triennial survey appeared nearly uniform over all sizes, which appeared very unlikely for a research bottom trawl survey.

A rebuilding analysis was not brought forward, and was not reviewed. The Panel provided in this report what it feels are appropriate recommendations for the parameters and historic recruitments to be used. Specifically, the Panel recommends B1-base and B2 models with constant recruitment to 1969 as alternative model scenarios (equal probability) with recruitment resampled only back to 1970. The Panel re-emphasizes its recommendation against using the Stock Synthesis estimates of steepness or recruitment strength prior to 1970 in rebuilding analyses.

Biomass and recruitment prior to 1970 are highly uncertain since the only available time series is the CalCOFI index, which may not be reliable, and in any case would be unable to resolve the relative strength of individual year-classes.

The RecFIN CPUE indices and the triennial survey trends are contradictory. Fishery-dependent CPUE indices can mask real declines in abundance if fishers are able to redirect effort to areas of high density. Similarly, the triennial trawl survey may be less efficient at low stock abundance because bocaccio preferentially occupy untrawlable habitat (varying q with stock abundance). Generally, the Panel felt that data sources with conflicting information should not be used together in the assessment.

In general, Stock Synthesis predicted modes within the size composition data for bocaccio reasonably well, but had a tendency to consistently under-fit the magnitude of the modal size and overestimate the dispersion about the mode. The residual pattern from the fit to the length frequency data is unusual and indicates systematic lack of fit. Its effect on the assessment results is unknown.

Recommendations

Due to the extensive fishery closures and regulations prohibiting retention of catch in excess of the legal limits, fishery CPUE indices in the future will be biased indices of abundance. The Council and NMFS need to consider to how to monitor bocaccio status in the future. The CPFV data set consisting of reef-specific indices of abundance from partyboats is extremely valuable for evaluating of local fishing effects and as an index of overall abundance. Reef-specific CPUE is not as subject to the typical limitations of fishery CPUE data. A program of exempted fishing permits for partyboats with observers to monitor stock status should be considered.

More attention needs to be given to how growth is modeled in the assessment. A model with time varying growth or cohort-specific growth may improve the fit to the length frequency data. Alternative ways to model variation in length with age should also be considered. Also, the Panel recommends that ageing of bocaccio be re-visited. A modest ageing sample could be used to evaluate whether the linear trend in the coefficient of variation (CV) of length with age in Stock Synthesis is a reasonable assumption, as well as confirming the model estimates of growth.

The Stock Synthesis model apparently does not perform well with the diverse data sets used to assess bocaccio. Consideration should be given to moving the bocaccio assessment to a new modeling environment, ideally one with optimization routines using automatic differentiation rather than numerical differentiation as in Stock Synthesis.

Early catch history of bocaccio is a significant source of assessment uncertainty. Focused research on historical catch is needed. A comprehensive approach should be taken where historical catches of all West Coast groundfish species are investigated at the same time. Assessing historical effort in West Coast groundfish fisheries may be more successful as a collaborative undertaking between an expert in historical research and a stock assessment scientist.

Work needs to be done to figure how to the start the model with appropriate initial conditions and with sensible initial depletion which is consistent with the data.

The relationship between the CalCOFI index and climate should be evaluated. Two analyses are suggested. The first is to compare the residual patterns in model fits to an environmental index such as the Scripps Pier water temperatures. Adding an environmental covariate to the CalCOFI index catchability coefficient may improve the model fit to the index if annual egg production is influenced by environment conditions. A second analysis would be to compare biomass trends to indices associated with regime-scale environmental variability to see if significant correlations exist that would help explain long-term abundance trends.

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Exhibit B.3
Attachment 10
June 2003

The Status of Black Rockfish (*Sebastes melanops*) Off Oregon and Northern California in 2003

Stephen Ralston and E. J. Dick

National Marine Fisheries Service
Southwest Fisheries Science Center
Santa Cruz Laboratory
110 Shaffer Road
Santa Cruz, California 95060
Steve.Ralston@noaa.gov

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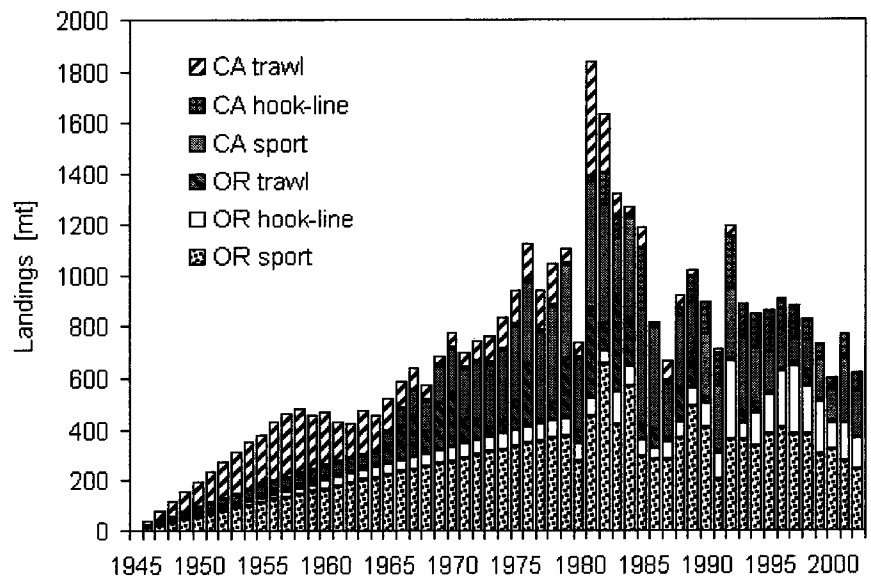
Executive Summary

Stock: This assessment pertains to the black rockfish (*Sebastes melanops*) population resident in waters located off northern California and Oregon, including the region between Cape Falcon and the Columbia River. Genetic information is presented that indicates black rockfish within that area represent a single homogeneous unit. A separate analysis of black rockfish off the coast of Washington and Oregon north of Cape Falcon was conducted by Wallace *et al.* (1999).

Catches: Catches of black rockfish from Oregon and California were classified into 6 distinct fisheries, i.e., the recreational, commercial hook-and-line, and trawl sectors from each State. Since 1978, when consistent catch reporting systems began, landings have ranged 602–1,836 mt. From 1978-2002 recreational catches have been reasonably consistent and have predominated. Concurrently, hook-and-line landings have increased as trawl landings have decreased. For this assessment, catches from 1945-77 were estimated from fragmented data and were ramped up by linear interpolation to known values in 1978.

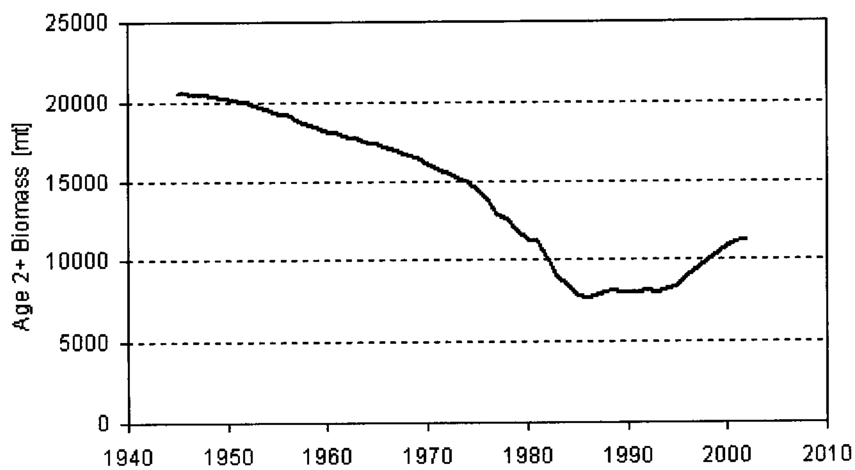


Data and Assessment: A variety of data sources was used in this assessment including: (1) recreational landings, age, and size composition data from the Oregon Department of Fish and Wildlife (ODF&W), (2) recreational landings (all California and Oregon shore-based modes) from the RECFIN data base, (3) Oregon commercial landings (trawl and hook-and-line) from the PACFIN data base, (4) size compositions for the commercial fisheries in Oregon from ODF&W, (5) California commercial landings and length compositions from the CALCOM data base, (6) a recreational catch-per-unit-effort (CPUE) statistic developed from information provided by ODF&W, (7) recreational CPUE statistics for each State derived from the RECFIN data base, and (8) a recreational CPUE statistic developed from the CDF&G central California CPFV data base. These multiple data sources were combined in a maximum likelihood statistical setting using the length-based version of the Stock Synthesis Model (Methot 1990, 2000).

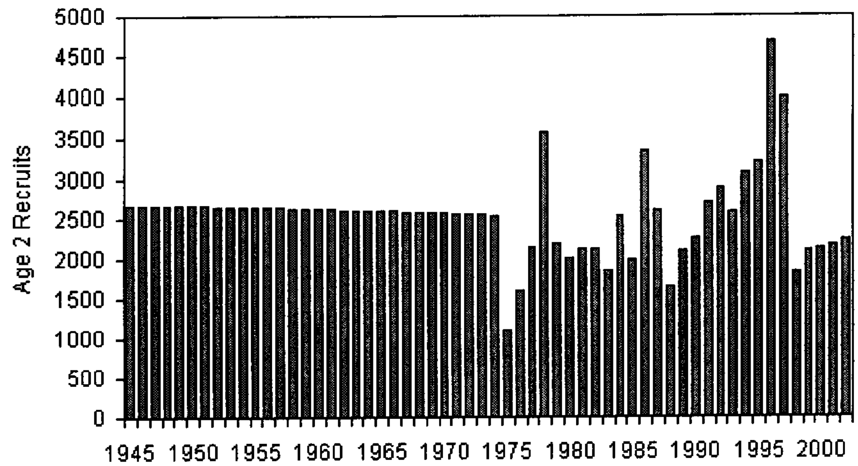
Unresolved Problems and Major Uncertainties: The major sources of uncertainty in this stock assessment include: (1) the amount of historical landings that occurred prior to the 1978, (2) the assumed natural mortality rate, and (3) the steepness of the spawner-recruit curve.

Reference Points: Based on the Pacific Fishery Management Council's current default harvest rate policy for *Sebastes*, the target harvest rate for black rockfish is $F_{50\%}$. Given the life history of the species, and the prevailing mix of fisheries in 2002 (predominately recreational with some commercial hook-and-line catches), this corresponds to an exploitation rate of about 7.7%. Moreover, the Council's current target biomass level for exploited groundfish stocks is $B_{40\%}$, i.e., the spawning output of the stock is reduced to 40% of that expected in the absence of fishing. For black rockfish that corresponds to spawning output of 1.258×10^9 larvae.

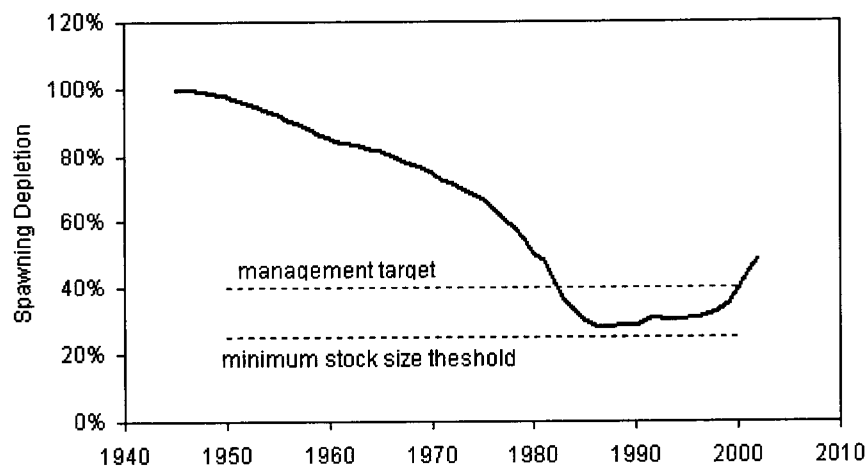
Stock Biomass: The biomass of age 2+ black rockfish underwent a significant decline from a high of 20,510 mt in 1945 to a low of 7,702 mt in 1986, representing a 62% decline. Since that time, however, the stock has increased and is currently estimated to be 11,232 mt. Most of the population's growth occurred after 1995, due to several large recruitment events, including especially the 1994 and 1995 year-classes.



Recruitment: In the assessment recruitment was treated as a blend of deterministic values (i.e., 1945-1974 & 1999-2002) and stochastic values (i.e., 1975-1998). The Beverton-Holt steepness parameter (h) was fixed at a value of 0.65, based upon on a profile of goodness-of-fit and results from a prior meta-analysis of rockfish productivity. During the 1975-1998 period there was a significant increasing trend in recruitment, even as spawning output declined. That trend culminated with the recruitment of the 1994 and 1995 year-classes, which were about twice as large as expected, based on the predicted value from the spawner-recruit curve.



Exploitation Status: The northern California-Oregon stock of black rockfish is in healthy condition, with 2002 spawning output estimated to be 49% of the unexploited spawning level. This places the stock well above the management target level of $B_{40\%}$. Likewise, age 2+ biomass in 2002 is estimated to be 11,232 mt, which is 55% of that expected in the absence of fishing.



Management Performance: Black rockfish in the southern area (Eureka & Monterey INPFC areas) have historically been managed as part of the "Other Rockfish" category, with no explicit ABC or OY designated. For 2001 the ABC of all species within that group was 2,702 mt. In contrast, in the northern area (Vancouver & Columbia INPFC areas) black rockfish is managed within the "Remaining Rockfish" category, with a designated 2001 ABC of 1,115 mt.

Forecasts: A forecast of stock abundance and yield was developed under the base model. In this projection there was no 40:10 reduction in OY from the calculated ABC because the stock is estimated to be above the management target ($B_{40\%}$) and annual yields were calculated using an $F_{50\%}$ exploitation rate (see above). Results are shown in the following table:

Year	Age 2+ Biomass	Spawning Output	Recruits	Exploitation Rate	Total Yield [mt]
2003	11,342	1.63E+09	2,307	7.60%	802
2004	11,217	1.66E+09	2,353	7.45%	775
2005	11,082	1.65E+09	2,386	7.34%	753
2006	10,938	1.62E+09	2,394	7.29%	736
2007	10,802	1.57E+09	2,392	7.28%	725
2008	10,700	1.53E+09	2,381	7.29%	719
2009	10,621	1.50E+09	2,366	7.30%	715
2010	10558	1.48E+09	2,354	7.32%	713
2011	10505	1.47E+09	2,343	7.34%	711
2012	10459	1.46E+09	2,335	7.35%	708

Decision Table: The amount of historical catch prior to 1978 was considered a major source of uncertainty in this assessment. Although some catch estimates were available prior to that time, which were not inconsequential, no continuous time series of catches from the sport and trawl fisheries in Oregon and California could be identified. Therefore, the catch record was assumed to begin in 1945, with no historical catches prior to that year. Catches were then made to ramp up to 1978, using whatever external were available and linear interpolations to fill missing values. To bracket uncertainty in these catches and their effect on the management system: (1) high and low catch scenarios were created, (2) the base assessment model was refitted to each series, and (3) 10-year yield projections run. Results show that if historical catches were lower than in the base model the calculated OY (= ABC) is reduced. Conversely, if historical catches were higher than modeled the OY would be higher. For purposes of comparison, total catches for 2000, 2001, and 2002 were 602, 768, and 617 mt, respectively.

	Low Catch Scenario		Base Model		High Catch Scenario	
Year	OY [mt]	Depletion	OY [mt]	Depletion	OY [mt]	Depletion
2003	757	54.2%	802	51.9%	886	48.1%
2004	729	54.9%	775	52.7%	861	49.0%
2005	706	54.5%	753	52.5%	842	48.9%
2006	688	53.3%	736	51.4%	828	48.2%
2007	676	51.7%	725	50.0%	820	47.1%
2008	668	50.3%	719	48.8%	817	46.2%
2009	663	49.2%	715	47.9%	816	45.6%
2010	660	48.3%	713	47.2%	816	45.1%
2011	657	47.7%	711	46.7%	816	44.9%
2012	654	47.2%	708	46.3%	816	44.7%

Research and Data Needs: To be provided later based on material from the STAR panel report.

Introduction

Black rockfish (*Sebastes melanops* = "magnificent black face"), also known as bass, black bass, black snapper, gray rockfish, and snapper, is a midwater/surface-dwelling member of the family Scorpaenidae, which is usually found schooling in water over submerged rocky reefs, often in the company of yellowtail (*S. flavidus*), dusky (*S. ciliatus*), silvergray (*S. brevispinis*), and blue (*S. mystinus*) rockfishes (Love 1996). Unlike some of the rockfishes (genus *Sebastes*), mature black rockfish are not strongly site attached, with tagging studies indicating movements of up to several hundreds of miles. The species feeds on a wide variety of foods, including mysid shrimps, krill, juvenile rockfishes, sandlance, zooplankton, etc. (Love 1996). Young-of-the-year juveniles are an important prey of other fishes, sea birds, and marine mammals.

Black rockfish, like all other rockfishes, is primitively viviparous (livebearing), with parturition of larvae occurring in the winter months of November-March (Wyllie-Echeverria 1987). The late-stage larvae transform into a pelagic juvenile stage at a size of about 25 mm and remain pelagic for periods of up to 5-6 months. Settlement occurs in nearshore, shallow water habitats that containing adequate structural relief for sheltering the newly settled young-of-the-year (e.g., tidepools, etc). Due to the extended pelagic larval and juvenile stages, there is likely substantial export of recruits to localities other than where spawning occurred.

Black rockfish is the most important "rockcod" species in the recreational fisheries of Washington, Oregon, and northern California, comprising over a third of the total marine recreational catch in some areas (Love 1996). It is not uncommon to catch the species incidentally while trolling for salmon (Eschmeyer *et al.* 1983, Wallace *et al.* 1999). Other fisheries responsible for the harvest of black rockfish include the commercial trawl fishery, which historically was significant but during the 1990s has declined in importance, and the commercial hook-and-line fishery, which has largely replaced the trawl fishery.

The regulatory history of black rockfish is complicated because the species has been managed as part of the "*Sebastes* complex" (PFMC 2000). Consequently the black rockfish allowable biological catch (ABC) has been added together with the ABCs of eleven other minor species of "remaining rockfish" and all "other" rockfish. The optimum yield (OY) is the target to which the fishery is managed, and is based upon the combined ABCs of the various elements within the *Sebastes* complex (Table 1).

Wallace *et al.* (1999), following on the work of Wallace and Tagart (1994) and Stewart (1993), assessed the status of the black rockfish resource off the coast of Washington and as far south as Cape Falcon, Oregon. They concluded that "the black rockfish stock can be characterized as declining in abundance but healthy, i.e., displaying abundance levels in excess of those assumed to promote sustainable production." Specifically, the estimated 1999 stock biomass in the assessed area was 9,500-10,100 mt, depending on assumptions concerning tag reporting rates, but the spawning biomass in 1998 was about double the equilibrium biomass associated with an $F_{45\%}$ harvest rate.

Distribution and Stock Structure

Black rockfish are found from southern California (i.e., San Miguel Island) to Amchitka in the Aleutian Islands (Hart 1988; Eschmeyer *et al.* 1983), but the center of distribution is from northern California to southeastern Alaska. Even so, Weinberg (1994) noted that during the period 1977-92 black rockfish occurred in only 23 of 1,874 hauls (1.2%) that were conducted by the AFSC triennial shelf trawl survey off the coasts of Oregon and Washington. Similarly, Jay (1996) reported that black rockfish was not among the top 33 fishes caught in the triennial survey. The near absence of this species in AFSC trawl surveys is due to its nearshore midwater distribution over rocky reefs and, for this reason, there has been little in the way of fishery-independent information with which to gauge the status of the population.

Wallace *et al.* (1999) reported evidence of a distinct genetic population of black rockfish off the Washington coast, extending south to Cape Falcon, a finding that was used to delineate the unit stock in that assessment. Subsequent work, however, has found little support for a discontinuity in black rockfish genetic structure at Cape Falcon. In particular, Baker (1999) conducted a genetic analysis of 720 black rockfish from 8 localities along the northern half of the Oregon coast, including one site well to the north of Cape Falcon (Cannon Beach). He found no evidence for any substantive constraints on gene flow among sites because, among the 14 polymorphic loci considered, F_{ST} values (a measure of genetic dissimilarity) were all relatively small (0.005-0.029). Moreover, cluster analysis of all the 28 loci he examined indicated that fish from Cannon Beach (north of Falcon) were genetically very similar to samples from Three Arch Rock, Cape Lookout, Pacific City, and Lincoln City (all south of Falcon).

More generally speaking, genetic studies have typically been unable to discriminate among rockfish populations inhabiting the open coastlines of California, Oregon, and Washington. For example, Wishard *et al.* (1980) identified no spatial genetic structure for *Sebastes goodei*, *S. paucispinis*, and *S. flavidus* from samples collected off the coasts of California, Oregon, and Washington. Similarly, no notable difference among samples of *S. alutus* from Oregon and Washington was detected, although samples from the Gulf of Alaska were distinct from the two more southerly locations. However, those authors did report weak evidence of genetic differentiation among samples of *S. pinniger* collected off southern Oregon/California and northern Oregon/Washington, which is consistent with the conclusions of Wallace *et al.* (1999). Lastly, Rocha-Olivares and Vetter (1999) found evidence of two distinct genetic populations of *Sebastes helvomaculatus*, i.e., a southern "stock" found off California, Oregon, and Vancouver Island and a northern stock off southeastern Alaska. This geographical pattern of stock structure is consistent with the findings of Wishard *et al.* (1980) concerning Pacific ocean perch. Thus, in the two situations where clear genetic differences have been observed among sub-populations of *Sebastes*, the boundary separating stocks has been between Vancouver Island and southeastern Alaska. Consequently, based on these studies we find no evidence that Oregon and California populations of black rockfish are genetically heterogeneous, and for the purposes of this assessment we define the unit stock to be the fish distributed within that geographic area, i.e., we treat California and Oregon as the unit stock under analysis. This overlaps to a small degree with assessment of Wallace *et al.* (1999), who included the stretch of coastline between the mouth of the Columbia River and Cape Falcon, a distance of 27 nmi. In contrast, the distance between Point Arena (a fairly arbitrary southern limit of latitudinal distribution in California) and the Columbia River (the northern Oregon border) is about 420 nmi.

Biological Parameters

For this study we obtained length and weight measurements from 1,987 male and 1,873 female black rockfish from personnel at the Oregon Department of Fish and Wildlife (ODF&W, D. Bodenmiller, pers. comm.). After logarithmic transformation, we evaluated the data for sex-specific differences in the length-weight relationship and found none (ANCOVA for differences in slope P = 0.992; ANCOVA for differences in adjusted mean P = 0.980). Consequently, the data were pooled and a single relationship estimated (Figure 1). After back-transformation bias correction, the predictive equation to the arithmetic scale resulted in:

$$W = 1.677\times10^{-5}\ FL^{\ 3.000}$$

where W is weight [kg] and FL is fork length [cm].

A large quantity of age [yr] and fork length [cm] data were available for use in this assessment, particularly from the recreational fishery in Oregon. We used those data to estimate sex-specific von Bertalanffy growth equations for black rockfish using the Schnute (1981) parameterization with τ_1 = 5.0 yr and τ_2 = 15.0 yr. This initial estimation of the black rockfish growth curve was completed external to and prior to any modeling of the stock and was based on 28,453 observations of age, length, and known sex. The results of fitting the data are displayed in Figure 2 and the parameter estimates are provided in Table 2 under the column labeled initial value. Because black rockfish are winter spawners (Wyllie-Echeverria 1987), when fitting the data we assumed a January 1 birthdate for all fish and we therefore added 0.5 yr to each integer age.

We then used the residuals from the fit to estimate variation in the Fork Length (FL) of black rockfish at age. Specifically, each residual was squared and the mean squared deviation was calculated as:

$$\sigma^2_{FL|sex,age} = \frac{\sum_k (FL_{ijk} - \hat{FL}_{ijk})^2}{N_{ij}}$$

where FL_{ijk} is the observed length for the sex $\boldsymbol{i}$ at age $\boldsymbol{j}$ for specimen $\boldsymbol{k}$. Sex-specific coefficients of variation (CVs) of length at age were then computed as the ratio of the root-mean-squared error to predicted age and these were then regressed on age for $\tau_1 \leq$ age $\leq \tau_2$ (Figure 3). Finally, the resulting regression equations were used to predict the CVs of male and female fish at ages 5 and 15 yr (Table 2).

Wyllie-Echeverria (1987) provided information on the maturity of black rockfish from northern California. In particular, she estimated the parameters of a logistic relationship between the proportion mature and total length [cm]. For use here, those results were expressed in terms of FL by employing the linear transformation provided in Echeverria and Lenarz (1984).

Similarly, Bobko and Berkeley (unpub.) provide logistic parameter estimates for the relationship between maturity and FL [mm] for fish sampled in Oregon. Both studies were based on histological examination of ovaries and both indicate that black rockfish are 50% mature at a size of about 39 cm FL. However, the Wyllie-Echeverria curve ascends more slowly than the Bobko-Berkeley relationship (Figure 4). Because the inflection points are virtually identical, in practice we expect a negligible difference in result from applying the two curves. For example, a simple spreadsheet evaluation of the effect of using different maturity slope parameters shows that a 1% change in slope parameter value induces only a 0.036% change in spawning biomass, an insensitive dependence. Even so, for this assessment we calculated a maturity schedule based on the average expected maturity from the two studies and fitted a logistic curve to the mean. Specifically, we employed the following female logistic maturity relationship in the stock assessment:

$$P = \frac{1}{1 + e^{-0.4103(FL - 39.53)}}$$

where P is the proportion mature and FL is fork length [cm].

Bobko and Berkeley (unpub.) also presented information on the fecundity of black rockfish from Oregon. Their data, which are based on an examination of 263 mature females collected from Depoe Bay, Newport, Charleston, and Port Orford, indicate that there is a significant relationship between weight-specific fecundity (Φ, larvae/kg) and female weight (Figure 5; $P < 0.0001$). If this relationship is assumed to be linear, the linear regression equation relating weight-specific fecundity to weight is:

$$\Phi = 289{,}406 + 103{,}076\ W$$

This result implies that the spawning output of black rockfish is not directly proportional to spawning biomass. An age structure shifted towards older, larger fish (e.g., an unexploited population) would have greater spawning output than a population shifted towards younger, smaller fish, even if the biomass of spawning females were the same. Both parameters were then re-scaled (division by 1,000) to prevent overflow problems within the model. As a consequence the egg output from the model should be multiplied by 10^3 to obtain the absolute spawning output.

Landings

Landings estimates for the contemporary period (1978-2002) were obtained from four different sources. For the northern California recreational fishery, information contained in the RECFIN data base (http://www.psmfc.org/recfin/data.htm) provided landings estimates for the period 1980-2001, excluding the 1990-92 time period when the MRFSS program was unfunded. Landings for that period were interpolated from the catch statistics reported in 1989 and 1993. Moreover, to extend the time series to 1978 (i.e., the starting year of the model) the catch in 1978 and 1979 was assumed to be equal to the average catch from 1980-83. Similarly, the catch in 2002 was assumed equal to the average catch for the three preceding years (1999-2001).

Landings estimates for both the California commercial hook-and-line and trawl fisheries from 1978-2001 were extracted from the CALCOM data base maintained at the Santa Cruz Laboratory, SWFSC. Landings for 2002, the last year of the model, were assumed equal to the 2001 catch (i.e., hook-and-line fishery = 67 mt and trawl fishery = 2 mt).

For the Oregon recreational fishery, data were provided by the Oregon Department of Fish & Wildlife (ODF&W), representing the estimated catch in numbers of black rockfish taken in the ocean boat fishery from 1979-2002 (D. Bodenmiller, pers. comm.). Those estimates were then converted to annual catch weights using year-specific estimates of the mean weight of fish caught, derived from annual length composition samples (see below) and the length-weight regression described above. For completeness, we note that the catch of black rockfish from shore-based modes of fishing in Oregon was obtained from the RECFIN data base and added to the ODF&W ocean boat catch estimates, although shore-based modes accounted for less than 2% of the State's recreational catch. Oregon sport landings in 1978 were assumed to be equal to the average of the 1979-81 catch. Likewise, the 2002 catch was estimated by ratio with the 1998-2001 reported RECFIN catch and the 2002 RECFIN estimate.

Initially, information regarding 1982-2002 Oregon commercial hook-and-line landings was derived from the PACFIN data base, as provided by ODF&W (M. Freeman, pers. comm.). For the assessment landings from "hook-and-line," "bottom longline," and "troll" gears (hook-and-line) were pooled in this summary. However, an examination of the data for the period 1982-89 indicated they were quite noisy and/or erratic and, as a consequence, the STAR panel recommended that landings for that time period be obtained by ratio estimate from the Oregon aggregate hook-and-line "rockfish" catch. Results provided by ODF&W staff during the STAR panel meeting showed that during the period 1990-2000 black rockfish accounted for 28.6% of rockfish landings. Consequently, that ratio was applied to the total hook-and-line rockfish catch from 1982-89 to provide annual estimates of black rockfish catch from that fishery for those years. Finally, landings for the period 1978-81 were estimated as the average landings from 1982-89 period (i.e., 72.2 mt/yr).

Trawl landings from Oregon (1982-2002) were also obtained from the PACFIN data base (M. Freeman, pers. comm.). For this assessment, landings from Oregon shrimp trawl and bottom trawl gears were pooled (trawl). Kupillas (unpub.) developed independent estimates of black rockfish catch by gear type for the period 1994-2000 and his data agree well with the PACFIN information, differing by only 1.4% in aggregate. To estimate landings for 1978-1981 results from Wallace *et al.* (1999) were utilized. They provided trawl landings estimates that started in 1963 for the State of Washington, which demonstrated a good correlation with Oregon landings over the period 1982-98. Therefore, the ratio of Oregon to Washington cumulative catch (69.5%) from that time period was used to estimate Oregon landings for years prior to 1982.

We have summarized these various landings data/estimates in Table 3 and Figure 6. Note that six distinct fisheries are identified, i.e., recreational (sport), hook-and-line (HKL), and trawl (TWL) from each State (Oregon and California). Overall, over the period 1978-2002, the sport fisheries have taken most of the catch (65%), followed by the commercial hook-and-line fisheries (21%), and trawl fisheries (14%). Note that there has been a definite shift in the commercial fisheries from trawl landings to hook-and-line landings over this time period.

Results show that landings peaked in 1981 with estimated landings of 1,835 mt. In recent years, annual combined black rockfish landings from both States have been in the 600-800 mt range.

Historical Catch

During the STAR panel review the amount of harvest that occurred in years preceding 1978 became a focal point of discussion. Initial results showed that the amount of "historical catch" had a strong affect on the estimated depletion level of the stock. Moreover, in preliminary runs of the Stock Synthesis model that catch was treated using the HISTCAT option, i.e., the estimated catch from the stock between the unexploited virgin level and the equilibrium level that occurred just prior to the modeled era. In addition, selectivity during the historical period was initially treated as knife-edge at age 1. However, due to concerns expressed by the STAR panel about the effect of an abrupt transition from an equilibrium stock age composition based on a single simplistic selectivity curve, to a non-equilibrium composition in 1978 based on 6 complex selectivity curves, the modeled era was extended backwards in time to start in the year 1945. As part of this exercise, black rockfish catches prior to 1946 were assumed to be zero. However, starting the model in 1945 with zero catch required the estimation of time series of landings for each of the six modeled fisheries from 1946-77. To accomplish this a number of outside sources were consulted.

Results presented in Nitsos (1965) provided annual estimates of black rockfish landings in the California trawl fishery for the years 1954-63. Likewise, Gunderson *et al.* (1974) provided annual estimates of California trawl landings for the period 1969-73. To fill in the missing years in the California trawl time series we used linear interpolation, i.e., 1946-53, 1964-68, and 1974-77. For the Oregon trawl fishery from 1963-77, landings were estimated using the Wallace *et al.* (1999) ratio described above (i.e., Oregon catch equal to 69.5% of the Washington catch). For the earlier period (1946-62), landings were linearly interpolated to zero in 1945.

Because the commercial hook-and-line fisheries from both Oregon and California developed largely after 1986, as the trawl fisheries waned, we assumed that landings from those two fisheries could be estimated by linear interpolation between a zero catch in 1945 and the estimated landings in 1978 (72.2 and 7.3 mt, respectively; Table 3).

The only available information that we could uncover regarding recreational catches of black rockfish prior to 1978 in the States of Oregon and California came from Miller and Gotschall (1965) and Young (1969). Findings gleaned from those two references allow one to infer landings estimates of black rockfish in the California sport fishery for the years 1955, 1960, and 1965, which only ranged 38.8–47.3 mt/year. We therefore interpolated all missing values in the California sport time series, i.e., between 1946-1954, 1956-1959, 1961-1964, and 1966-1977 (assumed zero catch in 1945). Likewise, anecdotal information from Oregon indicates that during the 1950s and 1960s the sport catch was much lower than that observed during the early 1980s (D. Bodenmiller, pers. comm.). Hence we interpolated all Oregon sport landings estimates and assumed a linear increase in catch from zero 1945 to 365.0 mt in 1978 (Table 3).

This reconstruction of historical black rockfish catches prior to 1978 is highly uncertain and, as a consequence, the overall sensitivity of the stock assessment was evaluated by conducting a decision analysis that incorporated a likely range of possible alternatives to the catch reconstruction presented here (Figure 6).

Age and Length Compositions

The Oregon Department of Fish & Wildlife has engaged in the collection of specimen data from the State's recreational fishery since 1978. A comprehensive data set was made available for use in the assessment (D. Bodenmiller, pers. comm.), which included 31,061 age determinations from sexed fish. In the early years of the ODF&W survey, sampling effort was much less than in recent years, primarily because collections from 1978-89 were limited to the port of Garibaldi, but throughout the 1990s over 1,000 fish have been aged and lengthed each year.

An examination of black rockfish sex ratio as a function of age shows that starting around age 10 yr, the representation of females in the older age categories falls from about 50% to about 10-20% by age 20 yr (Figure 7). This finding is consistent with results presented in Figure 2, which shows that female black rockfish do not live much beyond 25 yr, whereas males have about an additional 10 years of life expectancy. In combination, these two results indicate that females may experience a higher mortality rate than males.

An examination of the Garibaldi age and length data from showed that fish from that port were on average larger than fish taken elsewhere. Consequently, upon recommendation of the STAR panel the data from 1978-89 were excluded from further use in the stock assessment, which reduced the age/length sample size from 31,061 to 26,278 fish. Next, the age data were aggregated into frequency distributions by year (1990-2001) and sex and expressed as annual percent distributions for the combined sex sample (Table 4, Figure 8). Note that fish over 20 yr old are quite uncommon in the data and an accumulator age of 25+ was used to aggregate the oldest fish in the assessment model.

Similar to the age data, ODF&W provided an extensive data base containing length measurements of fish captured in the Oregon ocean boat recreational fishery (D. Bodenmiller, pers. comm.). Those data represented 33,468 fork length (FL) measurements from individually sexed fish. In addition, a substantial quantity of length measurements (N = 41,520 fish) was obtained from the RECFIN data base (W. Van Buskirk, pers. comm.), although those fish were unsexed. In order to utilize both sets of data, we compared the aggregated length composition of black rockfish for the years where both programs sampled (1980-89 and 1993-2001). Results show that the two programs sample fish of similar length structure (Figure 9). Consequently, the data were pooled, after deleting the Garibaldi fish (see above). This reduced the sample size 70,179 measured fish.

For the years 1990-2001, we estimated the sex ratio of black rockfish by length interval using the ODF&W data. We then applied those rates to the unsexed RECFIN data to decompose those samples into sex-specific data. However, because RECFIN was the only source of samples for the years 1980-89 and 2002, those data were entered into the stock assessment model as unsexed fish (Table 5, Figure 11), while the length data for 1990-2001 were assembled into sex-specific length frequency vectors (Table 5, Figure 12). These figures shows that in the Oregon sport fishery between 1978-2002, all fish were in the range 20 cm $\leq$ FL $\leq$ 60 cm. Therefore, in the stock assessment model fish were classified into 2 cm length bins within that size range.

Information provided by ODF&W (M. Freeman, personal communication) allowed a description of the sex-specific length composition of black rockfish taken in the Oregon hook-and-line and trawl fisheries. Specifically, length measurements from 2,390 male and 2,098 female fish were provided from samples taken in the former fishery and 172 males and 123 females were measured from samples acquired in the latter fishery. In addition, adjusted hail weights for the sampled trips were provided, and these were used in expanding the sample data to trip totals. Finally, the expanded sex-specific length data for the Oregon hook-and-line fishery was summarized as sex- and year-specific length-frequency compositions using the combined sex annual total as the denominator (Table 6, Figures 13). However, due to the sparseness of the data the sexes were combined in the trawl fishery calculations (Table 7, Figure 14).

Information on the size distribution of black rockfish in the California recreational fishery was obtained from the RECFIN sampling program (W. Van Buskirk, pers. comm.), including length measurements from 18,641 fish. In addition, the California Department of Fish & Game (CDF&G) sponsored a Commercial Passenger Fishing Vessel (CPFV) survey from 1987-98 (D. Wilson-Vandenberg and H. King, pers. comm.) that includes information on the lengths of black rockfish captured in the central and northern California recreational fishery (N = 8,959). As was the case for the Oregon recreational data, the RECFIN data were compared directly with the State agency data (CDF&G CPFV survey) to evaluate whether the length data could be aggregated. Results showed that the two sources of information were reasonably similar (Figure 10) and so they were combined. Next the data were condensed into unsexed length-frequency vectors, which were input as data into the model (Table 8, Figure 15).

California hook-and-line (Table 9, Figure 16)
California trawl (Table 10, Figure 17)

Recreational Catch Per Unit Effort

Oregon RECFIN (Figure 18 &20)
California RECFIN (Figure 19 & 21)

In addition to the analysis of RECFIN catch and effort data, a statistic representing the catch rate of black rockfish in the Oregon sport fishery was developed from information provided by personnel at the ODF&W (D. Bodenmiller, personal communication). In particular, those data were used to calculate catch rates of black rockfish in the Oregon ocean-boat recreational fishery. Information in the file included the following variables: (1) year, (2) port, (3) month, (4) trip type, (5) estimated boats, (6) estimated anglers, and (7) estimated catch. We analyzed those data in a simple ANOVA to estimate annual catch rates of black rockfish in the fishery. Specifically, the model we finally adopted was:

$$\log_e(\text{catch/boat})_{ijk} = Y_i + P_j + M_k + \epsilon_{ijk}$$

where "catch" and "angler" are aggregated statistics from each year-port-month stratum, $\boldsymbol{Y_i}$ is the year effect {i = 1979-86, 1999-2002}, $\boldsymbol{P_j}$ is a port effect {j = Astoria, Bandon, Brookings, Coos

Bay, Depoe Bay, Florence, Garibaldi, Gold Beach, Newport, Port Orford, Pacific City, Winchester Beach}, M_k is a month effect {k = January-December}, and ϵ_{ijk} is a normal error term with mean zero and variance σ^2. Note that, due to the aggregated nature of the data, no more than one observation was available for each cell in the ANOVA classification.

We used the number of boats, as opposed to the number of anglers, as the effort statistic, although in practice it made little difference which effort statistics was used. I logarithmically transformed the dependent variable because the model under log-transformation produced a higher r^2 value than the untransformed model and because the resulting multiplicative model under back-transformation was well behaved. Also, because the data were aggregated into year-port-month strata, there were no zero CPUE values in the data set and no additive constant was needed for log-transformation.

The resulting GLM model was based on the analysis of N = 526 records, with 34 parameters estimated for the 12 years, 12 ports, and 12 months listed above. The full model was highly significant ($P < 0.0001$) with a total $r^2 = 0.51$. All three factors in the model (year, port, and month) were highly significant ($P < 0.0001$).

For use in modeling the stock's trajectory, year effects from the GLM model were back-transformed to the arithmetic scale. The resulting time series is shown in Figure 22, where it is apparent that catch rates, which initially were about 40 fish·boat^{-1} in 1979-80, rose rapidly to relatively high rates of about 70 fish·boat^{-1} from 1981-86 and remained high during the latter part of the 1990s and into the new millennium.

We also estimated a black rockfish CPUE statistic developed from the CDF&G central California CPFV data base (D. Wilson-Vandenberg, personal communication). Those data span the 1988-98 time period and include information on the actual locations of catch during fishing trips. Consequently, the data were filtered to include only those locations that produced black rockfish on at least 5 separate occasions (cutoff values of 3, 10, and 15 occasions were also evaluated). Upon determination of sites that could reasonably be expected to produce black rockfish the data were analyzed using a delta-gamma GLM model with year, location, and month factors (see section on RECFIN abundance statistics above). Results suggest (Figure 23) a minor increase in the catch rate of black rockfish from 1988-98, although the jackknife error estimates are relatively greater than for the other three CPUE statistics (Figures 20-22).

Model Selection

We used Stock Synthesis (Methot 1990, 1998, 2000) to model the dynamics of the black rockfish population inhabiting the coast off Oregon and California. The model is a forward-projecting, separable, age-structured population model. Key features of the model are (1) it incorporates a multinomial sampling error structure for age and length composition data, (2) log-normal errors for survey indices, (3) it explicitly models age reading error when constructing predicted age composition data, and (4) it conveniently allows a variety of data elements to be combined and evaluated under one umbrella formulation. In particular, all data types are combined in a total $\ell_{Total} = \sum_{i=1}^{m} \ell_i \cdot \lambda_i$ $\log_e$-likelihood equation of the form:

where ℓ_{Total} is the total $\log_e$-likelihood of the model and the ℓ_i are the individual $\log_e$-likelihoods for each of the ***m*** data components used by the model. These are weighted by the "emphasis" factors (λ_i), such that in combination the various data sources used by the model can be controlled. To reduce the influence of one data type, the particular λ_i can be reduced to a nil emphasis (e.g., 0.0001). For this assessment, the length-based version of the Synthesis Model was used, which allows more effective use of length-frequency data. In particular, we used the most recent version of SYNL32R.EXE (compiled 4/2/2003, 1,239 KB). All modeling was conducted using a convergence criterion of 0.001 log-likelihood units.

A variety of model structures were explored prior to establishing a base stock assessment model. Initial efforts were simply to get the model to converge using all data elements, which included the following likelihood components (ℓ_i): (1) Oregon recreational landings, (2) Oregon recreational age compositions, (3) Oregon recreational length compositions, (4) Oregon recreational mean lengths-at-age, (5) Oregon hook-and-line landings, (6) Oregon hook-and-line length compositions, (7) Oregon trawl landings, (8) Oregon trawl length compositions, (9) California recreational landings, (10) California recreational length compositions, (11) California hook-and-line landings, (9) California hook-and-line length compositions, (10) California trawl landings, (11) California trawl length compositions, (12) RECFIN CPUE for the Oregon recreational fishery, (13) ODF&W CPUE for the Oregon recreational fishery, (14) RECFIN CPUE for the California recreational fishery, and (15) CDF&G CPUE for the California recreational fishery (Table 11).

The first models all included dome-shaped selectivity patterns for the four recreational and hook-and-line fisheries but logistic (asymptotic) selectivities for the two trawl fisheries, although all six fisheries were modeled using selectivity option #7 in the length-based model, with pure length based selectivity and no selectivity differences between sexes (Methot 2000). An effort to implement logistic selectivity curves for the four recreational and hook-and-line fisheries was attempted and then dropped due to unacceptable deteriorations in total model log-likelihood. Initially the spawner-recruit section of the model was configured as a simple stock reduction analysis. Specifically, a deterministic Beverton-Holt spawner-recruit curve with steepness fixed at 1.0 was used (i.e., constant recruitment). Profiling on the steepness parameter was conducted at a later stage to evaluate density-dependence (see uncertainty analysis below). Moreover, natural mortality rate, which initially was set equal to 0.18 yr^{-1} (see catch curve analysis above), was profiled at an early stage of the analysis to locate a region of superior fit. Results of that fitting exercise indicated M = 0.14 yr^{-1} provided a better overall model performance (see uncertainty analysis below).

Natural Mortality (Figure 25)

Base Population Model

One of the more unique aspects of the Stock Synthesis Model is its ability to simulate measurement errors associated with ageing fish (Methot 1990, 2000). Observed data are assumed to subject to ageing error, with strong year-classes smeared into adjacent weaker cohorts. To configure this aspect of the model, we used information on black rockfish summarized in Wallace and Tagart (1994), who reported that 45.9% of 4-year-olds were mis-aged by WDFW staff, and that 80.3% of fish older than 20 years were mis-aged. Using their data, we estimated about 60% agreement for 2-year-old fish and 10% agreement for 25-year-old black rockfish. These percent agreement values were fixed in all subsequent model runs.

The determination of appropriate sample sizes has been a recurring problem in composite maximum likelihood models, including Stock Synthesis. For example, catch and survey samples are typically taken as clusters of fish and a number of mechanisms can cause within-cluster variance to be severely reduced relative to an equivalent number of independently and identically distributed samples. However, an empirical estimate of the "effective" sample size (N_{eff}) is provided by the Synthesis Model, based on the ratio of the variance of the expected proportion (***p***) from a multinomial distribution to the mean squared error of the observed proportion (***p'***), i.e.,

$$N_{eff} = \frac{\sum p(1-p)}{\sum (p-p')^2}$$

We treat N_{eff} as an imprecise measurement from which one can derive a general relationship between effective sample size and actual sample size (either in the number of fish examined or the number of clusters sampled) for each fishery. The general relationship between N_{eff} and actual sample size is given by a zero-intercept regression using the ratio estimator ΣY/ΣX for the slope, which is appropriate when the variance in Y is proportional to the magnitude of X. We then replaced each observed sample size with the corresponding effective sample size predicted by the regression, thus "smoothing" the estimates. When alternative regression estimates exist (e.g., based on the number of fish or the number of clusters), we used the mean of the alternative estimates. The effective sample sizes are generally much smaller than the actual numbers of fish examined (Figure 24), but still can be quite large in some years.

Recruitment (Table 12, Figure 26)
Summary Biomass (Table 12, Figure 27)
Spawning Output (Table 12, Figure 28)
Exploitation Rate (Figure 29)
Selectivity (Table 13, Figure 30)
Composition residuals (Figure 31 & 32)
Fits to CPUE (Figure 33)
New growth curve (Figure 34)
Profile on len@age emphasis (Figure 35)
Convergence (Figure 36)
Retrospective (Figure 37)

Sources of Uncertainty

It is important to consider as many potential sources of error as possible when fitting complex nonlinear models to multiple sets of data, like we have attempted here. For example, one obvious source of uncertainty is the model's measurement error, that is the residual variance remaining after a particular model has been fit to specific data. In that regard the Monte Carlo-Markov Chain (MCMC) method is a good way of characterizing the marginal distribution of derived quantities from the model (e.g., terminal year spawning depletion). However, the Stock Synthesis model does not currently have an option for doing MCMC calculations, although that capability is being developed and implemented as a feature within the model. Even so, a much simpler estimate of measurement error is provided by the program that is based on the so-called Delta-Method, which uses numerical derivatives, the parameter variance-covariance matrix, and the first few terms of a Taylor series expansion as an approximation to the quantity in question. In this instance, the approximate coefficient of variation for the terminal year spawning output of black rockfish, based on the Delta-Method approach, is 5.7%, which provides a rough sense of the residual variability in the assessment. Thus, we might expect that quantity to be estimated with an accuracy of about ± 10-15%.

There are other important sources of uncertainty, however, that are unaccounted for in the model's remaining residual variance. One is model specification error, which represents the error that occurs when an inappropriate model is used to represent reality. Of course the analyst seldom knows for certain what the "correct" model is but, instead, engages in a process of model selection and evaluation, using goodness-of-fit measures and other diagnostics, until the key characteristics of the data are captured by the model (Hilborn and Mangel 1997). We previously described the development of the black rockfish stock assessment model (see Model Selection) and, following the arguments presented in that section, we assume that model specification error can be considered minimal. Nonetheless, there still remains a potentially important source of error in the assessment that is attributable to errors in the data and/or to fixed parameters, which essentially behave like data. In particular, for the black rockfish model two items merit increased scrutiny to evaluate the sensitivity of the final results to errors in their specification. These are: (1) the spawner-recruit steepness parameter and (2) the level of historical catch prior to 1978.

In this assessment we modeled the black rockfish spawner-recruit relationship using the Mace and Doonan (1988) formulation of the Beverton-Holt curve. The key parameter of that curve, which governs the overall resilience and productivity of the stock, is the steepness parameter (**h**). In our base model we fixed **h** = 0.65, primarily based on Dorn's (2002) Bayesian hierarchical meta-analysis of *Sebastes* productivity. That study showed that a value of 0.65 is a good point estimate for west coast rockfish stocks. However, there is considerable variability in steepness within the genus and some species (bocaccio, canary, and widow rockfish) show virtually no compensatory response (steepness ≈0.2). In addition to Dorn's (2002) meta-analysis, a preliminary likelihood profile over steepness values ranging from 0.50–1.00, obtained from the penultimate version of the black rockfish model that preceded final changes in natural mortality rates, indicated that the best fit of the model occurred at **h** = 0.65 (Figure 38). Following changes to the mortality schedule, however (see Figure 25), a subsequent profile on steepness (solid line in Figure 38) showed a marginally better fit at a steepness value of 0.50, corresponding to a small improvement of 0.70 units of log-likelihood. While such a minor change in likelihood is, in isolation, largely inconsequential, it is worth noting that spawning depletion in the base model drops from 48.8% to 42.5% as steepness goes from 0.65 to 0.50, i.e., stock status is quite sensitive to this poorly estimated parameter. Because **h** is fixed in the assessment, we urge caution in using the model due to this significant source of uncertainty.

Also shown in Figure 38 are changes in log-likelihood specific to certain data elements within the model. Only those components whose fit was clearly affected by altering the steepness parameter are presented in the figure. It is intriguing that increasing steepness degrades fits to Oregon recreational length compositions, but improves fits to the Oregon recreational age compositions. Similarly, model fits to the California trawl length composition data and the California hook-and-line length composition data are oppositely affected by the steepness parameter. We have no explanation for these patterns.

During the review of the black rockfish assessment a fair amount of discussion was devoted to establishing the historic level of catch prior to 1978 (see **Historical Catch** above). Initially, there was considerable discomfort among members of the panel with starting the model in 1978, while simultaneously specifying a substantial level of historical catch. That concern led to the reconstruction of a black rockfish catch history back to 1945, when catches were assumed to be zero. However, the panel was still concerned that the reconstruction was highly uncertain and could have a major influence on the conclusions of the stock assessment. Consequently, the STAR panel requested an analysis to assess the affect of uncertainty vis-à-vis the time series of historical catch. In so doing, the panel specified high and low historic catch levels to bracket a plausible range of historical catches (Figure 39). Note that under the base model the 1945-77 cumulative black rockfish catch from all fisheries from was 17,100 mt. To bracket that value a hypothetical high catch stream was constructed, which would have resulted in 26,100 mt of catch. Similarly, the supposed low catch stream would produce a cumulative catch of 9,400 mt.

Next, the base model formulation was re-fitted to separate data sets constructed with the high and low catch streams and the result fits were compared with the base model (Figure 40). Note that under the high catch scenario, virgin recruitment (i.e., recruitment in 1945) and all deterministic recruitments were relatively high, whereas the low catch scenario produced the lowest recruitments. During the period 1975-98, when year-specific stochastic recruitments were estimated, the three models showed little difference. Plots of the spawning depletion ratio for each of the three models (lower panel) showed that the "high catch" population underwent a more rapid depletion, as would be expected. However, by the ending year of the model (2002) the three representations of catch produced similar depletion ratios, that only ranged from 45% (high catch) to 51% (low catch). Thus, the increased recruitment/production that characterized the high catch population model was nearly sufficient to compensate for the much greater removals.

Yield Projections

The base model estimated that the spawning depletion ratio of black rockfish in 2002 was 48.8% (Table 12), putting it well above the PFMC's precautionary threshold of 40% of unfished spawning output. Hence the default harvest policy for *Sebastes* spp. is to harvest at an $F_{50\%}$ rate with no 40:10 precautionary reduction in OY. That is the rate of fishing mortality that reduces the spawning potential per recruit to half of that expected in the absence of fishing (Figure 41). In this instance an $F_{50\%}$ rate is equivalent to an exploitation rate of ~7.7%.

The Stock Synthesis program was used to project the base population model forward for ten years under an $F_{50\%}$ harvest regime, with catch allocation among the six fisheries based on the last three years of landings (2000-2002) and deterministic recruitments drawn from the spawner-recruit curve. In addition, comparable projections were developed for the high and low catch scenarios discussed previously. Results show (Table 14, Figure 42) that over the next 10 years the allowable biological catch (ABC) is forecast to decline from 802 mt in 2003 to 708 mt in 2012, as the elevated recruitments of 1994-1997 pass through the population (see Figure 26). For comparison, the high historical catch scenario would be expected to produce greater ABCs (i.e., 886-816 mt from 2003-2012) but to be at a lower depletion level than the base model, consistent with the discussion above. Likewise, the low catch scenario results in lower ABCs (757-654 mt) with the stock at a relatively higher level of abundance. After 10 years of harvesting at $F_{50\%}$ all three models predict that the depletion ratio will remain above the 40% precautionary threshold. Similarly, the lowest forecasted ABC, among all year and model combinations, is 654 mt. That quantity is about equal to the annual average of recent landings (2000-2002). Using projections from the base model, there is some room for catches in the next few years to increase, although given the projected trend in biomass (down), and uncertainty in historical catches and the spawner-recruit steepness (see above), a *status quo* total harvest would be a robust alternative.

In order to characterize a key source of uncertainty in the stock assessment the STAR panel chose to highlight the importance of the 1945-77 time series of historical catches. To demonstrate the conservation repercussions that could arise if the stock were managed based on an assumed 1945-77 catch stream (i.e., the base model), when in fact historical catches were something different (i.e., high & low catch scenarios), we constructed a decision table (Table 15). Note that in the upper portion of the table, under the heading labeled "True" State of Nature, the columns represent three alternative views of reality, with their associated ABCs. Thus, if actual catches from 1945-77 were equivalent to the high scenario, the appropriate five-year average ABC (2003-2007) would be 847 mt, and so on. The lower portion of the table shows what happens to the "True" stock if removals are based on an assumed state of nature (i.e., high, medium, or low ABCs). Clearly if the true state is "low catch history" and the assigned ABC is 711 mt, the appropriate management action is taken. Thus, the diagonal of the table represents no management error. Off-diagonal elements, however, represent situations where the wrong ABC is taken from the stock (either too high or too low).

To gauge the conservation impact of errors in management due to mis-specifying ABC, we calculated the total spawning depletion of the stock after five years of removals. Thus, the base model predicts that the stock will be reduced to 50.0% of virgin spawning output after five years of harvesting with an average ABC of 758 mt (see also Table 14). Similarly, "correct" management under the low and high catch scenarios is expected to result in spawning depletion ratios of 51.7% and 47.1%, respectively. Note that, with respect to stock conservation, the worst type of error is assuming a high catch scenario (ABC = 847 mt) when in fact the true state of nature was a low catch scenario (least stock production). In that instance, the depletion ratio after 5 years of harvest is 48.3%, which is down from 51.7% when properly managed. In no case within the decision table does depletion fall below, or even approach, the precautionary threshold (40%). We conclude from this analysis that management errors in setting ABC based on having to chose among alternative levels of historic catch are of relatively minor consequence to black rockfish stock conservation.

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Table 1. Regulatory history for west coast black rockfish south of the Columbia River.

Date	Regulatory Action
1/83	40,000 lb trip limit *Sebastes* complex coastwide; recreational: California and Oregon 15 fish per angler
1/84	30,000 lb trip limit for *Sebastes* complex north of Cape Blanco with a 1 trip per week restriction, no change south
5/84	15,000 lb trip limit for *Sebastes* complex once per week north of Cape Blanco
8/84	7,500 lb/trip once per week or 15,000 lb/trip once per 2 weeks for *Sebastes* complex north of Cape Blanco
1/85	30,000 lb weekly trip limit for *Sebastes* complex north of Cape Blanco, no change south
4/85	15,000 lbs per weekly trip or 30,000 lbs per biweekly trip north of Cape Blanco
10/85	20,000 lbs per weekly trip or 40,000 lbs per biweekly trip north of Cape Blanco for *Sebastes* complex
1/86	25,000 lbs per weekly trip or 50,000 lbs per biweekly trip for *Sebastes* complex north of Cape Blanco, no change south
9/86	30,000 lbs per weekly trip or 60,000 lbs per biweekly trip north of Cape Blanco for *Sebastes* complex
1/87	25,000 lbs per weekly trip or 50,000 lbs per biweekly trip north of Cape Blanco for *Sebastes* complex, no change south
1/88	No change for *Sebastes* complex
1/89	No change for *Sebastes* complex
1/90	No change for *Sebastes* complex
1/91	25,000 lbs per trip south of Cape Blanco for *Sebastes* complex, no change north
1/92	50,000 lbs cumulative *Sebastes* complex per 2 weeks coastwide
1/93	No change for *Sebastes* complex
1/94	Limited entry: 80,000 lbs cumulative *Sebastes* complex per month month coastwide open access: 10,000 lbs per trip not to exceed 40,000 lbs per month coastwide recreational: **10 black rockfish in 15 rockfish bag per angler for Oregon**
9/94	Limited entry south of Cape Mendocino raised to 100,000 lbs cumulative per month
1/95	Limited entry: 35,000 lbs cumulative *Sebastes* complex north of Cape Lookout; 50,000 lbs cumulative per month between Cape Lookout; 100,000 lbs cumulative per month south of Cape Mendocino; open access fixed gear: 35,000 lbs cumulative north of Cape Lookout for fixed gear (except pot and hook and line); 40,000 lbs per cumulative month south of Cape Lookout; 10,000 lbs per trip for pot and hook and line coastwide
1/96	Limited entry: 70,000 per 2 months north of Cape Lookout; 100,000 lbs per 2 month between Cape Lookout and Cape Mendocino; 200,000 lbs per 2 month period south of Cape Mendocino; open access fixed gear except hook and line and pot: 35,000 lbs per month north of Cape Lookout; 40,000 lbs per month south of Cape Lookout open access fixed hook and line and pot: 10,000 lbs/trip open access trawl: not to exceed 50% of limited entry
1/97	Limited entry: 30,000 lbs per 2 month period north of Cape Mendocino; 150,000 lbs per 2 month period south of Cape Mendocino; open access trawl not to exceed 50% of this open access; fixed gear: 40,000 lbs per month coastwide with a 10,000 lb trip limit for hook and line and pot
1/98	Limited entry: 40,000 lbs per 2 months north of Cape Mendocino; 150,000 lbs per 2 months south of Cape Mendocino open access, fixed gear: no change open access, trawl: no change
7/98	Limited entry: south of Cape Mendocino reduced to 40,000 lbs per two months
10/98	Limited entry: monthly trip limit reduced to 15,000 lbs open access: no landings north of Cape Blanco
1/99	Limited entry managed by a complex 3 phase landing system, Open access: North of Cape Mendocino - 3,600 lbs/month; 2,000 lbs per month south of Cape Mendocino
4/99	Open Access: North of Cape Mendocino - 12,000 lbs per month with no more than 3,500 lbs per month being blue and black rockfish
5/99	Limited Entry: North of Cape Mendocino - 2 month cumulative limit of 30,000 lbs of *Sebastes* complex through Sep; South of Cape Mendocino - 2 month cumulative limit of 3,500 lbs of *Sebastes* complex
8/99	Limited entry north of Cape Mendocino: 10,000 lbs cumulative bimonthly limit for all *Sebastes* other than canary and yellowtail rockfish
1/00	Black rockfish managed as a minor nearshore species, Limited Entry Trawl: 200 lbs per month of minor nearshore species coastwide, Limited Entry Fixed Gear: 2,400 lbs coatwide limit for minor nearshore of which no more than 1,200 lbs may be species other than blue or black rockfish, Open Access: North - 1,000 lbs/2 months of minor nearshore rockfish of which no more than 500 lbs may be other than blue or black rockfish, South - 550 lbs/2 months with a 2 month closure (variable by location), Recreational: 2 month closures (variable by location) south of Cape Mendocino, bag limit 10 fish per day, Oregon bag limit of 10 fish per day.

Table 1 (cont.).

Date	Regulatory Action
5/00	Limited entry non-trawl limit: north of Cape Mendocino -cumulative bimonthly limit of nearshore rockfish increased to 3,000 lbs of which no more than 1,400 lbs may be other than blue or black rockfish; south of Cape Mendocino - 1,300 lbs per 2 months of minor nearshore rockfish, Open Access, Non trawl fishery: 1,500 lbs minor nearshore rockfish per two months of which no more than 700 lbs may be species other than blue or black rockfish. Special: from May-Sep 2,200 lbs of minor nearshore rockfish per month for Pacific City (Oregon) of which no more than 700 lbs may be other than blue or black rockfish; landings of minor nearshore rockfish at Pacific City prohibited after September
7/00	Limited entry, fixed gear: North of Cape Mendocino - 5,000 lbs of minor nearshore rockfish per 2 month period with a maximum of 1,800 lbs of species other than blue or black rockfish; south of Cape Mendocino - 2,000 lbs of minor nearshore species per 2 month period, Open Access: North of Cape Mendocino - 3,000 lbs of minor nearshore rockfish with no more than 900 lbs of species other than blue or black rockfish; South of Cape Mendocino - 1,600 lbs per 2 month period of minor nearshore rockfish
10/00	Limited entry, fixed gear: North of Cape Mendocino - 10,000 lbs cumulative bimonthly for minor nearshore rockfish with no more than 2,000 lbs of non blue or black rockfish; south of Cape Mendocino - 6,000 lbs of minor nearshore rockfish per two month trip; South of Pt Conception - 9,000 lbs /2 months for October and 3,000 lbs per two month period for November and December; Open Access: North - 6,000 lbs of minor nearshore rockfish per 2 months with no more than 2,000 lbs other than blue or black rockfish; South - 4,000 lbs of minor nearshore rockfish per 2 month period
1/01	Limited entry trawl: 200 lbs/month of minor nearshore rockfish coastwide limited entry fixed gear: North - 10,000 lbs per 2 months of minor nearshore rockfish of which no more than 4,000 lbs may be other than blue or black rockfish; South (Monterey INPFC area) - 2,000 lbs per 2 months during Jan-Feb and July-Dec, closed Mar-April, closed outside of 20 fathoms May-June; open access: North - 3,000 lbs per 2 month period of which no more than 900 lbs may be other than blue or black rockfish; Monterey INPFC area - 1,800 lbs per 2 months during Jan-Feb and July-Dec, closed Mar-April, closed outside of 20 fathoms May-June; recreational: California - Closed March-April, In the Monterey INPFC area closed May-June except for inside the 20 fathom line
5/01	Limited entry in north: 7,000 lbs per 2 month period through December of which no more than 4,000 lbs may be other than blue or black rockfish open access in north: 7,000 lbs per 2 month period through December of which no more than 900 lbs may be other than blue or black rockfish
1/02	Limited entry trawl: North - minor nearshore rockfish closed Sep-Oct, otherwise 300 lbs/month; South 500 lbs per month minor nearshore rockfish Jan-April, 1,000 lbs/month May-June, then closed Limited entry fixed gear: North - 5,000 lbs/month of minor nearshore rockfish no more than 2,000 lbs of which may be other than blue or black rockfish through April, reducing to 7,000 lbs per 2 months by year end; South (Monterey INPFC area) - 1,600 lbs per 2 months Jan-Feb, closed Mar-Apr, then 1,600 lbs per 2 months inside of 20 fathoms May-Aug, then closed; Open access: North - 3,000 lbs per 2 months of minor nearshore rockfish through April (no more than 1,200 lbs of which may be other than blue or black rockfish), increasing to 7,000 lbs per 2 months by year end (no more than 3,000 lbs of which may be other than blue or black rockfish); South (Monterey INPFC area) - 1,200 lbs of minor nearshore rockfish Jan-Feb, closed Mar-April, 1,200 lbs inshore of 20 fathoms through September, then closed; recreational: California - North of Cape Mendocino open year round, Monterey INPFC are is closed March - April and Nov-Dec and outside of 20 fathoms it is closed May - Oct
1/03	Limited Entry trawl: 300 lbs per month costwide limited entry fixed gear: North - 3,000 lbs per 2 months of minor nearshore rockfish of which no more than 900 lbs may be other than blue or black rockfish; South - All fishing inside of 20 fathoms or outside of 150 fathoms, 200 lbs per 2 months minor nearshore rockfish Jan-Feb and Nov-Dec, closed Mar-April, 400 lbs per 2 months May - June and Sep-Oct, 500 lbs per 2 months July-Aug; Open Access: Same as limited entry; Recreational: California (Monterey INPFC) - inside of 20 fathoms, closed Jan-June; No change for Oregon or northern California

Table 2. Sex-specific von Bertalanffy growth parameter estimates for black rockfish from Oregon and California. The Schnute (1981) parametization was employed in fitting the data, with $\tau_1 = 5.0$ yr and $\tau_2 = 15.0$ yr. Initial values of parameters were obtained by fitting the growth model external to the stock assessment model. Other than the four coefficients of variation (CVs), final values were estimated within the model.

Sex	Parameter	Initial Value	Final Value
female	K [yr^{-1}]	0.1495	0.2022
	FL [cm] @ age 5	34.83	32.21
	FL [cm] @ age 15	46.34	47.95
	CV FL @ age 5	8.79%	8.79%
	CV FL @ age 15	8.82%	8.82%
male	K [yr^{-1}]	0.1384	0.1979
	FL [cm] @ age 5	34.56	31.88
	FL [cm] @ age 15	43.85	45.39
	CV FL @ age 5	8.24%	8.24%
	CV FL @ age 15	6.45%	6.45%

Table 3. Black rockfish landings [mt] from the sport (i.e., recreational), hook-and-line, and trawl fisheries from 1945-2002 in Oregon and northern California.

	Oregon			California			
Year	Sport	Hook	Trawl	Sport	Hook	Trawl	Total
1945	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1946	11.1	2.2	0.7	3.9	0.2	21.3	39.4
1947	22.1	4.4	1.5	7.8	0.4	42.6	78.8
1948	33.2	6.6	2.2	11.6	0.7	63.8	118.1
1949	44.2	8.8	2.9	15.5	0.9	85.1	157.4
1950	55.3	10.9	3.7	19.4	1.1	106.4	196.8
1951	66.4	13.1	4.4	23.3	1.3	127.7	236.2
1952	77.4	15.3	5.1	27.2	1.5	149.0	275.5
1953	88.5	17.5	5.9	31.0	1.8	170.3	315.0
1954	99.5	19.7	6.6	34.9	2.0	191.5	354.2
1955	110.6	21.9	7.3	38.8	2.2	196.9	377.7
1956	121.7	24.1	8.1	40.0	2.4	230.6	426.9
1957	132.7	26.3	8.8	41.2	2.7	250.1	461.8
1958	143.8	28.4	9.5	42.5	2.9	253.6	480.7
1959	154.8	30.6	10.3	43.7	3.1	216.4	458.9
1960	165.9	32.8	11.0	44.9	3.3	209.3	467.2
1961	177.0	35.0	11.7	45.4	3.5	157.8	430.4
1962	188.0	37.2	12.5	45.9	3.8	138.3	425.7
1963	199.1	39.4	13.2	46.4	4.0	173.8	475.9
1964	210.2	41.6	5.6	46.8	4.2	150.6	459.0
1965	221.2	43.8	75.1	47.3	4.4	127.4	519.2
1966	232.3	45.9	129.3	72.0	4.6	104.2	588.3
1967	243.3	48.1	162.6	96.7	4.9	81.0	636.6
1968	254.4	50.3	84.8	121.3	5.1	57.7	573.6
1969	265.5	52.5	181.4	146.0	5.3	34.5	685.2
1970	276.5	54.7	210.6	170.7	5.5	57.3	775.3
1971	287.6	56.9	93.2	195.3	5.8	55.3	694.1
1972	298.6	59.1	80.6	220.0	6.0	78.2	742.5
1973	309.7	61.3	33.4	244.7	6.2	108.0	763.3
1974	320.8	63.4	52.1	269.3	6.4	119.0	831.0
1975	331.8	65.6	108.4	294.0	6.6	130.0	936.4
1976	342.9	67.8	241.3	318.7	6.9	141.0	1118.6
1977	353.9	70.0	10.4	343.3	7.1	152.1	936.8
1978	365.0	72.2	66.6	368.0	7.3	163.1	1042.2
1979	373.6	72.2	223.1	368.0	2.8	59.6	1099.3
1980	270.4	72.2	45.2	285.0	1.8	59.5	734.1
1981	451.1	72.2	343.1	500.0	19.6	449.8	1835.8
1982	649.0	55.2	106.2	467.0	123.4	235.2	1636.0
1983	418.9	125.9	374.4	220.0	87.2	99.1	1325.5
1984	566.2	81.0	177.3	400.0	10.2	38.0	1272.7
1985	294.2	66.5	55.7	442.0	245.8	82.3	1186.5
1986	279.3	44.5	73.6	398.0	8.2	12.2	815.8
1987	280.6	69.4	17.0	212.0	9.8	75.0	663.8
1988	367.2	62.3	130.1	283.0	23.7	49.6	915.9
1989	486.0	72.8	101.7	230.0	101.3	25.7	1017.5
1990	402.0	97.5	23.9	243.5	128.1	0.5	895.5
1991	201.7	107.0	1.4	257.0	123.1	21.1	711.3
1992	360.3	302.2	10.5	270.5	200.4	50.3	1194.2
1993	360.8	65.7	43.7	284.0	129.1	2.2	885.5
1994	330.0	131.2	43.4	210.0	130.9	1.1	846.6
1995	377.4	158.5	4.3	158.0	156.9	2.7	857.8
1996	401.3	225.6	7.7	154.0	103.4	10.5	902.5
1997	375.9	267.6	17.1	91.0	112.8	14.1	878.5
1998	375.2	191.6	58.6	117.0	78.6	6.3	827.3
1999	301.6	207.7	2.3	162.0	49.0	3.9	726.5
2000	320.7	105.6	0.6	129.0	43.7	2.3	601.9
2001	275.4	146.2	0.2	248.0	96.6	2.1	768.5
2002	241.6	125.2	1.2	179.7	67.0	2.0	616.7

Table 4. Sex-specific age compositions for black rockfish taken in the Oregon recreational fishery (1990-2001).

		Age (yr)																						
Year	sex	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25+
1990	female	0.0000	0.0081	0.0105	0.0763	0.1211	0.0672	0.0591	0.0391	0.0424	0.0386	0.0324	0.0095	0.0086	0.0057	0.0057	0.0019	0.0014	0.0005	0.0010	0.0000	0.0000	0.0000	0.0000	0.0000
1990	male	0.0000	0.0062	0.0138	0.0663	0.0911	0.0482	0.0520	0.0329	0.0296	0.0296	0.0215	0.0205	0.0119	0.0100	0.0072	0.0052	0.0029	0.0067	0.0033	0.0024	0.0019	0.0014	0.0024	0.0038
1991	female	0.0010	0.0029	0.0240	0.0692	0.1212	0.1250	0.0529	0.0471	0.0346	0.0183	0.0106	0.0115	0.0010	0.0010	0.0019	0.0010	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
1991	male	0.0000	0.0058	0.0125	0.0510	0.1125	0.0952	0.0442	0.0375	0.0288	0.0279	0.0212	0.0096	0.0058	0.0087	0.0038	0.0010	0.0010	0.0029	0.0010	0.0010	0.0029	0.0000	0.0000	0.0029
1992	female	0.0088	0.0246	0.0613	0.1094	0.0957	0.0870	0.0574	0.0142	0.0120	0.0098	0.0077	0.0049	0.0022	0.0016	0.0005	0.0005	0.0005	0.0005	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
1992	male	0.0027	0.0284	0.0487	0.0832	0.0804	0.0957	0.0481	0.0274	0.0235	0.0126	0.0109	0.0120	0.0088	0.0055	0.0038	0.0011	0.0044	0.0000	0.0000	0.0000	0.0005	0.0000	0.0000	0.0033
1993	female	0.0023	0.0376	0.0660	0.0859	0.0959	0.0859	0.0475	0.0253	0.0092	0.0061	0.0115	0.0046	0.0008	0.0023	0.0008	0.0008	0.0000	0.0000	0.0000	0.0000	0.0008	0.0008	0.0000	0.0000
1993	male	0.0008	0.0460	0.0790	0.0744	0.0874	0.0621	0.0460	0.0291	0.0238	0.0138	0.0184	0.0107	0.0069	0.0069	0.0023	0.0015	0.0031	0.0008	0.0023	0.0000	0.0000	0.0000	0.0000	0.0008
1994	female	0.0000	0.0035	0.0605	0.0953	0.1134	0.0779	0.0452	0.0424	0.0299	0.0083	0.0049	0.0007	0.0035	0.0042	0.0042	0.0028	0.0014	0.0007	0.0014	0.0000	0.0000	0.0000	0.0000	0.0014
1994	male	0.0000	0.0063	0.0396	0.0974	0.0904	0.0605	0.0487	0.0466	0.0396	0.0146	0.0111	0.0090	0.0076	0.0083	0.0070	0.0014	0.0028	0.0007	0.0014	0.0028	0.0007	0.0000	0.0014	0.0007
1995	female	0.0010	0.0108	0.0424	0.0945	0.1054	0.0795	0.0532	0.0372	0.0258	0.0088	0.0062	0.0031	0.0021	0.0041	0.0021	0.0010	0.0021	0.0005	0.0005	0.0000	0.0005	0.0000	0.0000	0.0000
1995	male	0.0005	0.0062	0.0356	0.0961	0.1064	0.0764	0.0501	0.0367	0.0305	0.0196	0.0124	0.0119	0.0067	0.0088	0.0057	0.0036	0.0021	0.0041	0.0000	0.0005	0.0000	0.0005	0.0005	0.0041
1996	female	0.0024	0.0207	0.0520	0.0804	0.0928	0.0763	0.0426	0.0331	0.0177	0.0142	0.0112	0.0024	0.0018	0.0030	0.0012	0.0012	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
1996	male	0.0024	0.0166	0.0509	0.1041	0.1041	0.0692	0.0585	0.0396	0.0195	0.0183	0.0130	0.0136	0.0089	0.0065	0.0047	0.0012	0.0059	0.0030	0.0030	0.0000	0.0024	0.0012	0.0000	0.0006
1997	female	0.0022	0.0234	0.0592	0.1206	0.0923	0.0891	0.0435	0.0369	0.0168	0.0114	0.0054	0.0049	0.0022	0.0011	0.0011	0.0000	0.0005	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
1997	male	0.0005	0.0141	0.0435	0.0777	0.1010	0.0798	0.0521	0.0348	0.0255	0.0223	0.0120	0.0060	0.0054	0.0033	0.0027	0.0022	0.0011	0.0000	0.0005	0.0027	0.0000	0.0011	0.0000	0.0011
1998	female	0.0000	0.0118	0.0439	0.0705	0.0848	0.0817	0.0594	0.0390	0.0316	0.0173	0.0124	0.0105	0.0074	0.0062	0.0031	0.0019	0.0019	0.0000	0.0000	0.0006	0.0006	0.0000	0.0000	0.0006
1998	male	0.0000	0.0087	0.0248	0.0675	0.0897	0.0829	0.0514	0.0501	0.0359	0.0167	0.0235	0.0111	0.0087	0.0074	0.0074	0.0062	0.0043	0.0012	0.0019	0.0037	0.0025	0.0019	0.0025	0.0050
1999	female	0.0000	0.0050	0.0380	0.1064	0.1092	0.0869	0.0670	0.0363	0.0254	0.0078	0.0061	0.0036	0.0036	0.0011	0.0008	0.0006	0.0003	0.0000	0.0003	0.0003	0.0000	0.0003	0.0000	0.0006
1999	male	0.0003	0.0053	0.0338	0.1036	0.0930	0.0810	0.0665	0.0416	0.0218	0.0142	0.0087	0.0084	0.0061	0.0036	0.0028	0.0028	0.0017	0.0008	0.0014	0.0006	0.0008	0.0003	0.0003	0.0008
2000	female	0.0000	0.0062	0.0234	0.0827	0.1124	0.0808	0.0609	0.0452	0.0282	0.0145	0.0097	0.0056	0.0037	0.0023	0.0008	0.0012	0.0006	0.0000	0.0002	0.0000	0.0002	0.0002	0.0002	0.0000
2000	male	0.0006	0.0062	0.0280	0.0929	0.1177	0.0755	0.0551	0.0442	0.0299	0.0176	0.0126	0.0075	0.0070	0.0070	0.0073	0.0033	0.0021	0.0012	0.0008	0.0012	0.0012	0.0004	0.0004	0.0008
2001	female	0.0013	0.0010	0.0114	0.0344	0.0905	0.1203	0.0782	0.0701	0.0487	0.0214	0.0211	0.0071	0.0052	0.0039	0.0026	0.0013	0.0010	0.0026	0.0006	0.0003	0.0013	0.0003	0.0003	0.0016
2001	male	0.0003	0.0039	0.0117	0.0311	0.0834	0.1096	0.0590	0.0542	0.0363	0.0234	0.0156	0.0071	0.0075	0.0062	0.0065	0.0058	0.0026	0.0016	0.0016	0.0010	0.0006	0.0010	0.0000	0.0036

Table 5. Length compositions for black rockfish taken in the Oregon recreational fishery (1980-2002).

		Fork Length [cm]																				
Year	sex	20	22	24	26	28	30	32	34	36	38	40	42	44	46	48	50	52	54	56	58	60
1980	combined	0.0011	0.0043	0.0106	0.0223	0.0723	0.0648	0.0871	0.0903	0.1073	0.1063	0.0903	0.1158	0.0712	0.0659	0.0499	0.0255	0.0117	0.0032	0.0000	0.0000	0.0000
1981	combined	0.0018	0.0054	0.0072	0.0181	0.0578	0.0632	0.1065	0.1336	0.1047	0.0884	0.1011	0.0866	0.0884	0.0596	0.0397	0.0235	0.0090	0.0018	0.0036	0.0000	0.0000
1982	combined	0.0000	0.0010	0.0040	0.0109	0.0169	0.0526	0.0745	0.1033	0.1360	0.1241	0.1351	0.1221	0.0963	0.0596	0.0348	0.0179	0.0079	0.0020	0.0010	0.0000	0.0000
1983	combined	0.0083	0.0055	0.0083	0.0249	0.0665	0.0803	0.0831	0.1025	0.1330	0.1080	0.1163	0.0831	0.0859	0.0582	0.0139	0.0166	0.0000	0.0000	0.0055	0.0000	0.0000
1984	combined	0.0000	0.0034	0.0075	0.0103	0.0274	0.0459	0.0623	0.1082	0.1466	0.1452	0.1404	0.1123	0.0767	0.0596	0.0336	0.0089	0.0089	0.0027	0.0000	0.0000	0.0000
1985	combined	0.0016	0.0090	0.0485	0.0411	0.0364	0.0501	0.0685	0.1033	0.1107	0.1450	0.1497	0.0996	0.0585	0.0416	0.0179	0.0105	0.0021	0.0037	0.0005	0.0016	0.0000
1986	combined	0.0021	0.0049	0.0246	0.0323	0.0400	0.0421	0.0779	0.0885	0.1419	0.1461	0.1685	0.1053	0.0660	0.0386	0.0084	0.0084	0.0035	0.0000	0.0007	0.0000	0.0000
1987	combined	0.0039	0.0147	0.0275	0.0451	0.0658	0.0756	0.1001	0.0736	0.1217	0.1089	0.1148	0.1021	0.0618	0.0393	0.0255	0.0137	0.0029	0.0020	0.0000	0.0010	0.0000
1988	combined	0.0069	0.0107	0.0214	0.0289	0.0572	0.0722	0.0955	0.1394	0.1099	0.1401	0.1175	0.0854	0.0484	0.0289	0.0251	0.0088	0.0038	0.0000	0.0000	0.0000	0.0000
1989	combined	0.0018	0.0009	0.0136	0.0145	0.0254	0.0481	0.0763	0.1272	0.1353	0.1199	0.1544	0.1090	0.0708	0.0545	0.0254	0.0064	0.0045	0.0045	0.0036	0.0018	0.0018
1990	female	0.0000	0.0000	0.0000	0.0023	0.0015	0.0058	0.0098	0.0283	0.0575	0.0848	0.0820	0.0851	0.0666	0.0505	0.0328	0.0149	0.0053	0.0020	0.0005	0.0000	0.0000
1990	male	0.0000	0.0000	0.0000	0.0020	0.0013	0.0052	0.0087	0.0251	0.0511	0.0753	0.0728	0.0755	0.0591	0.0448	0.0291	0.0132	0.0047	0.0018	0.0004	0.0000	0.0000
1991	female	0.0000	0.0000	0.0000	0.0008	0.0029	0.0058	0.0162	0.0249	0.0460	0.0971	0.1107	0.0888	0.0556	0.0411	0.0232	0.0079	0.0050	0.0008	0.0000	0.0000	0.0000
1991	male	0.0000	0.0000	0.0000	0.0007	0.0026	0.0052	0.0145	0.0224	0.0414	0.0872	0.0995	0.0797	0.0499	0.0369	0.0209	0.0071	0.0045	0.0007	0.0000	0.0000	0.0000
1992	female	0.0000	0.0000	0.0003	0.0034	0.0029	0.0115	0.0230	0.0364	0.0578	0.0934	0.0893	0.0848	0.0484	0.0291	0.0099	0.0042	0.0010	0.0000	0.0003	0.0000	0.0000
1992	male	0.0000	0.0000	0.0003	0.0035	0.0029	0.0117	0.0234	0.0370	0.0588	0.0950	0.0908	0.0863	0.0493	0.0296	0.0101	0.0043	0.0011	0.0000	0.0003	0.0000	0.0000
1993	female	0.0001	0.0009	0.0010	0.0051	0.0104	0.0194	0.0293	0.0446	0.0648	0.0841	0.0769	0.0669	0.0429	0.0218	0.0108	0.0027	0.0006	0.0010	0.0003	0.0000	0.0001
1993	male	0.0002	0.0009	0.0011	0.0055	0.0111	0.0207	0.0313	0.0476	0.0692	0.0898	0.0821	0.0714	0.0458	0.0233	0.0116	0.0029	0.0006	0.0011	0.0003	0.0000	0.0002
1994	female	0.0001	0.0004	0.0009	0.0023	0.0063	0.0132	0.0252	0.0393	0.0518	0.0636	0.0744	0.0734	0.0482	0.0297	0.0122	0.0045	0.0012	0.0006	0.0002	0.0002	0.0000
1994	male	0.0001	0.0005	0.0011	0.0028	0.0078	0.0163	0.0311	0.0485	0.0639	0.0786	0.0919	0.0906	0.0595	0.0366	0.0150	0.0055	0.0015	0.0007	0.0002	0.0002	0.0000
1995	female	0.0000	0.0003	0.0006	0.0023	0.0066	0.0208	0.0358	0.0622	0.0761	0.0775	0.0771	0.0537	0.0327	0.0178	0.0080	0.0028	0.0004	0.0003	0.0000	0.0000	0.0000
1995	male	0.0000	0.0004	0.0006	0.0026	0.0073	0.0230	0.0395	0.0688	0.0841	0.0855	0.0852	0.0593	0.0361	0.0197	0.0089	0.0030	0.0005	0.0004	0.0000	0.0000	0.0000
1996	female	0.0006	0.0005	0.0010	0.0039	0.0092	0.0159	0.0347	0.0589	0.0666	0.0805	0.0713	0.0581	0.0311	0.0142	0.0042	0.0016	0.0002	0.0001	0.0001	0.0001	0.0000
1996	male	0.0007	0.0005	0.0012	0.0047	0.0111	0.0192	0.0420	0.0712	0.0805	0.0973	0.0862	0.0702	0.0376	0.0171	0.0051	0.0019	0.0003	0.0001	0.0001	0.0001	0.0000
1997	female	0.0002	0.0004	0.0018	0.0039	0.0105	0.0220	0.0401	0.0728	0.0838	0.0795	0.0724	0.0568	0.0343	0.0195	0.0068	0.0032	0.0010	0.0003	0.0001	0.0001	0.0000
1997	male	0.0002	0.0004	0.0018	0.0037	0.0102	0.0212	0.0386	0.0701	0.0807	0.0765	0.0697	0.0547	0.0330	0.0187	0.0065	0.0031	0.0010	0.0003	0.0001	0.0001	0.0000
1998	female	0.0002	0.0006	0.0010	0.0048	0.0130	0.0204	0.0399	0.0630	0.0765	0.0769	0.0689	0.0562	0.0344	0.0176	0.0085	0.0018	0.0010	0.0003	0.0002	0.0001	0.0000
1998	male	0.0002	0.0006	0.0011	0.0051	0.0138	0.0216	0.0423	0.0668	0.0811	0.0815	0.0731	0.0596	0.0365	0.0187	0.0090	0.0019	0.0011	0.0004	0.0002	0.0001	0.0000
1999	female	0.0000	0.0005	0.0005	0.0018	0.0069	0.0230	0.0479	0.0759	0.0895	0.0873	0.0702	0.0471	0.0272	0.0129	0.0060	0.0021	0.0005	0.0005	0.0001	0.0000	0.0000
1999	male	0.0000	0.0005	0.0005	0.0018	0.0070	0.0230	0.0479	0.0760	0.0896	0.0874	0.0702	0.0472	0.0272	0.0129	0.0060	0.0021	0.0005	0.0005	0.0001	0.0000	0.0000
2000	female	0.0002	0.0003	0.0009	0.0025	0.0073	0.0155	0.0331	0.0701	0.1006	0.0956	0.0711	0.0451	0.0232	0.0093	0.0031	0.0011	0.0004	0.0001	0.0001	0.0000	0.0000
2000	male	0.0002	0.0003	0.0010	0.0027	0.0079	0.0168	0.0359	0.0760	0.1092	0.1038	0.0772	0.0490	0.0252	0.0101	0.0034	0.0011	0.0005	0.0001	0.0001	0.0000	0.0000
2001	female	0.0000	0.0007	0.0014	0.0029	0.0067	0.0132	0.0255	0.0492	0.0930	0.1150	0.0983	0.0605	0.0317	0.0154	0.0050	0.0027	0.0011	0.0005	0.0001	0.0000	0.0000
2001	male	0.0000	0.0006	0.0013	0.0027	0.0061	0.0120	0.0233	0.0449	0.0848	0.1049	0.0896	0.0552	0.0290	0.0141	0.0046	0.0025	0.0010	0.0004	0.0001	0.0000	0.0000
2002	combined	0.0000	0.0000	0.0026	0.0065	0.0243	0.0335	0.0604	0.0791	0.1278	0.1887	0.1939	0.1343	0.0839	0.0400	0.0143	0.0070	0.0013	0.0013	0.0009	0.0000	0.0000

Table 6. Sex-specific length compositions for black rockfish taken in the Oregon hook-and-line fishery (1992, 1995-2002).

		Fork Length [cm]																				
Year	Sex	20	22	24	26	28	30	32	34	36	38	40	42	44	46	48	50	52	54	56	58	60
1992	female	0.0000	0.0000	0.0000	0.0000	0.0000	0.0032	0.0300	0.0056	0.0608	0.0727	0.0995	0.0787	0.0406	0.0696	0.0181	0.0314	0.0129	0.0000	0.0000	0.0000	0.0000
1992	male	0.0000	0.0000	0.0000	0.0000	0.0000	0.0165	0.0011	0.0011	0.0216	0.0251	0.0687	0.1100	0.0810	0.0907	0.0354	0.0143	0.0061	0.0050	0.0000	0.0000	0.0000
1995	female	0.0000	0.0000	0.0000	0.0000	0.0000	0.0049	0.0374	0.0407	0.0654	0.0757	0.0578	0.0681	0.0577	0.0474	0.0227	0.0102	0.0016	0.0027	0.0000	0.0000	0.0000
1995	male	0.0000	0.0000	0.0000	0.0000	0.0000	0.0031	0.0285	0.0531	0.0485	0.0658	0.0988	0.0724	0.1008	0.0243	0.0103	0.0008	0.0009	0.0000	0.0000	0.0000	0.0000
1996	female	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0077	0.0256	0.0728	0.0729	0.1064	0.0528	0.0843	0.0404	0.0257	0.0096	0.0000	0.0000	0.0000	0.0000	0.0000
1996	male	0.0000	0.0000	0.0000	0.0000	0.0000	0.0029	0.0000	0.0206	0.0466	0.0616	0.0905	0.1570	0.0959	0.0239	0.0028	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
1997	female	0.0000	0.0000	0.0000	0.0007	0.0037	0.0043	0.0067	0.0416	0.0563	0.0413	0.0737	0.0637	0.0484	0.0681	0.0037	0.0415	0.0038	0.0241	0.0080	0.0000	0.0000
1997	male	0.0000	0.0000	0.0005	0.0016	0.0016	0.0070	0.0092	0.0225	0.0243	0.0448	0.0581	0.1359	0.0795	0.0861	0.0025	0.0367	0.0000	0.0000	0.0000	0.0000	0.0000
1998	female	0.0000	0.0000	0.0000	0.0000	0.0000	0.0043	0.0190	0.0254	0.0415	0.1008	0.0800	0.0514	0.0645	0.0426	0.0335	0.0053	0.0056	0.0000	0.0076	0.0000	0.0000
1998	male	0.0000	0.0000	0.0000	0.0027	0.0015	0.0098	0.0223	0.0296	0.0663	0.0634	0.1114	0.0826	0.0726	0.0208	0.0216	0.0075	0.0066	0.0000	0.0000	0.0000	0.0000
1999	female	0.0000	0.0000	0.0000	0.0185	0.0000	0.0159	0.0397	0.1130	0.1097	0.0640	0.0534	0.0962	0.0166	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
1999	male	0.0000	0.0000	0.0000	0.0000	0.0118	0.0118	0.0451	0.0231	0.1016	0.0891	0.0784	0.0477	0.0289	0.0237	0.0118	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
2000	female	0.0000	0.0000	0.0000	0.0000	0.0022	0.0158	0.0229	0.0505	0.1006	0.1021	0.0705	0.0540	0.0492	0.0130	0.0116	0.0000	0.0058	0.0032	0.0000	0.0000	0.0000
2000	male	0.0000	0.0000	0.0000	0.0006	0.0013	0.0057	0.0123	0.0654	0.0885	0.1128	0.0737	0.0597	0.0370	0.0281	0.0091	0.0022	0.0022	0.0000	0.0000	0.0000	0.0000
2001	female	0.0000	0.0000	0.0000	0.0000	0.0006	0.0024	0.0187	0.0264	0.0662	0.0903	0.1159	0.0700	0.0701	0.0172	0.0230	0.0010	0.0004	0.0003	0.0000	0.0000	0.0000
2001	male	0.0000	0.0000	0.0000	0.0000	0.0004	0.0007	0.0046	0.0169	0.0595	0.0875	0.1534	0.0787	0.0602	0.0221	0.0122	0.0004	0.0000	0.0000	0.0008	0.0000	0.0000
2002	female	0.0000	0.0000	0.0000	0.0000	0.0000	0.0029	0.0150	0.0293	0.0471	0.0786	0.0873	0.0781	0.0841	0.0353	0.0178	0.0162	0.0003	0.0000	0.0000	0.0000	0.0000
2002	male	0.0000	0.0000	0.0000	0.0000	0.0000	0.0023	0.0068	0.0216	0.0401	0.0721	0.1375	0.1313	0.0488	0.0390	0.0081	0.0004	0.0000	0.0000	0.0000	0.0000	0.0000

Table 7. Combined sex length compositions for black rockfish taken in the Oregon trawl fishery (1994, 1997, 1998, 2001).

		Fork Length [cm]																				
year	sex	20	22	24	26	28	30	32	34	36	38	40	42	44	46	48	50	52	54	56	58	60
1994	combined	0.0000	0.0000	0.0000	0.0000	0.0000	0.0488	0.0000	0.0245	0.0977	0.1952	0.0732	0.1220	0.1949	0.1708	0.0488	0.0243	0.0000	0.0000	0.0000	0.0000	0.0000
1997	combined	0.0000	0.0000	0.0000	0.0000	0.0000	0.0043	0.0000	0.0000	0.0000	0.0192	0.0384	0.1738	0.2391	0.2379	0.1561	0.0776	0.0382	0.0153	0.0000	0.0000	0.0000
1998	combined	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0016	0.0000	0.0287	0.1142	0.1747	0.2057	0.1637	0.1879	0.0857	0.0062	0.0285	0.0031	0.0000	0.0000
2001	combined	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.4725	0.1324	0.0000	0.2627	0.0265	0.0530	0.0265	0.0265	0.0000	0.0000	0.0000

Table 8. Combined sex length compositions for black rockfish taken in the northern California recreational fishery (1980-2002).

		Fork Length [cm]																				
Year	Sex	20	22	24	26	28	30	32	34	36	38	40	42	44	46	48	50	52	54	56	58	60
1980	combined	0.0000	0.0020	0.0059	0.0176	0.0332	0.0664	0.1074	0.1094	0.0820	0.0879	0.0996	0.0801	0.1035	0.0801	0.0566	0.0430	0.0156	0.0078	0.0000	0.0020	0.0000
1981	combined	0.0000	0.0021	0.0000	0.0166	0.0229	0.0312	0.0374	0.1102	0.1164	0.1102	0.0894	0.1019	0.1372	0.0832	0.0748	0.0437	0.0083	0.0125	0.0021	0.0000	0.0000
1982	combined	0.0017	0.0035	0.0000	0.0052	0.0175	0.0750	0.0820	0.0733	0.0733	0.0733	0.1030	0.1274	0.0855	0.0890	0.0890	0.0489	0.0384	0.0017	0.0105	0.0017	0.0000
1983	combined	0.0000	0.0026	0.0026	0.0026	0.0205	0.0462	0.0821	0.1051	0.0923	0.0974	0.1205	0.1026	0.0974	0.0769	0.0872	0.0410	0.0077	0.0077	0.0051	0.0026	0.0000
1984	combined	0.0016	0.0032	0.0273	0.0353	0.0770	0.0594	0.1059	0.0899	0.0690	0.0770	0.0963	0.0803	0.1252	0.0690	0.0465	0.0177	0.0096	0.0064	0.0032	0.0000	0.0000
1985	combined	0.0022	0.0073	0.0146	0.0321	0.0774	0.1314	0.1350	0.1161	0.0803	0.0679	0.0810	0.0577	0.0599	0.0584	0.0423	0.0212	0.0131	0.0022	0.0000	0.0000	0.0000
1986	combined	0.0029	0.0029	0.0048	0.0213	0.0397	0.0735	0.1064	0.1199	0.0861	0.0957	0.1054	0.1006	0.0706	0.0793	0.0464	0.0193	0.0174	0.0058	0.0019	0.0000	0.0000
1987	combined	0.0106	0.0106	0.0211	0.0529	0.0973	0.0930	0.1332	0.1057	0.1416	0.0825	0.0613	0.0148	0.0402	0.0507	0.0423	0.0233	0.0085	0.0063	0.0000	0.0021	0.0021
1988	combined	0.0033	0.0133	0.0398	0.1044	0.0754	0.0729	0.1036	0.1301	0.0845	0.0721	0.0406	0.0398	0.0505	0.0547	0.0605	0.0307	0.0141	0.0058	0.0033	0.0008	0.0000
1989	combined	0.0007	0.0062	0.0201	0.0408	0.0734	0.1370	0.1730	0.1502	0.1114	0.0519	0.0429	0.0464	0.0346	0.0471	0.0311	0.0166	0.0097	0.0069	0.0000	0.0000	0.0000
1990	combined	0.0038	0.0077	0.0613	0.0843	0.0843	0.2222	0.2759	0.1724	0.0575	0.0192	0.0115	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
1991	combined	0.0038	0.0345	0.0384	0.1420	0.1958	0.1823	0.1785	0.1286	0.0672	0.0192	0.0000	0.0038	0.0019	0.0019	0.0000	0.0000	0.0000	0.0000	0.0019	0.0000	0.0000
1992	combined	0.0000	0.0052	0.0104	0.0547	0.1302	0.1198	0.2109	0.1380	0.1042	0.0573	0.0443	0.0365	0.0260	0.0365	0.0156	0.0078	0.0026	0.0000	0.0000	0.0000	0.0000
1993	combined	0.0020	0.0071	0.0360	0.0826	0.1145	0.1597	0.1389	0.1029	0.0679	0.0573	0.0507	0.0669	0.0446	0.0319	0.0198	0.0117	0.0030	0.0015	0.0010	0.0000	0.0000
1994	combined	0.0073	0.0114	0.0322	0.0716	0.1235	0.1796	0.1832	0.1090	0.0903	0.0503	0.0337	0.0348	0.0296	0.0218	0.0161	0.0026	0.0016	0.0010	0.0000	0.0005	0.0000
1995	combined	0.0026	0.0093	0.0622	0.1390	0.1899	0.2197	0.1198	0.0668	0.0470	0.0371	0.0318	0.0212	0.0185	0.0132	0.0073	0.0053	0.0040	0.0013	0.0013	0.0000	0.0026
1996	combined	0.0000	0.0114	0.0204	0.0541	0.1188	0.1540	0.1510	0.1207	0.0772	0.0605	0.0681	0.0530	0.0488	0.0341	0.0174	0.0057	0.0011	0.0030	0.0008	0.0000	0.0000
1997	combined	0.0029	0.0198	0.0595	0.1450	0.1924	0.2152	0.1452	0.1037	0.0579	0.0230	0.0115	0.0083	0.0075	0.0056	0.0013	0.0011	0.0000	0.0000	0.0000	0.0000	0.0000
1998	combined	0.0038	0.0063	0.0347	0.0859	0.1768	0.2273	0.1313	0.0840	0.0385	0.0366	0.0505	0.0417	0.0360	0.0227	0.0126	0.0051	0.0044	0.0013	0.0006	0.0000	0.0000
1999	combined	0.0030	0.0079	0.0225	0.0596	0.1163	0.2642	0.2605	0.1656	0.0584	0.0207	0.0110	0.0043	0.0030	0.0018	0.0006	0.0000	0.0006	0.0000	0.0000	0.0000	0.0000
2000	combined	0.0000	0.0039	0.0146	0.0527	0.0956	0.2937	0.3161	0.1307	0.0468	0.0107	0.0088	0.0059	0.0049	0.0068	0.0039	0.0000	0.0000	0.0000	0.0039	0.0010	0.0000
2001	combined	0.0039	0.0088	0.0215	0.0371	0.0713	0.1494	0.2207	0.2139	0.1074	0.0557	0.0430	0.0283	0.0088	0.0049	0.0117	0.0117	0.0000	0.0010	0.0010	0.0000	0.0000
2002	combined	0.0040	0.0103	0.0459	0.0878	0.0965	0.1108	0.1590	0.1582	0.1566	0.0672	0.0332	0.0237	0.0158	0.0103	0.0079	0.0087	0.0024	0.0008	0.0000	0.0008	0.0000

Table 9. Combined sex length compositions for black rockfish taken in the northern California hook-and-line fishery (1982-2002).

		Fork Length [cm]																				
year	sex	20	22	24	26	28	30	32	34	36	38	40	42	44	46	48	50	52	54	56	58	60
1982	combined	0.0000	0.0000	0.0000	0.0000	0.0000	0.0188	0.0188	0.0375	0.1167	0.1202	0.0375	0.1202	0.1466	0.1953	0.0980	0.0452	0.0188	0.0264	0.0000	0.0000	0.0000
1983	combined	0.0000	0.0000	0.0000	0.0000	0.0000	0.0090	0.0000	0.0202	0.0179	0.0355	0.0940	0.2454	0.2310	0.1529	0.0883	0.0707	0.0352	0.0000	0.0000	0.0000	0.0000
1984	combined	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0677	0.0417	0.0209	0.1433	0.3204	0.1980	0.1613	0.0338	0.0130	0.0000	0.0000	0.0000	0.0000
1985	combined	0.0000	0.0000	0.0000	0.0000	0.0000	0.0323	0.0323	0.0323	0.0323	0.1290	0.0968	0.1935	0.1613	0.1613	0.1290	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
1992	combined	0.0000	0.0000	0.0019	0.0072	0.0102	0.0111	0.0302	0.0491	0.0858	0.1398	0.1960	0.1669	0.1097	0.0838	0.0792	0.0260	0.0028	0.0000	0.0003	0.0000	0.0000
1993	combined	0.0000	0.0008	0.0239	0.0435	0.0634	0.0608	0.0721	0.0909	0.1080	0.1302	0.1387	0.1146	0.0764	0.0412	0.0190	0.0091	0.0043	0.0006	0.0000	0.0005	0.0019
1994	combined	0.0002	0.0010	0.0054	0.0094	0.0203	0.0548	0.0813	0.1206	0.1083	0.1307	0.1180	0.1416	0.0812	0.0649	0.0290	0.0190	0.0076	0.0060	0.0007	0.0000	0.0000
1995	combined	0.0000	0.0006	0.0001	0.0016	0.0184	0.0528	0.0985	0.1141	0.1092	0.1528	0.1398	0.1201	0.0851	0.0577	0.0262	0.0063	0.0096	0.0041	0.0030	0.0000	0.0000
1996	combined	0.0108	0.0108	0.0215	0.0779	0.0378	0.0715	0.0965	0.0868	0.1321	0.1110	0.1009	0.0997	0.0660	0.0455	0.0208	0.0079	0.0019	0.0007	0.0000	0.0000	0.0000
1997	combined	0.0000	0.0000	0.0096	0.0077	0.0234	0.0431	0.0841	0.1547	0.1602	0.1527	0.1159	0.0980	0.0735	0.0517	0.0180	0.0063	0.0011	0.0000	0.0000	0.0000	0.0000
1998	combined	0.0000	0.0000	0.0000	0.0000	0.0029	0.0441	0.0487	0.1452	0.1379	0.1748	0.1751	0.1706	0.0530	0.0257	0.0126	0.0093	0.0000	0.0000	0.0000	0.0000	0.0000
1999	combined	0.0000	0.0000	0.0000	0.0021	0.0028	0.0193	0.0564	0.1322	0.1724	0.1805	0.1594	0.1074	0.0775	0.0428	0.0249	0.0170	0.0035	0.0017	0.0000	0.0000	0.0000
2000	combined	0.0000	0.0000	0.0000	0.0000	0.0057	0.0203	0.0583	0.0997	0.1510	0.1902	0.1640	0.1320	0.0809	0.0681	0.0182	0.0056	0.0011	0.0047	0.0000	0.0000	0.0000
2001	combined	0.0000	0.0000	0.0000	0.0025	0.0016	0.0120	0.0545	0.0850	0.1469	0.1999	0.2000	0.1794	0.0669	0.0217	0.0261	0.0032	0.0002	0.0000	0.0000	0.0000	0.0000
2002	combined	0.0000	0.0000	0.0000	0.0012	0.0130	0.0213	0.0518	0.0738	0.1270	0.1790	0.1825	0.1223	0.0866	0.0733	0.0401	0.0204	0.0023	0.0055	0.0000	0.0000	0.0000

Table 10. Combined sex length compositions for black rockfish taken in the northen California trawl fishery (1978-1999).

		Fork Length [cm]																				
Year	Sex	20	22	24	26	28	30	32	34	36	38	40	42	44	46	48	50	52	54	56	58	60
1978	combined	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.1418	0.1865	0.2236	0.1016	0.0630	0.1031	0.0864	0.0137	0.0228	0.0493	0.0000	0.0083
1980	combined	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0028	0.0456	0.0615	0.1618	0.1093	0.2275	0.1611	0.1231	0.0062	0.0629	0.0284	0.0055	0.0041
1981	combined	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0385	0.0385	0.0035	0.0373	0.0739	0.0895	0.1340	0.1523	0.2152	0.1236	0.0508	0.0080	0.0267	0.0084	0.0000
1982	combined	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0001	0.0387	0.1423	0.1204	0.1129	0.2128	0.1814	0.1166	0.0699	0.0045	0.0002	0.0000	0.0000
1983	combined	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0096	0.0096	0.1030	0.1157	0.2230	0.1916	0.2137	0.0768	0.0293	0.0144	0.0120	0.0007	0.0005
1984	combined	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0173	0.1077	0.2699	0.2367	0.1117	0.1529	0.0412	0.0505	0.0066	0.0053	0.0000
1985	combined	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0291	0.0520	0.1590	0.2420	0.1177	0.2549	0.0775	0.0339	0.0339	0.0000	0.0000
1987	combined	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0040	0.0121	0.0464	0.0539	0.1629	0.2105	0.1916	0.1411	0.0971	0.0727	0.0069	0.0008
1988	combined	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0123	0.0162	0.2270	0.0349	0.2309	0.1185	0.1636	0.1421	0.0547	0.0000
1989	combined	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0047	0.0000	0.0093	0.1131	0.0673	0.2290	0.1402	0.2879	0.0879	0.0290	0.0243	0.0075
1991	combined	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0515	0.0000	0.1802	0.0000	0.1470	0.2426	0.3015	0.0515	0.0257	0.0000	0.0000	0.0000	0.0000
1992	combined	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0046	0.1030	0.0671	0.3693	0.1516	0.1701	0.0543	0.0266	0.0266	0.0000	0.0266	0.0000
1996	combined	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0800	0.0400	0.0800	0.2400	0.1600	0.1200	0.1200	0.0000	0.0800	0.0800	0.0000
1997	combined	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0030	0.0000	0.0488	0.1500	0.1283	0.2843	0.1590	0.0398	0.1500	0.0367	0.0000	0.0000
1999	combined	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0400	0.0000	0.0000	0.0400	0.1600	0.2400	0.2000	0.0400	0.1600	0.0400	0.0400	0.0400	0.0000

Table 11. Likelihood components from the base model.

Component	Emphasis	log-Likelihood
OR Sport Age Compositions	1.00	-169.95
OR Sport Length Compositions	1.00	-345.04
OR Sport Length @ Age	0.10	-2177.19
OR Hook-and-line Length Compositions	1.00	-90.77
OR Trawl Length Compositions	1.00	-35.37
CA Sport Length Compositions	1.00	-179.49
CA Hook-and-line Length Compositions	1.00	-124.35
CA Trawl Length Compositions	1.00	-101.46
OR RECFIN CPUE	1.00	11.11
OR ODF&W CPUE	1.00	8.79
CA RECFIN CPUE	1.00	8.39
CA CDF&G CPUE	1.00	1.98

Table 12. Base model outputs of population trend from the stock synthesis model.

Year	Age 2+ biomass	Spawning Output	Age 2 Recruits	Catch	Depletion
1945	20,510	3,144,660	2,665	0	100.0%
1946	20,515	3,144,656	2,665	39	100.0%
1947	20,488	3,137,664	2,665	79	99.8%
1948	20,429	3,124,300	2,665	118	99.4%
1949	20,343	3,105,440	2,664	157	98.8%
1950	20,230	3,081,864	2,662	197	98.0%
1951	20,094	3,054,112	2,660	236	97.1%
1952	19,935	3,022,598	2,658	276	96.1%
1953	19,756	2,987,689	2,655	315	95.0%
1954	19,559	2,949,664	2,651	354	93.8%
1955	19,344	2,908,637	2,647	378	92.5%
1956	19,127	2,867,876	2,643	427	91.2%
1957	18,886	2,822,325	2,638	462	89.7%
1958	18,636	2,775,204	2,633	481	88.3%
1959	18,390	2,729,732	2,627	459	86.8%
1960	18,183	2,693,445	2,621	467	85.7%
1961	17,985	2,659,520	2,615	430	84.6%
1962	17,831	2,636,094	2,610	426	83.8%
1963	17,690	2,615,718	2,605	476	83.2%
1964	17,515	2,587,293	2,602	459	82.3%
1965	17,365	2,564,296	2,599	519	81.5%
1966	17,169	2,531,879	2,594	588	80.5%
1967	16,923	2,489,712	2,591	637	79.2%
1968	16,647	2,442,234	2,586	574	77.7%
1969	16,444	2,410,467	2,579	685	76.7%
1970	16,149	2,360,400	2,572	775	75.1%
1971	15,792	2,296,956	2,567	694	73.0%
1972	15,530	2,253,688	2,558	743	71.7%
1973	15,238	2,204,445	2,547	763	70.1%
1974	14,944	2,154,721	2,539	831	68.5%
1975	14,403	2,095,805	1,100	936	66.6%
1976	13,759	2,021,053	1,602	1,119	64.3%
1977	12,948	1,915,076	2,140	937	60.9%
1978	12,506	1,839,876	3,573	1,042	58.5%
1979	11,912	1,725,506	2,187	1,099	54.9%
1980	11,346	1,587,449	2,013	734	50.5%
1981	11,182	1,523,701	2,119	1,836	48.5%
1982	10,014	1,288,784	2,123	1,636	41.0%
1983	9,016	1,138,092	1,846	1,325	36.2%
1984	8,464	1,031,295	2,535	1,273	32.8%
1985	7,929	952,645	1,982	1,187	30.3%
1986	7,702	887,570	3,325	816	28.2%
1987	7,838	881,285	2,601	664	28.0%
1988	8,069	900,041	1,634	916	28.6%
1989	8,095	896,821	2,110	1,018	28.5%
1990	7,989	900,920	2,261	896	28.6%
1991	8,013	939,267	2,694	711	29.9%
1992	8,252	988,993	2,870	1,194	31.4%
1993	8,012	948,032	2,569	886	30.1%
1994	8,171	948,605	3,062	847	30.2%
1995	8,442	956,929	3,206	858	30.4%
1996	8,966	971,532	4,669	903	30.9%
1997	9,519	990,796	4,004	879	31.5%
1998	9,951	1,029,952	1,835	827	32.8%
1999	10,412	1,108,658	2,093	727	35.3%
2000	10,807	1,244,148	2,118	602	39.6%
2001	11,172	1,412,334	2,165	769	44.9%
2002	11,232	1,536,076	2,236	617	48.8%

Table 13. Length-specific summary of black rockfish population characteristics in the terminal year of the base model.

					Selectivities					
FL[cm]	Wt [kg]	larvae/gm	% mature	Spawn	OR sport	OR hook	OR trawl	CA sport	CA hook	CA trawl
20	0.14	305.7	0.000	0	0.001	0.001	0.001	0.001	0.001	0.001
22	0.18	310.7	0.001	0	0.009	0.002	0.001	0.205	0.014	0.001
24	0.23	316.7	0.002	0	0.024	0.003	0.001	0.405	0.036	0.001
26	0.30	323.8	0.004	0	0.055	0.008	0.001	0.591	0.075	0.001
28	0.37	332.0	0.009	1	0.112	0.020	0.001	0.755	0.140	0.002
30	0.46	341.4	0.021	3	0.211	0.051	0.002	0.891	0.240	0.002
32	0.55	352.0	0.047	9	0.362	0.131	0.004	1.000	0.382	0.004
34	0.66	364.1	0.100	24	0.554	0.302	0.011	1.000	0.554	0.007
36	0.79	377.6	0.198	59	0.747	0.568	0.032	0.782	0.732	0.016
38	0.92	392.6	0.354	128	0.900	0.832	0.091	0.379	0.886	0.034
40	1.08	409.3	0.546	241	1.000	1.000	0.239	0.276	1.000	0.076
42	1.25	427.7	0.726	387	1.000	1.000	0.498	0.266	1.000	0.160
44	1.43	447.8	0.855	549	0.731	0.933	0.757	0.265	0.829	0.308
46	1.64	469.9	0.930	716	0.480	0.734	0.908	0.265	0.662	0.510
48	1.86	493.8	0.968	890	0.332	0.484	0.969	0.265	0.525	0.710
50	2.10	519.9	0.985	1078	0.267	0.369	0.990	0.265	0.427	0.852
52	2.37	548.0	0.994	1289	0.242	0.340	0.997	0.265	0.363	0.932
54	2.65	578.4	0.997	1529	0.233	0.333	0.999	0.265	0.325	0.971
56	2.96	611.0	0.999	1804	0.230	0.332	1.000	0.265	0.303	0.989
58	3.28	636.7	0.999	2089	0.229	0.332	1.000	0.265	0.291	0.997
60	3.45	645.4	1.000	2228	0.229	0.332	1.000	0.265	0.284	1.000

Table 14. Projected optimum yield (OY) under the base assessment model and under two alternative views of the level of historical catch prior to 1978.

	Low Catch Scenario		Base Model		High Catch Scenario	
Year	OY [mt]	Depletion	OY [mt]	Depletion	OY [mt]	Depletion
2003	757	54.2%	802	51.9%	886	48.1%
2004	729	54.9%	775	52.7%	861	49.0%
2005	706	54.5%	753	52.5%	842	48.9%
2006	688	53.3%	736	51.4%	828	48.2%
2007	676	51.7%	725	50.0%	820	47.1%
2008	668	50.3%	719	48.8%	817	46.2%
2009	663	49.2%	715	47.9%	816	45.6%
2010	660	48.3%	713	47.2%	816	45.1%
2011	657	47.7%	711	46.7%	816	44.9%
2012	654	47.2%	708	46.3%	816	44.7%

Table 15. Decision table describing the conservation consequences of management errors that arise from incorrect assumptions about the true state of nature (i.e., the historical catch of black rockfish prior to 1978). Consequences are measured as the amount of spawning depletion following 5 years of management under each scenario.

	"True" State of Nature		
	Low Catch History	Base Model	High Catch History
Mean $F_{50\%}$ ABC ⇒	711 mt	758 mt	847 mt
Management Action (2003-2007 mean harvest)		Total Spawning Depletion After 5 Years of Harvest	
711 mt:	51.7%	51.2%	49.7%
758 mt:	50.7%	50.0%	48.9%
847 mt:	48.3%	48.1%	47.1%

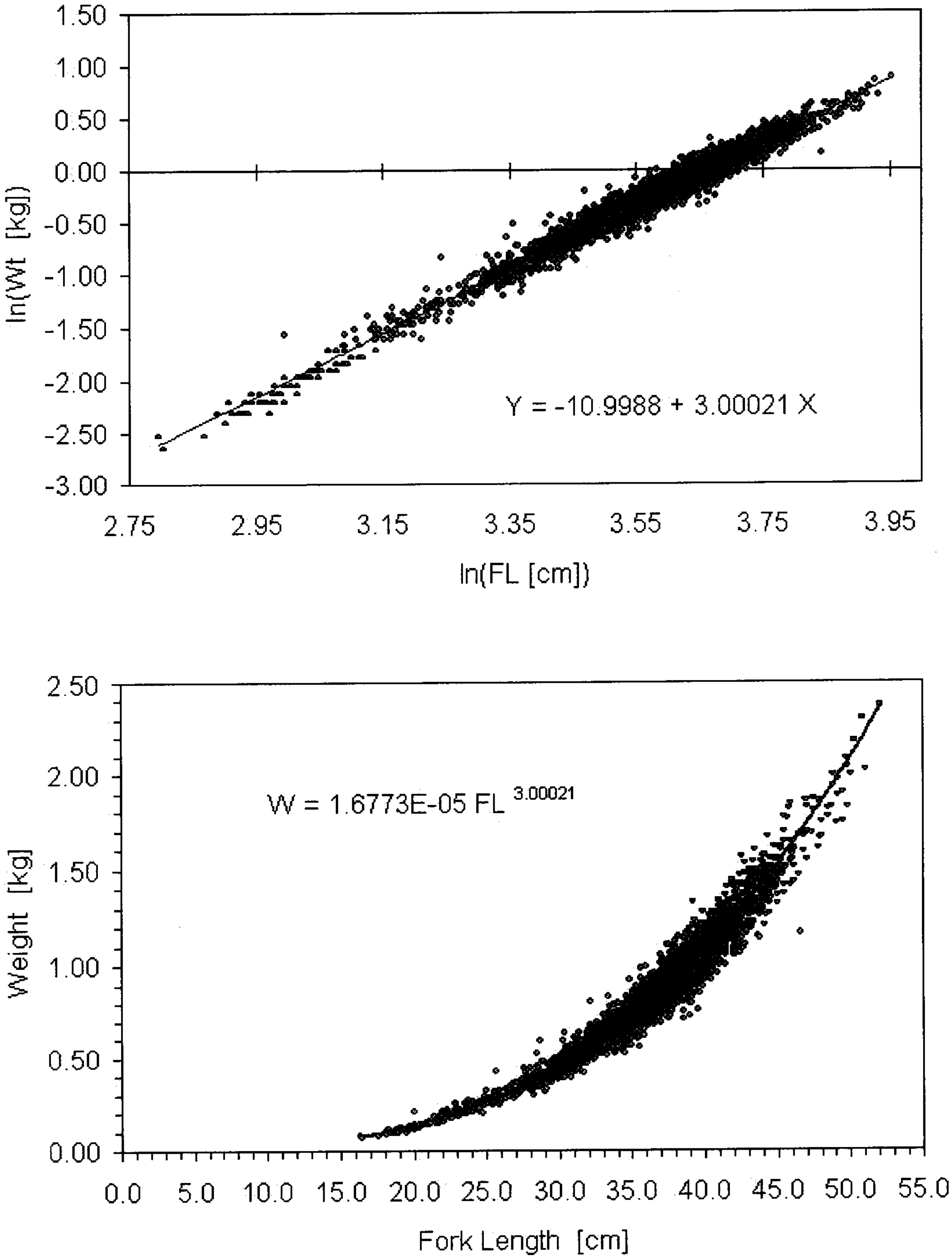


Figure 1. Length-weight relationship for black rockfish derived from fish sampled in the Oregon recreational fishery.

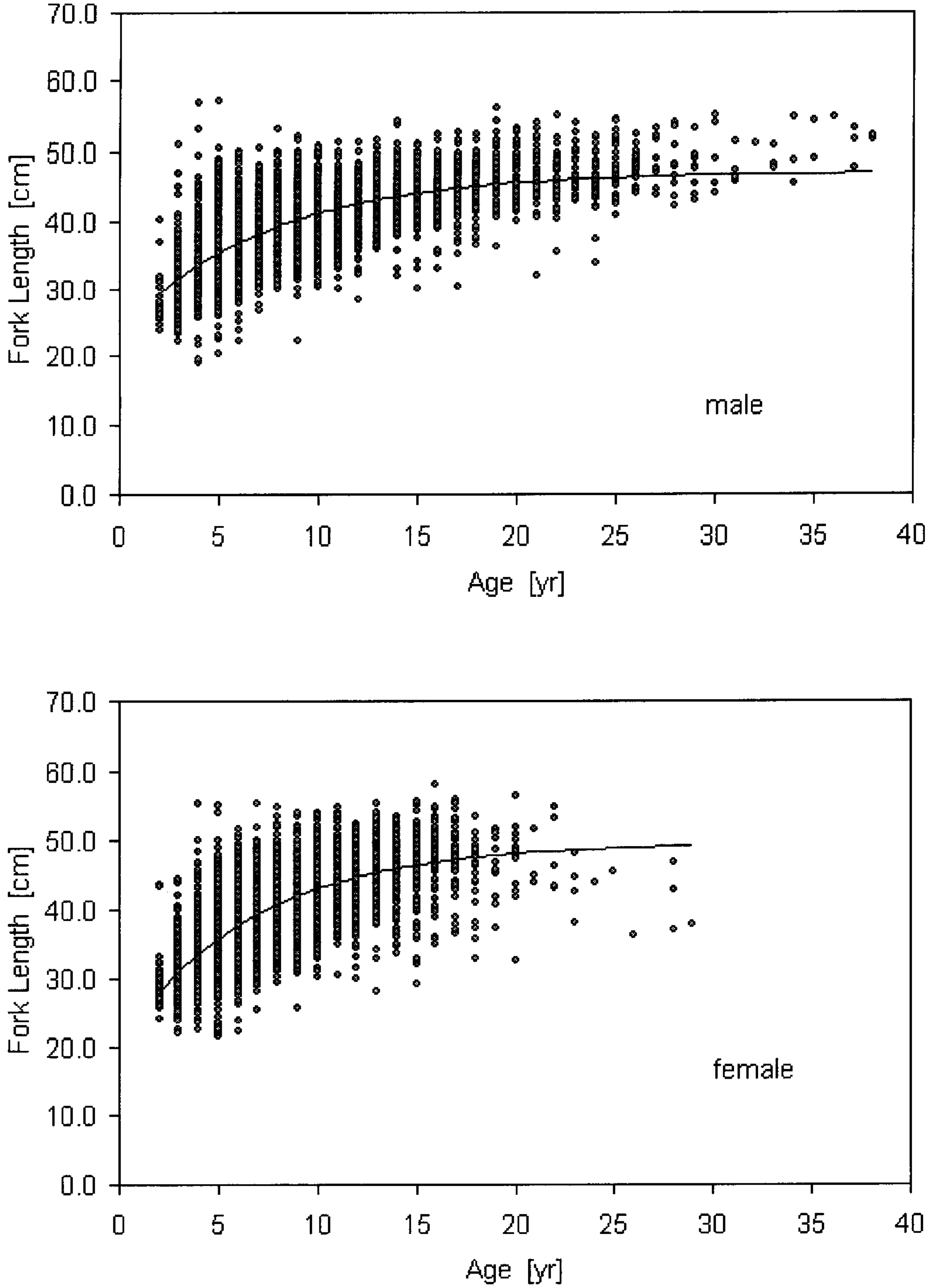


Figure 2. Fit of the von Bertalanffy growth model to black rockfish sampled from the Oregon recreational fishery.

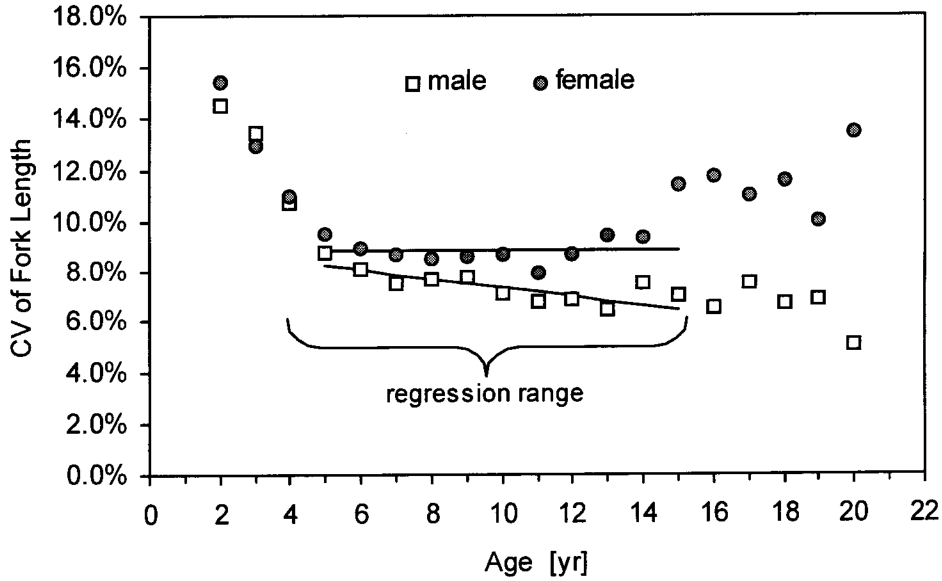


Figure 3. Variation in black rockfish fork length (FL) at age. Separate regressions were used to predict the sex-specific coefficients of variation for length variability at 5 and 15 years of age.

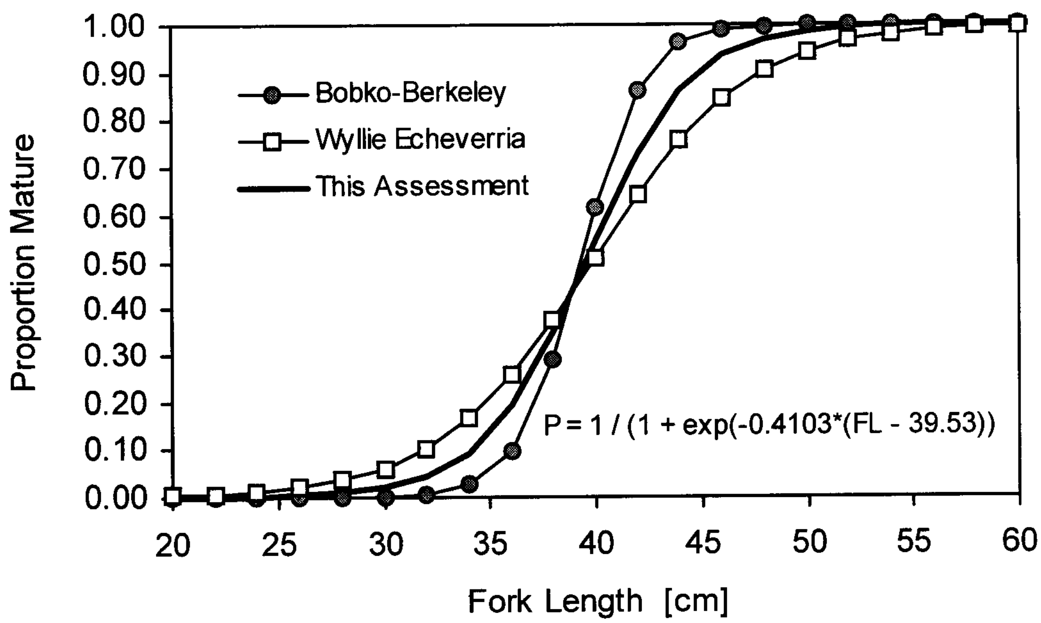


Figure 4. The relationship between black rockfish length and maturity.

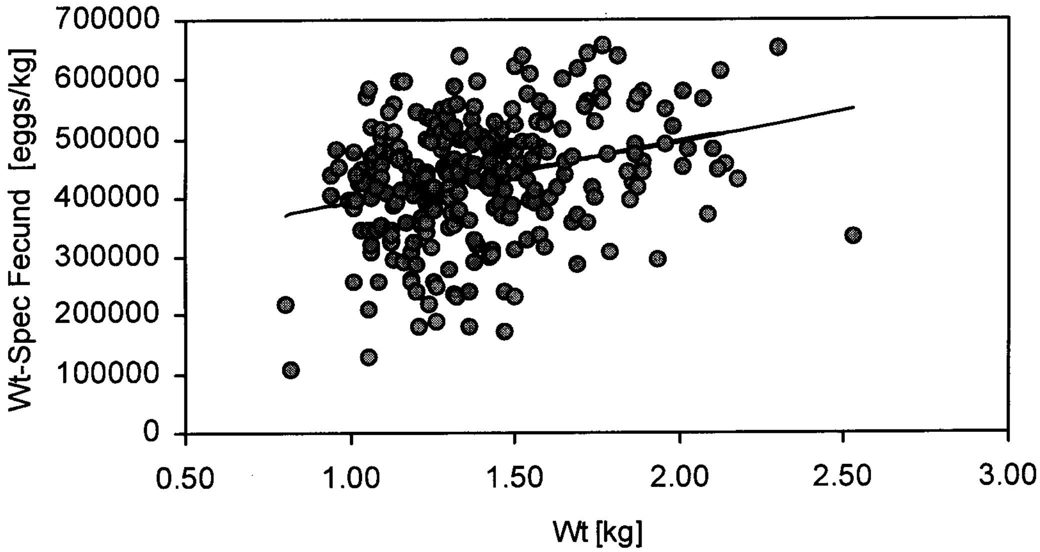


Figure 5. The dependence of weight-specific fecundity on female weight for black rockfish sampled in Oregon.

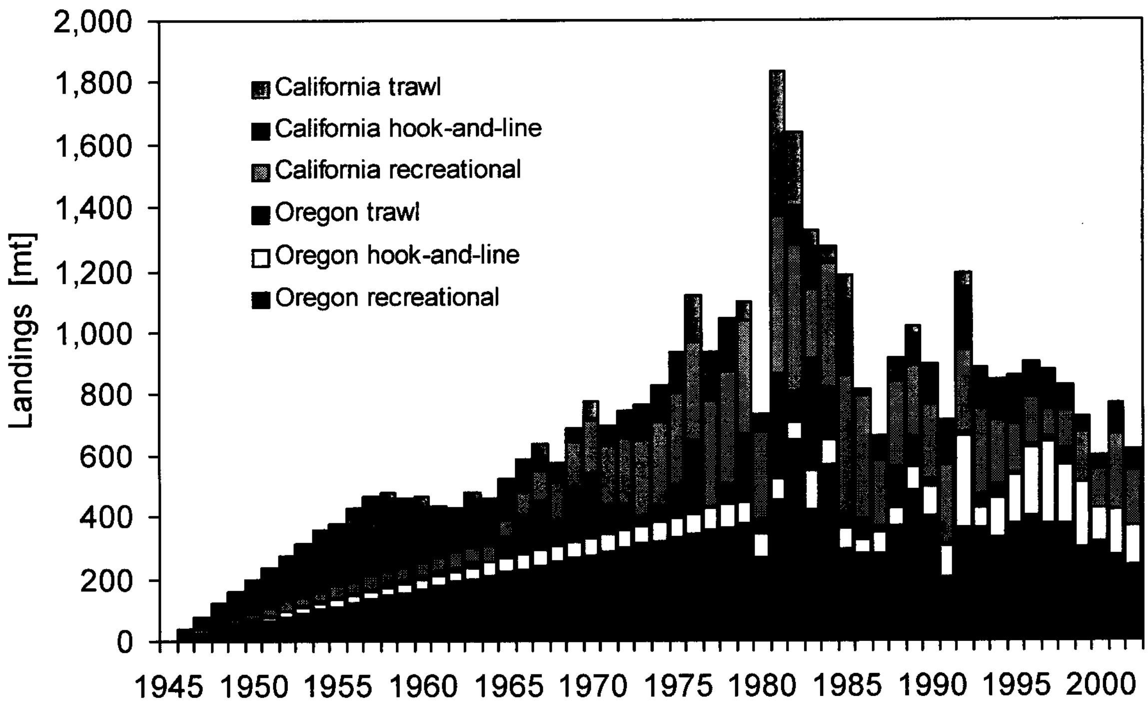


Figure 6. Estimated landings of black rockfish by fishery and State for the period 1945-2002. Landings information prior to 1978 were sparse and missing values were estimated by linear interpolation.

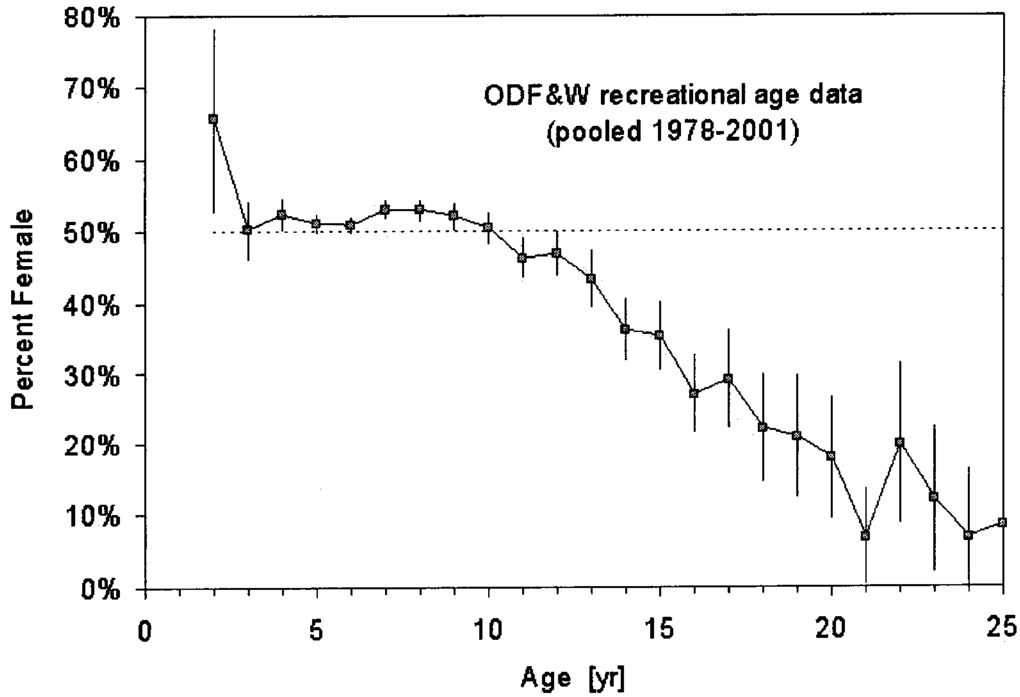


Figure 7. Decline in the relative abundance of females with age in the Oregon recreational fishery. The deficit of females after age 10 was interpreted as an increase in the natural mortality rate at that age.

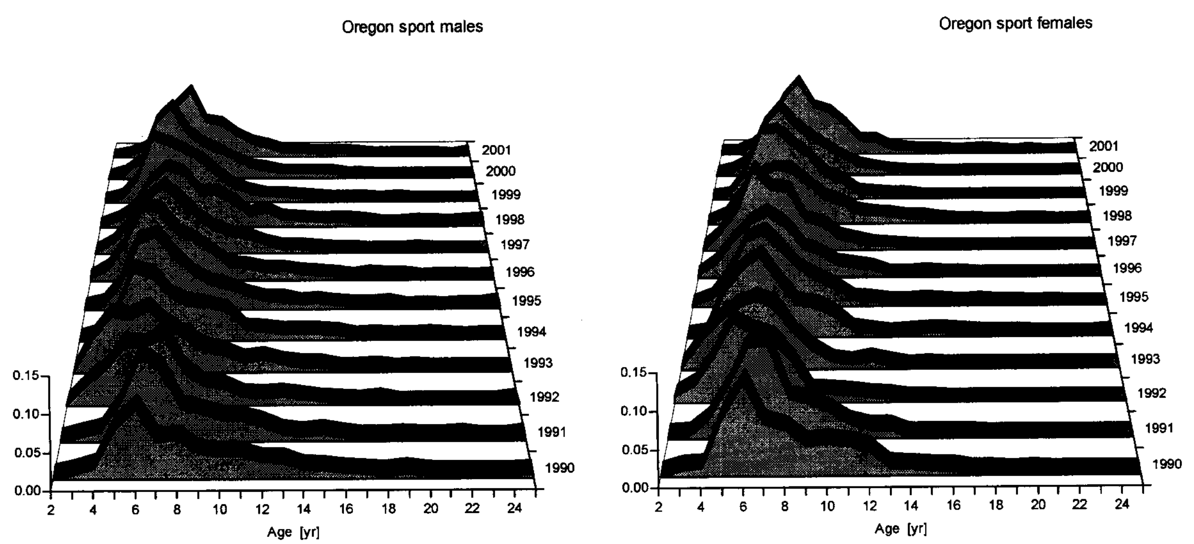


Figure 8. Age-frequency distributions for male (left) and female (right) black rockfish sampled from the Oregon recreational fishery (1990-2001). [ODF&W data]

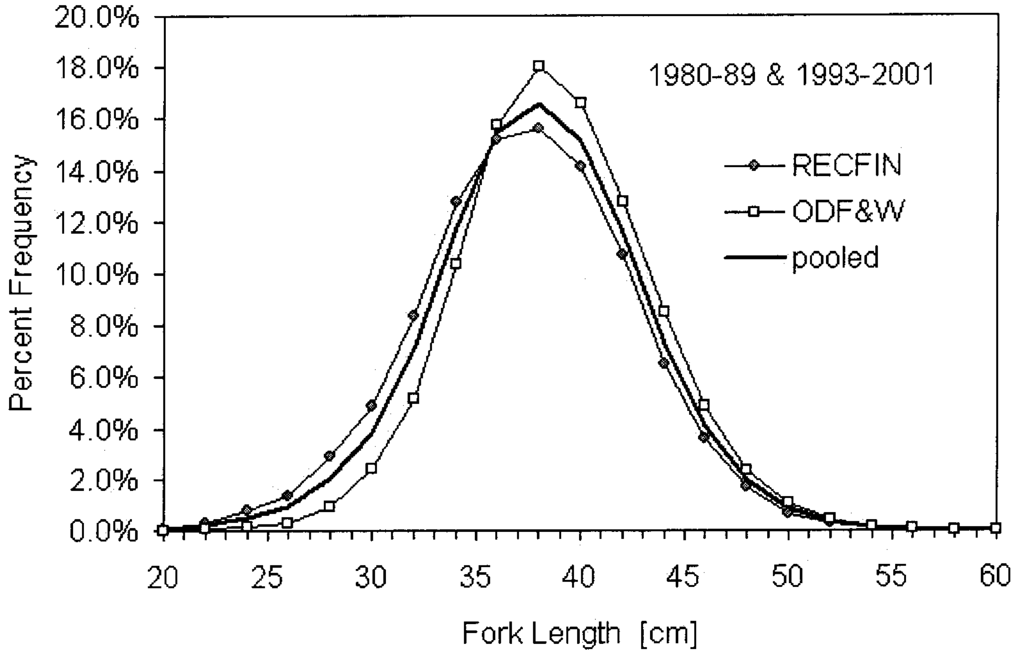


Figure 9. Comparison of Oregon recreational length-frequency data for samples obtained from RECFIN and ODF&W.

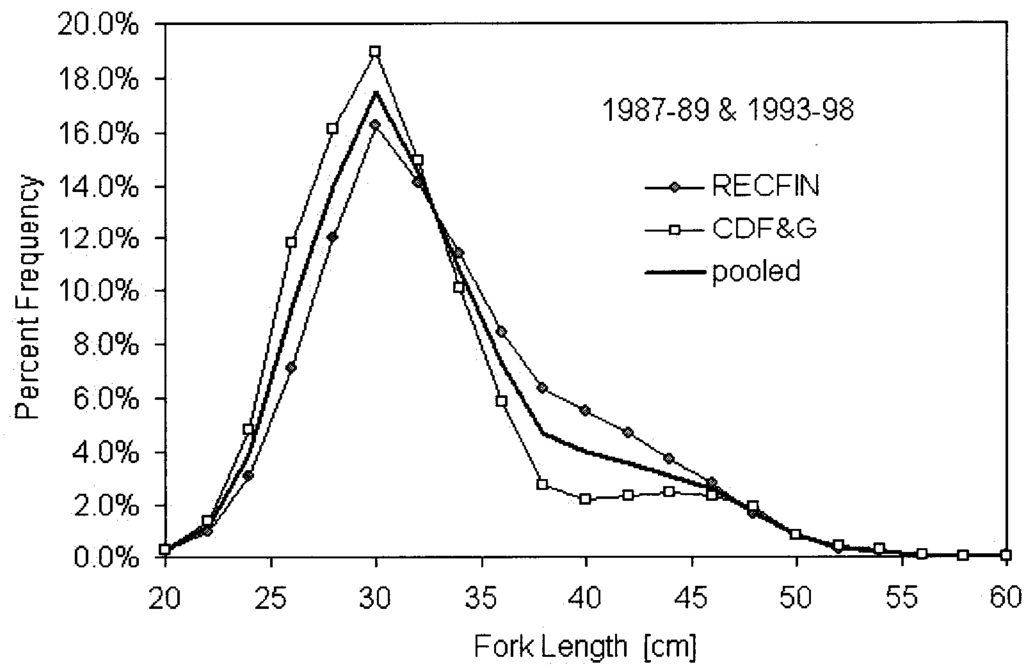


Figure 10. Comparison of northern California recreational length-frequency data for samples obtained from RECFIN and CDF&G.

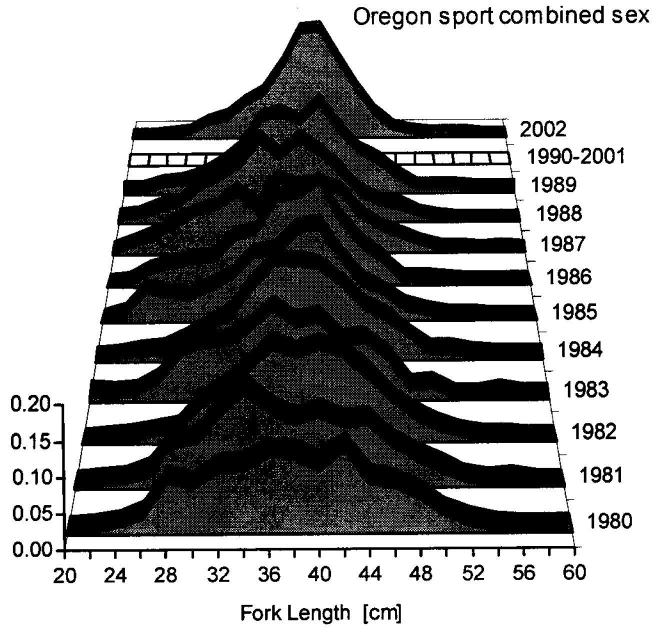


Figure 11. Length-frequency distributions for combined sex black rockfish sampled from the Oregon recreational fishery (1980-89 and 2002). [RECFIN data only]

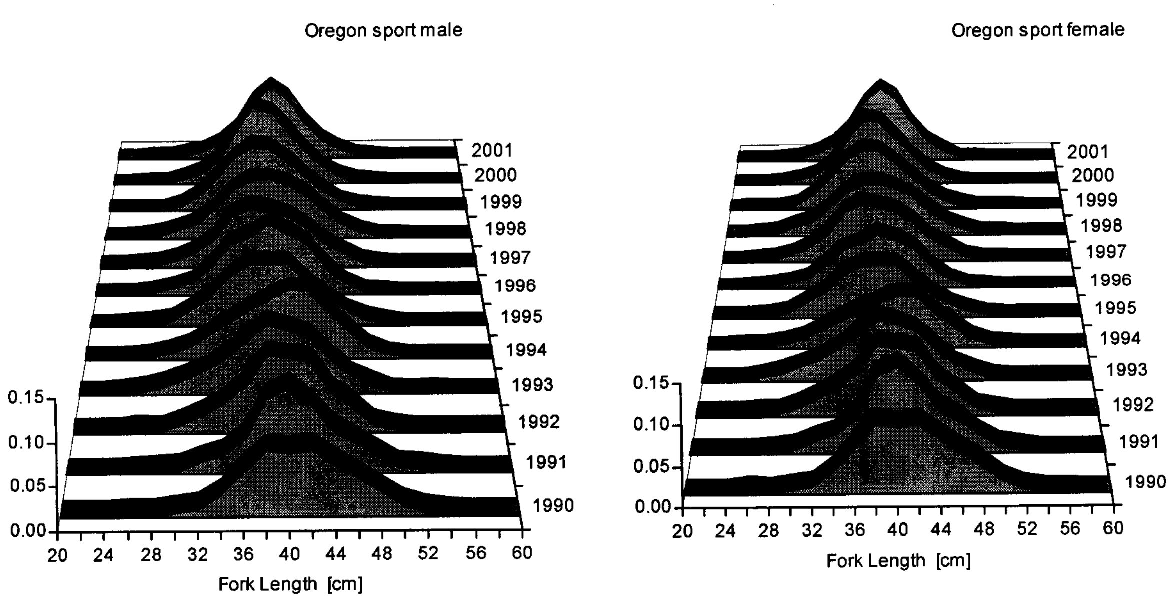


Figure 12. Length-frequency distributions for male and female black rockfish sampled from the Oregon recreational fishery (1990-2001). [ODF&W and RECFIN data]

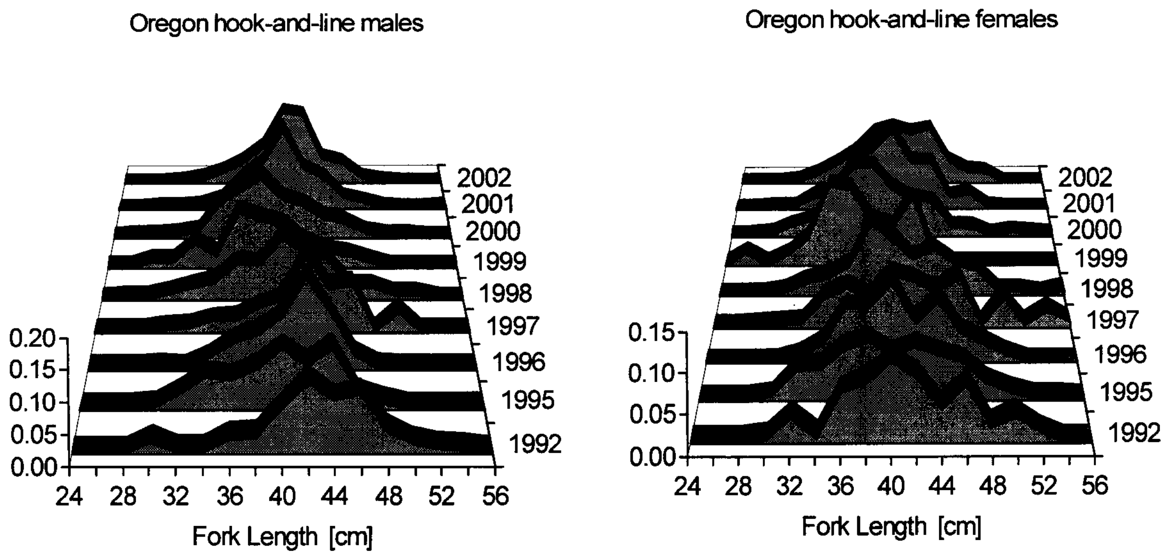


Figure 13. Length-frequency distributions for male and female black rockfish sampled from the Oregon commercial hook-and-line fishery (1992, 1995-2002).

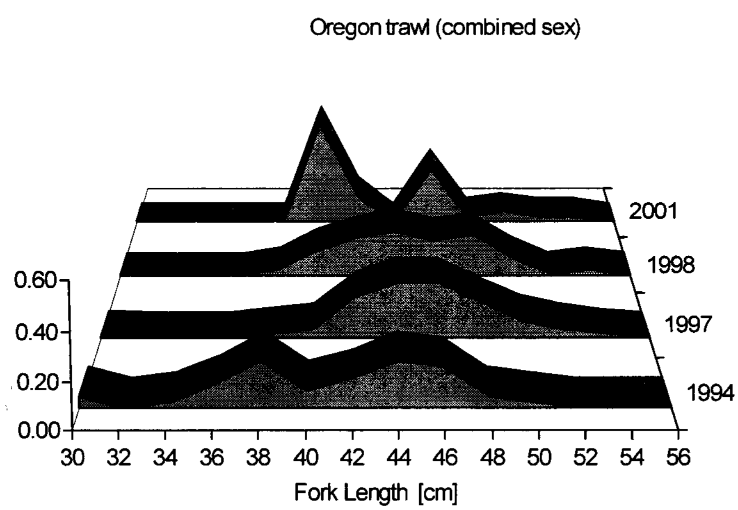


Figure 14. Length-frequency distributions for black rockfish sampled in the Oregon commercial trawl fishery (sexes combined).

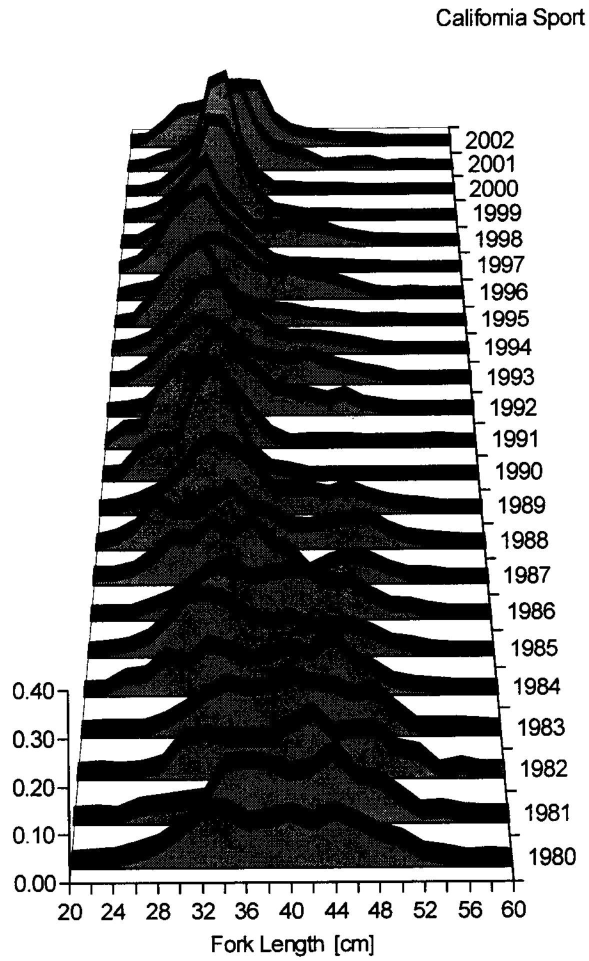


Figure 15. Combined-sex length-frequency distributions of black rockfish sampled in the California recreational fishery (1980-2002). [RECFIN and CDF&G data]

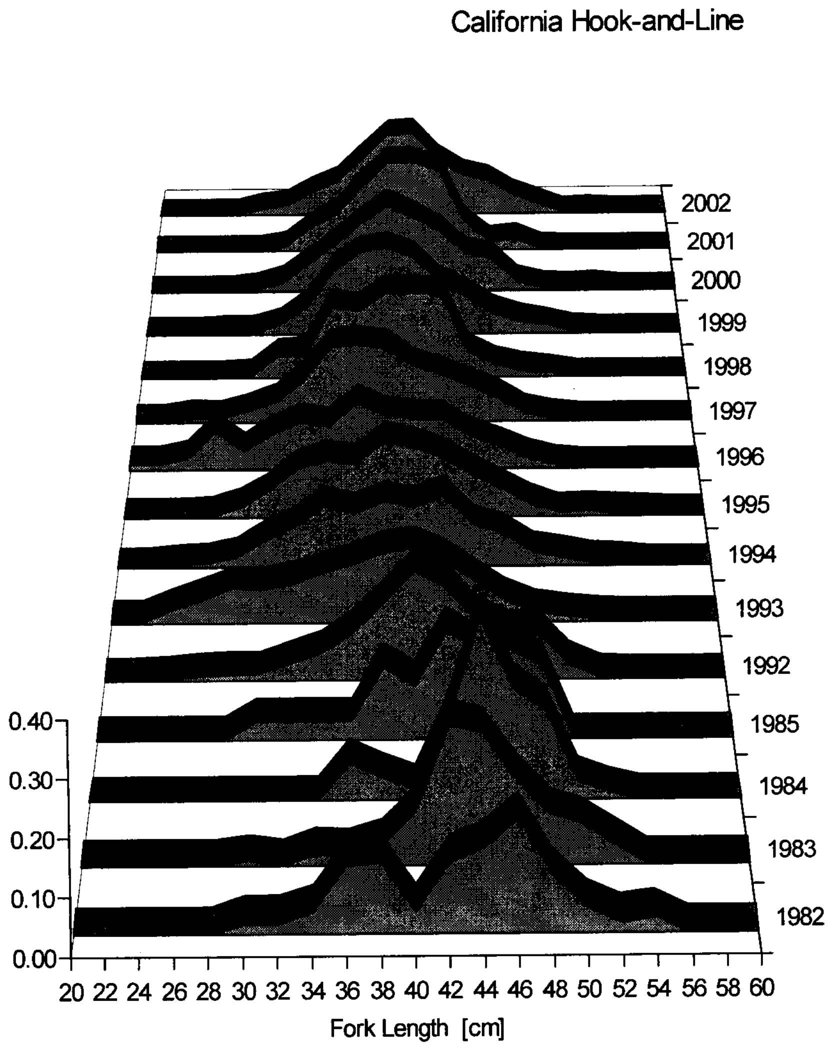


Figure 16. Combined-sex length-frequency distributions of black rockfish sampled in the California commercial hook-and-line fishery (1982-85, 1992-2002).

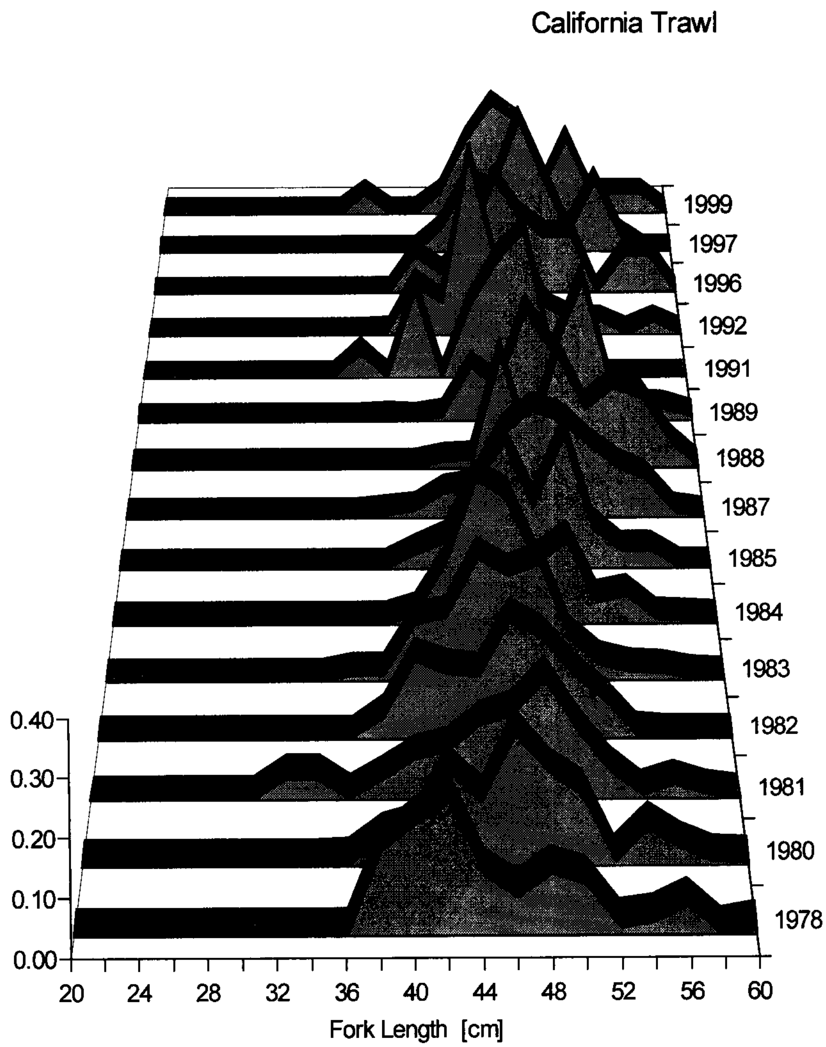


Figure 17. Combined-sex length-frequency distributions of black rockfish sampled in the California commercial trawl fishery (various years).

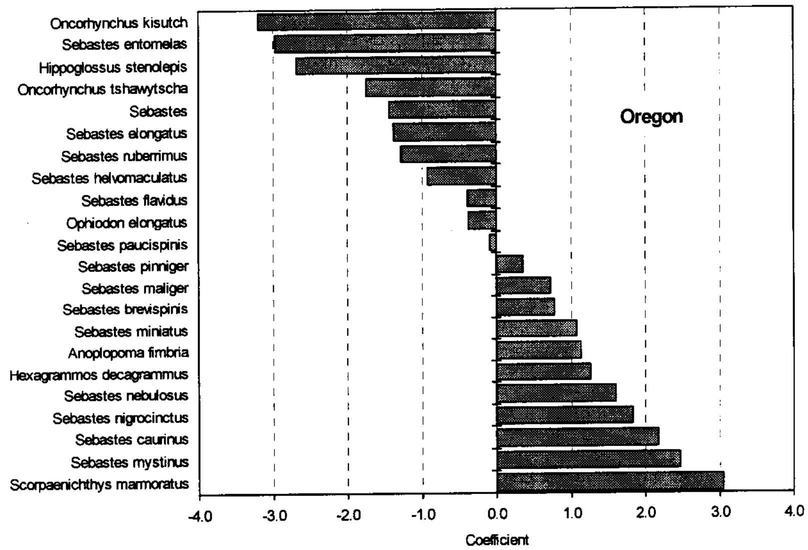


Figure 18. Species coefficients for presence of black rockfish in RECFIN trips conducted in Oregon.

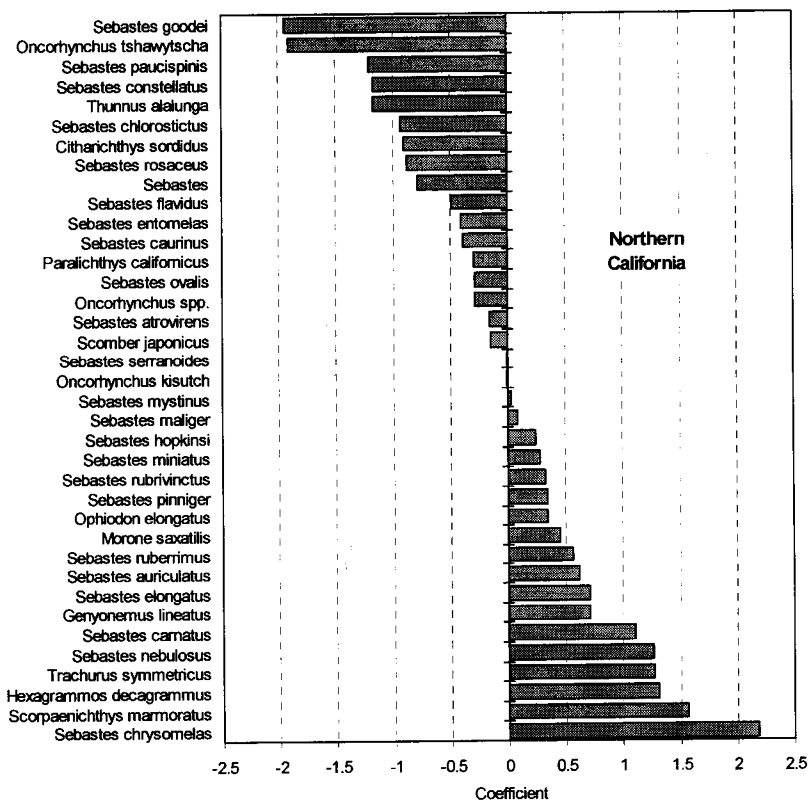


Figure 19. Species coefficients for the presence of black rockfish in RECFIN trips conducted in northern California.

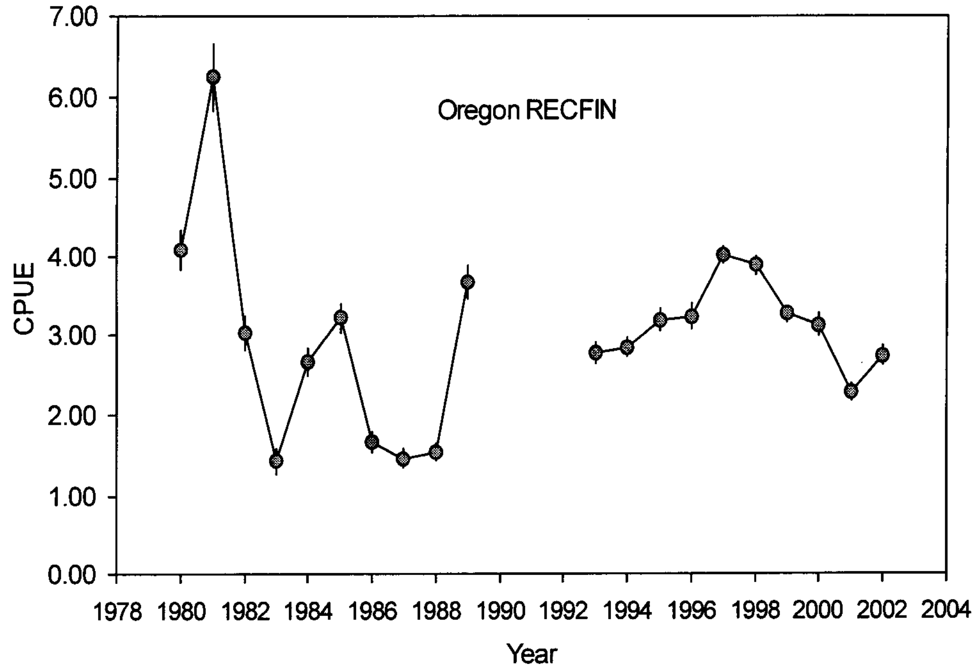


Figure 20. Time series of catch-per-unit effort in the Oregon recreational fishery based upon a weighted delta-gamma GLM analysis of RECFIN data. Error bars represent ± 1.0 standard error.

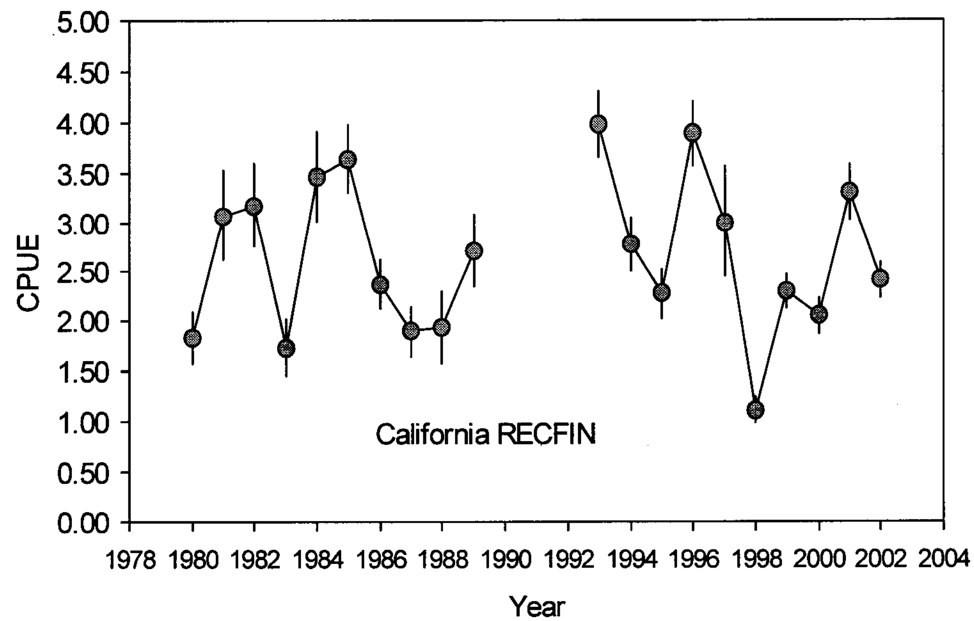


Figure 21. Time series of catch-per-unit-effort in the California recreational fishery based on a weighted delta-gamma GLM analysis of RECFIN data. Error bars represent ± 1.0 standard error.

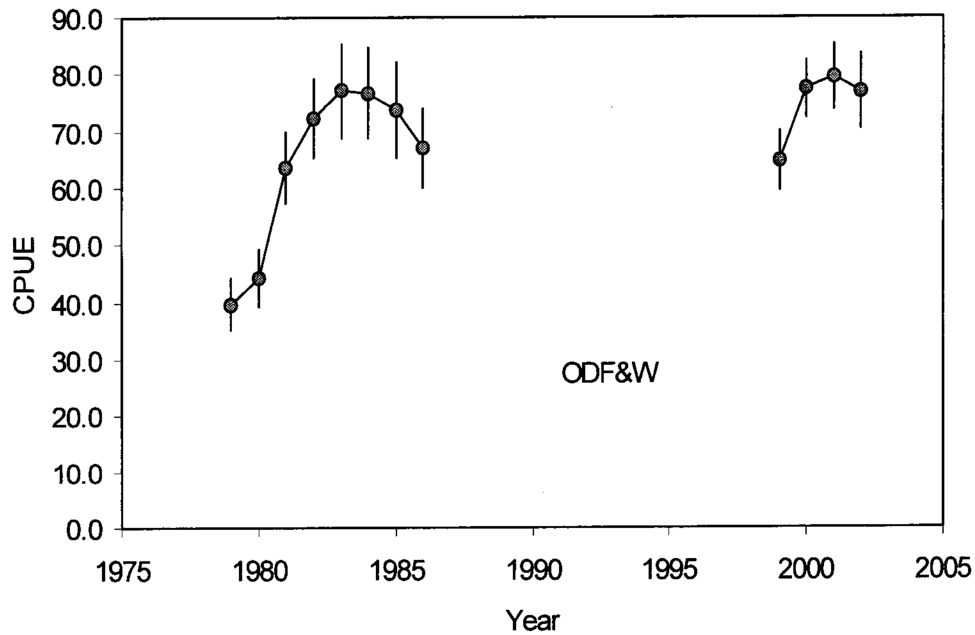


Figure 22. Time series of catch-per-unit-effort in the Oregon recreational fishery based on a 3-factor ANOVA model using ODF&W data. Error bars represent ± 1.0 standard error.

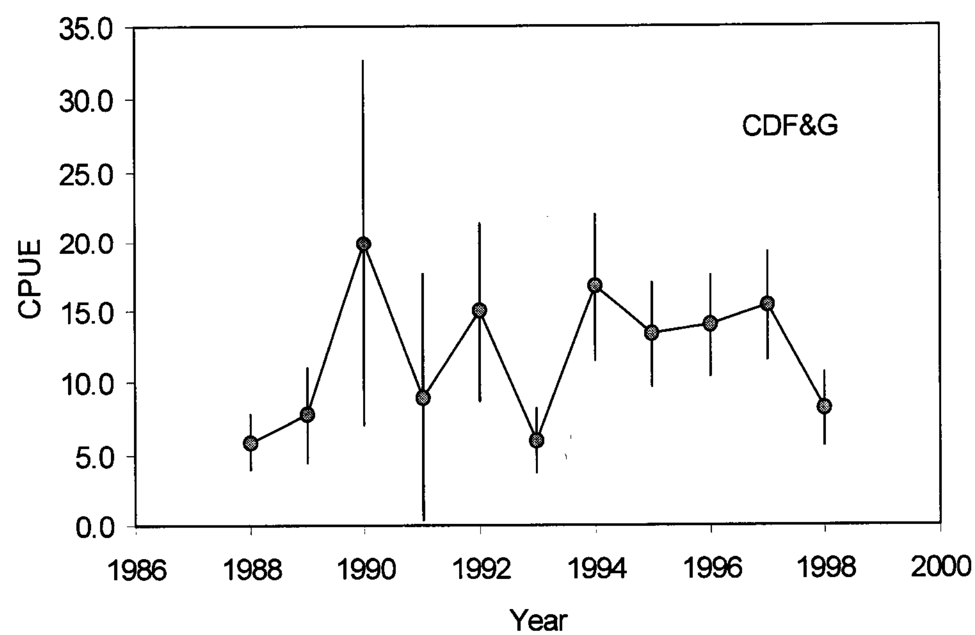


Figure 23. Time series of catch-per-unit effort in the California recreational fishery based on a delta-gamma GLM of CDF&G data. Error bars represent ± 1.0 standard error.

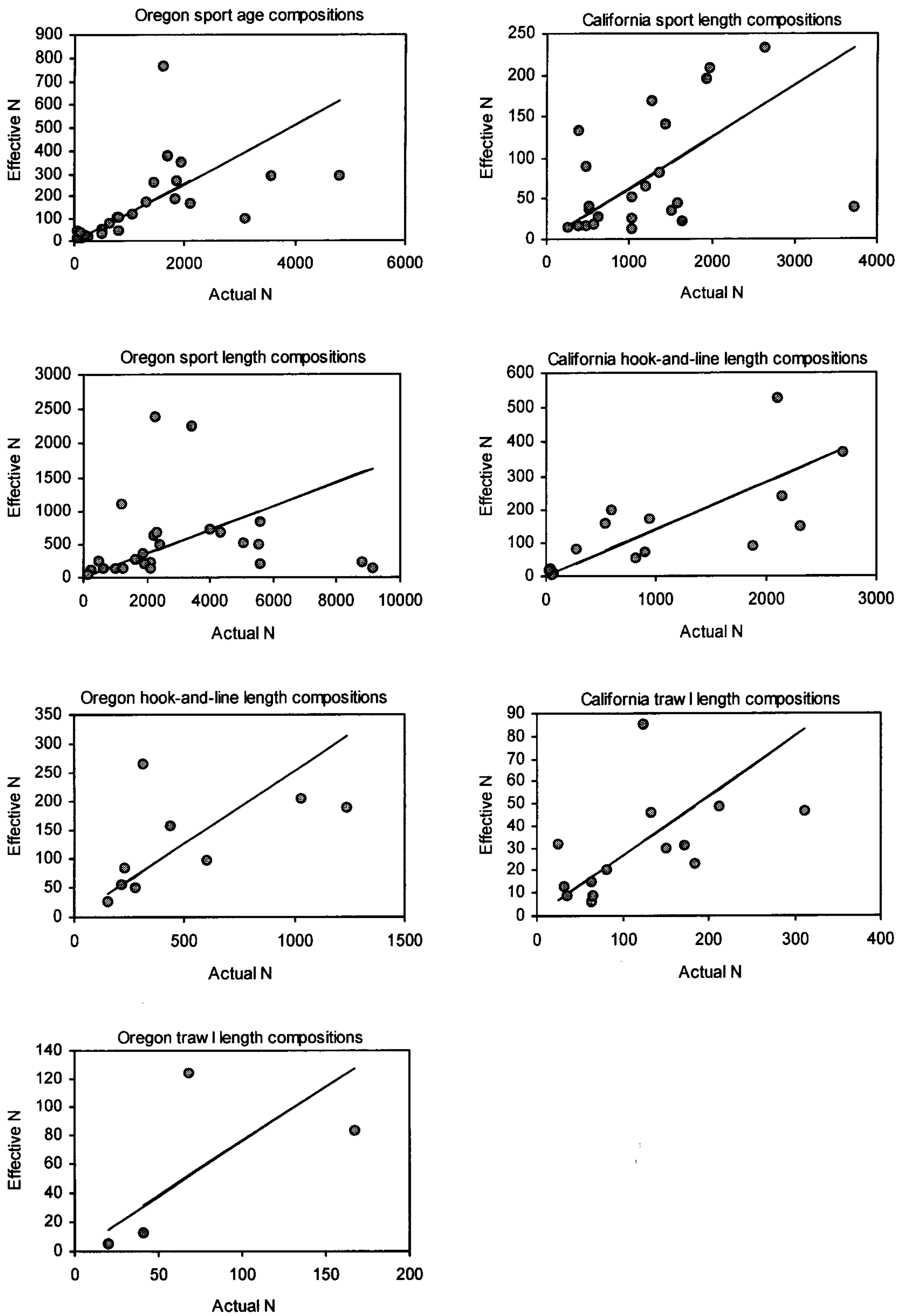


Figure 24. Relationship between the number of fish examined and the effective sample size for compositional data sets used in the assessment model.

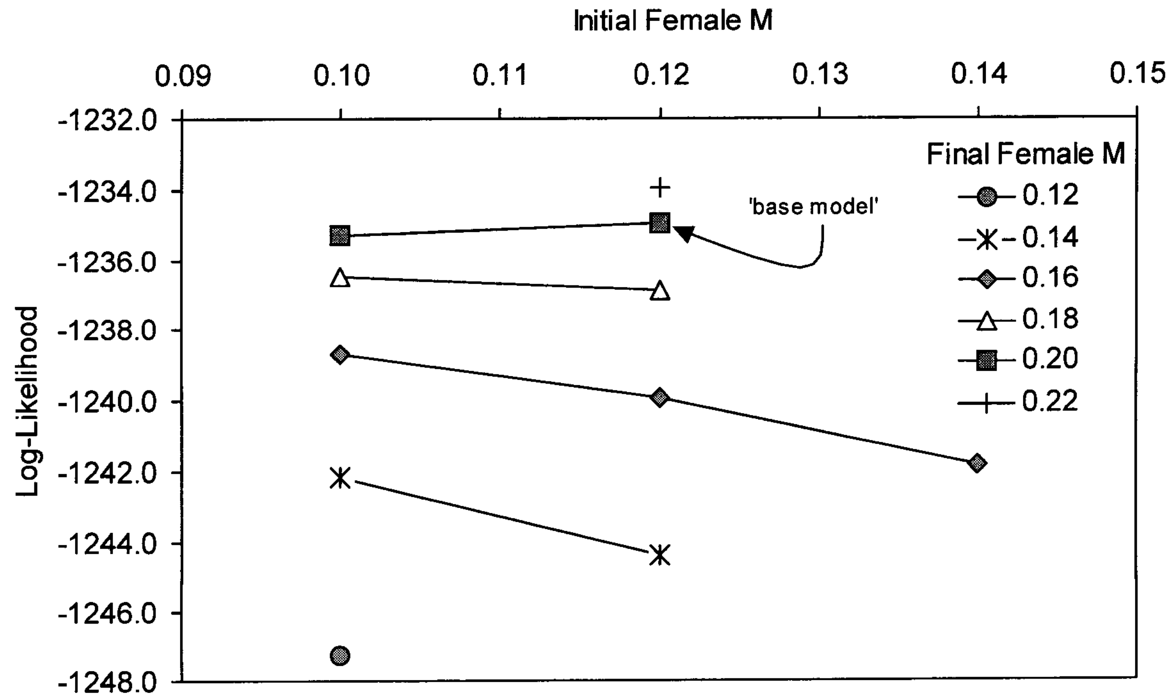


Figure 25. Likelihood profile of the fit of the data to the assessment model for different fixed values of initial and final female natural mortality rate (M [yr^{-1}]).

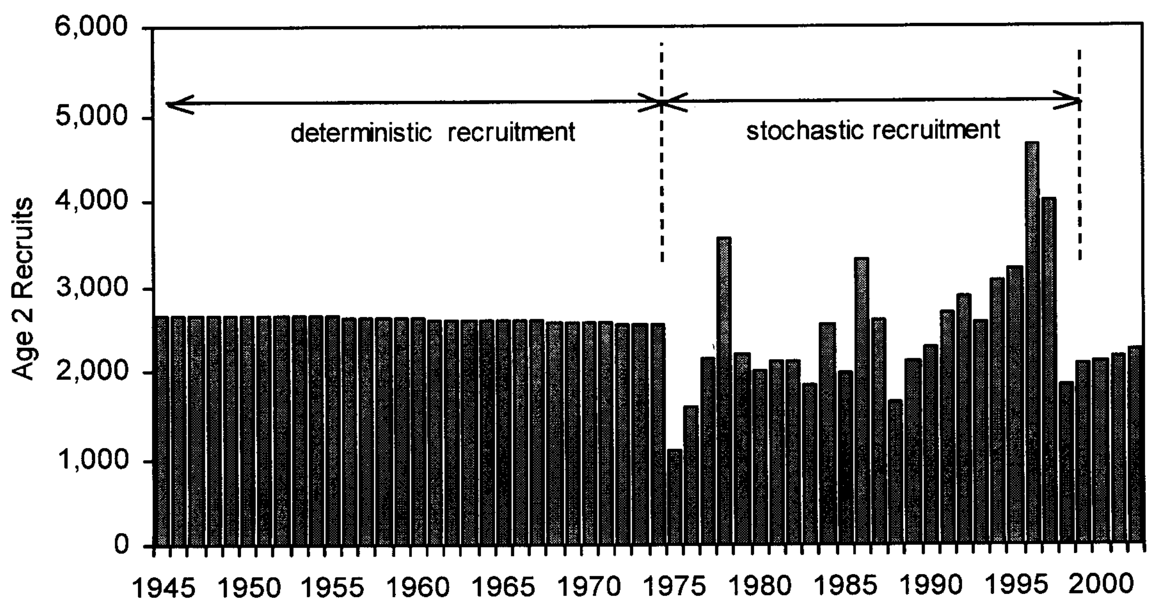


Figure 26. Time series of recruitments from the base assessment model.

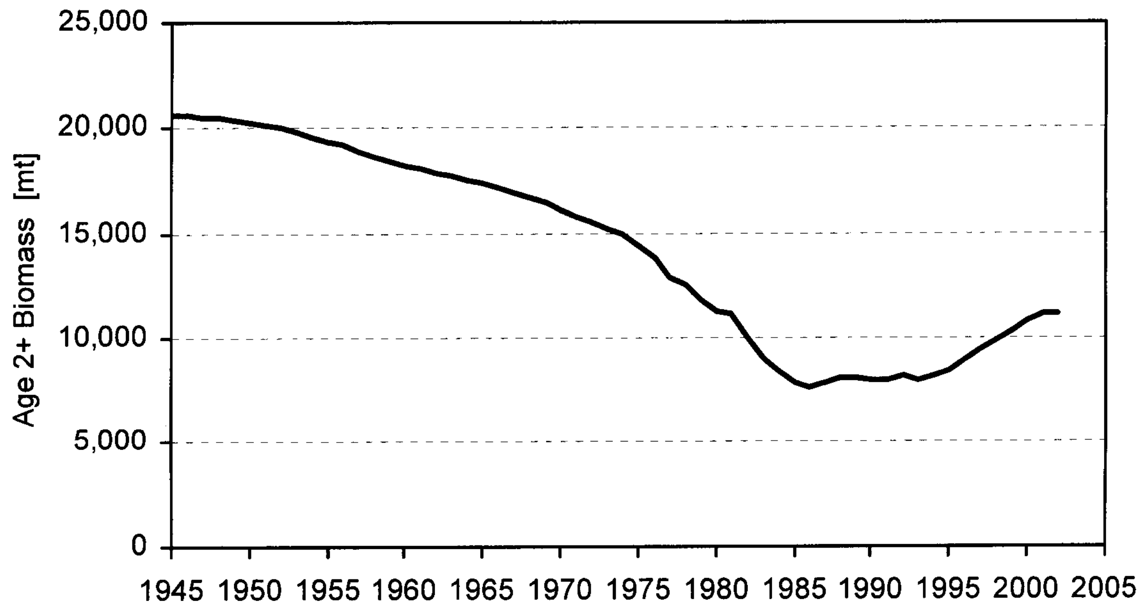


Figure 27. Estimated time series of age 2+ stock biomass from the base assessment model.

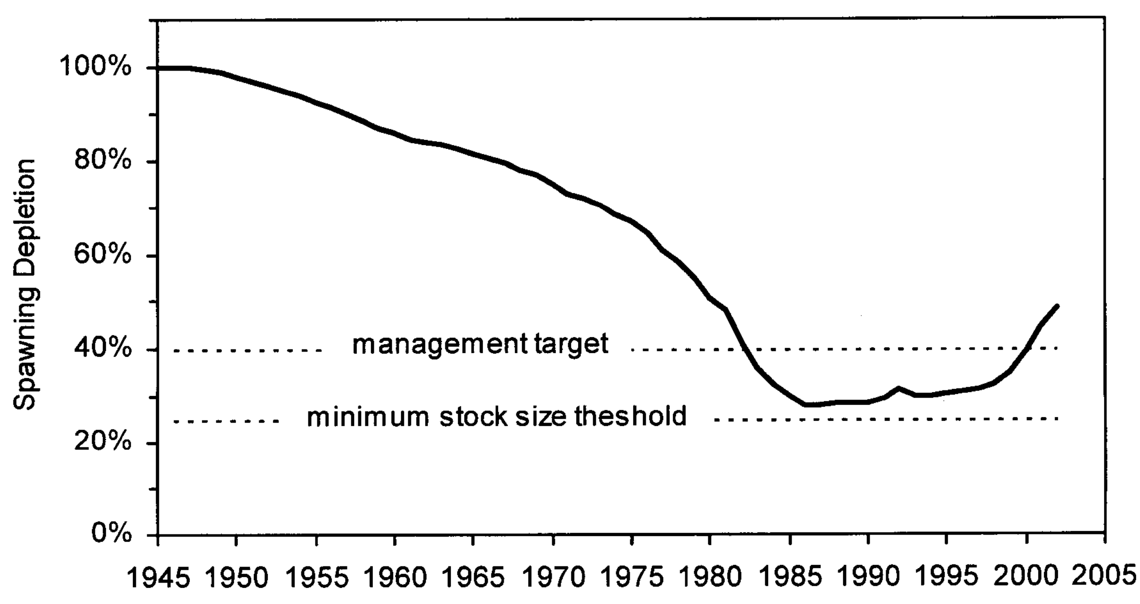


Figure 28. Estimated time series of spawning output of black rockfish relative to the unexploited state (=spawning depletion) from the base assessment model. The management target is 40% and the overfished minimum stock size threshold is 25%.

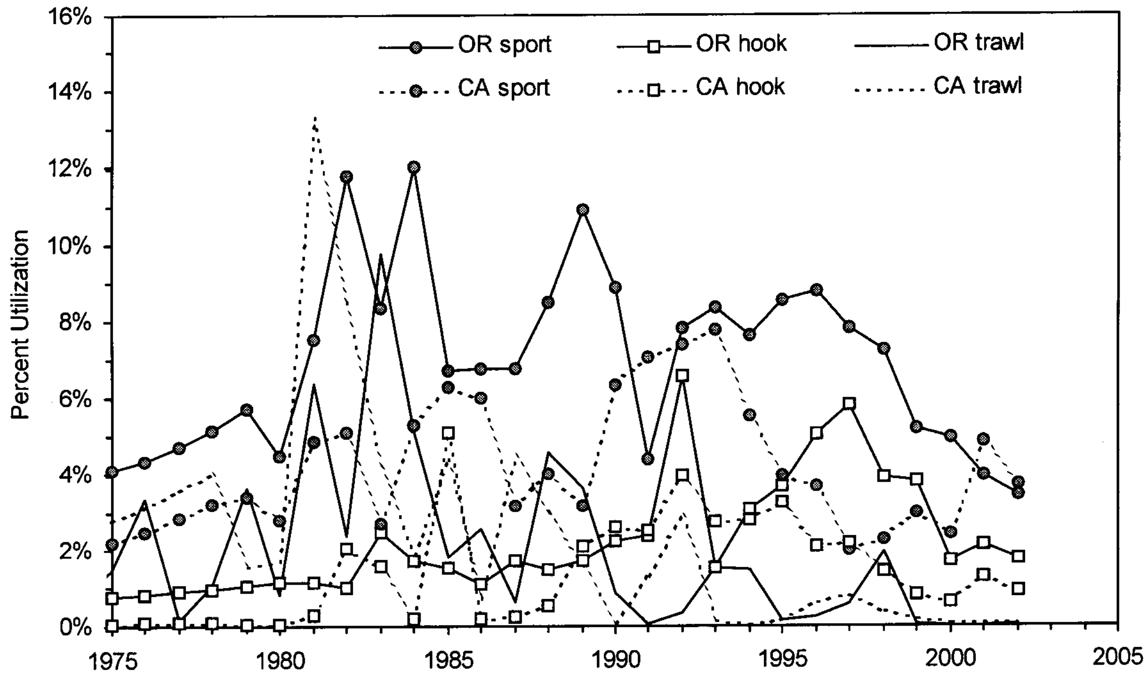


Figure 29. Time series of exploitation rate for each of the 6 modeled fisheries. Percent utilization is the catch divided by the fishery-specific exploitable biomass.

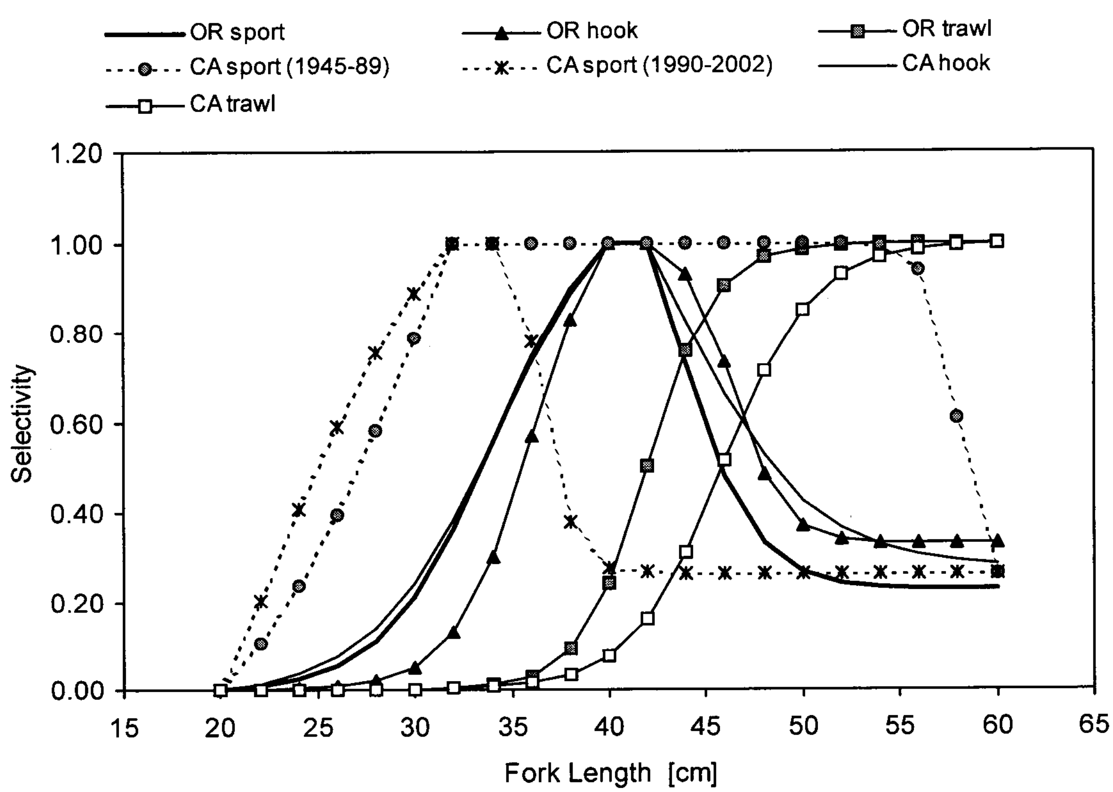


Figure 30. Fishery-specific selectivity curves from the base assessment model.

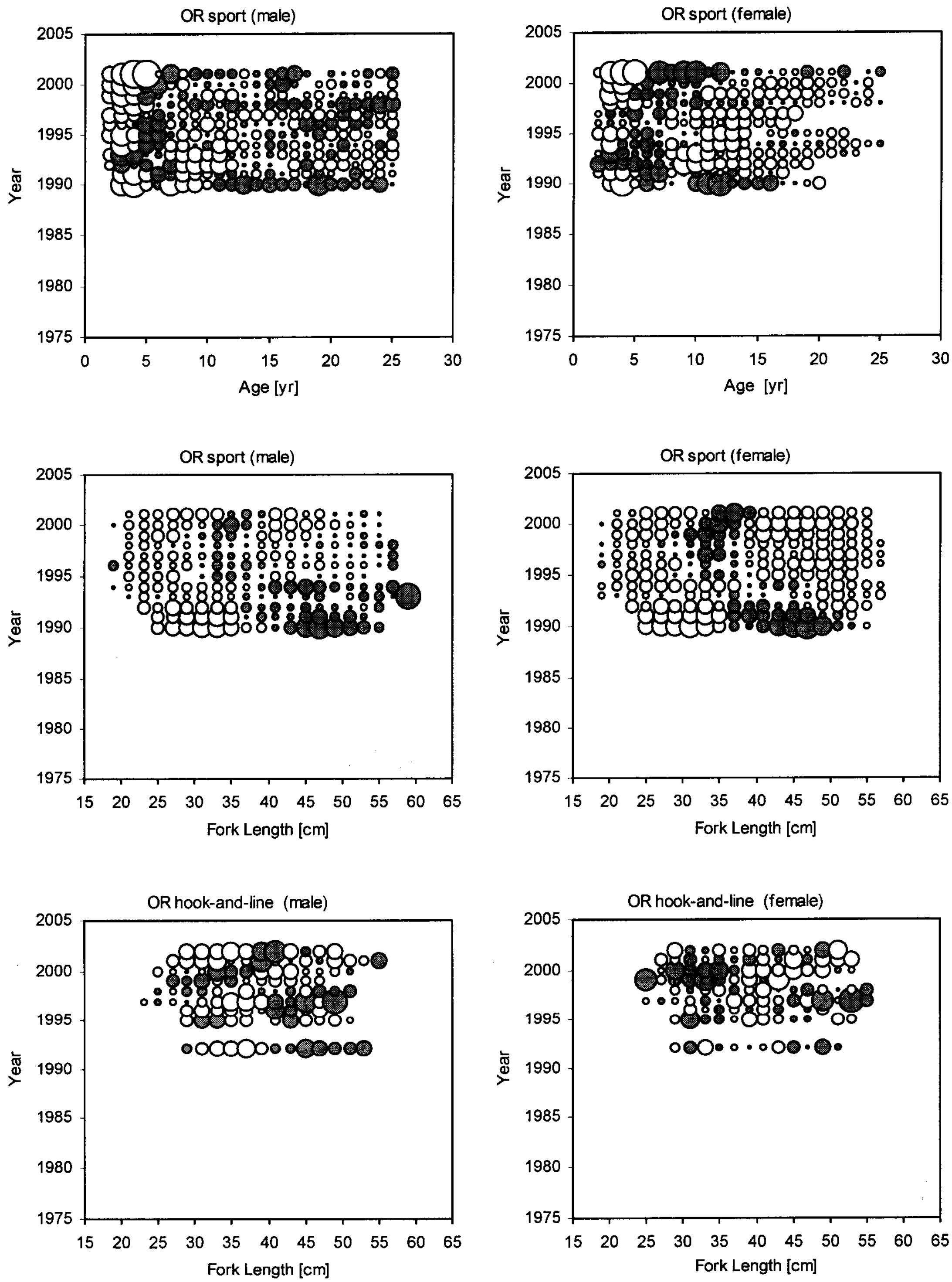


Figure 31. Fit of base stock assessment model to composition data from the Oregon recreational and hook-and-line fisheries. Filled circles are positive residuals (observed > expected), whereas open circles are negative residuals. Circle area is proportional to the normalized probability.

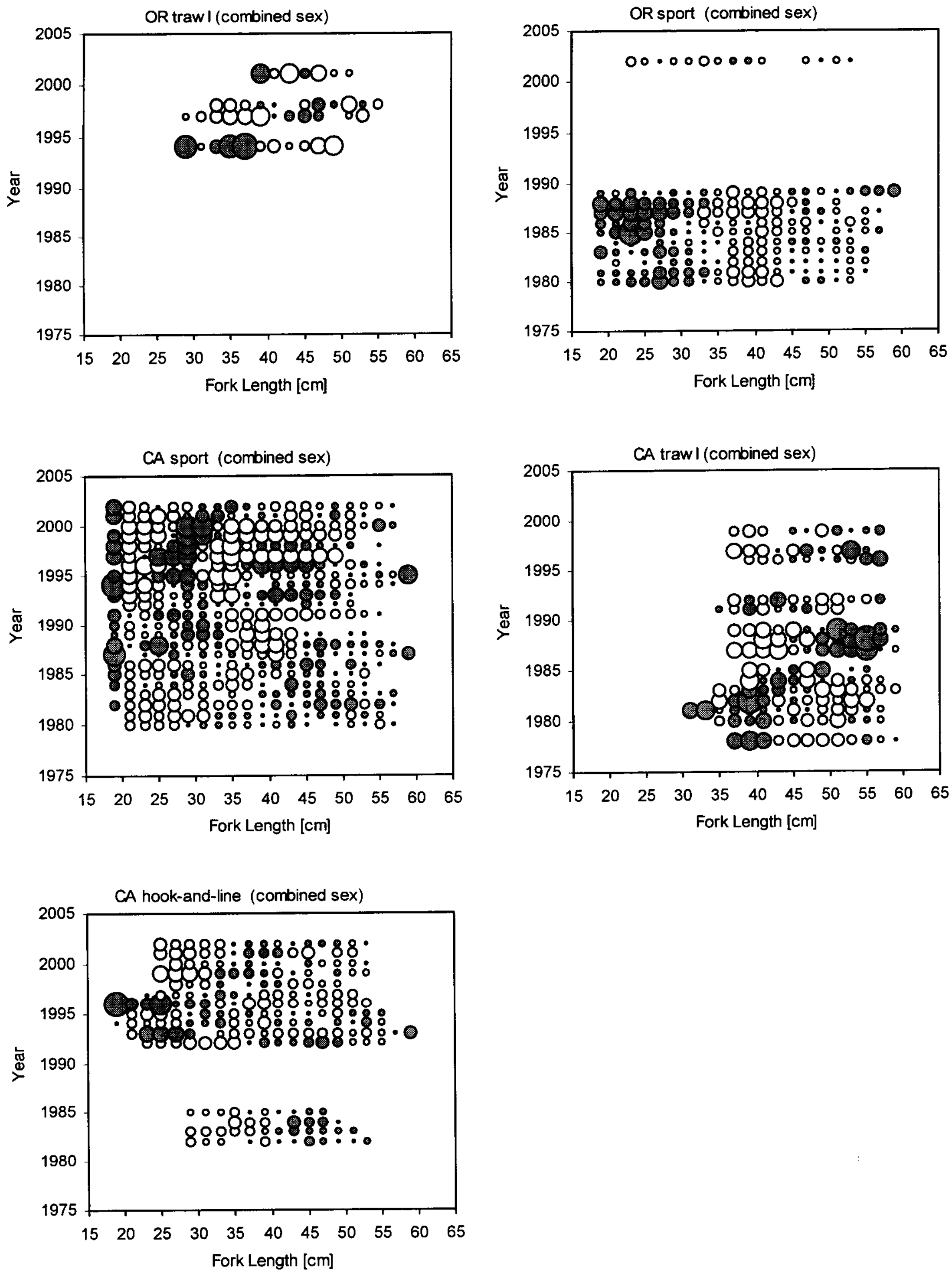


Figure 32. Fit of base stock assessment model to composition data from the Oregon trawl and California fisheries (recreational, hook-and-line, and trawl). Filled circles are positive residuals (observed > expected), whereas open circles are negative residuals. Circle area is proportional to the normalized probability.

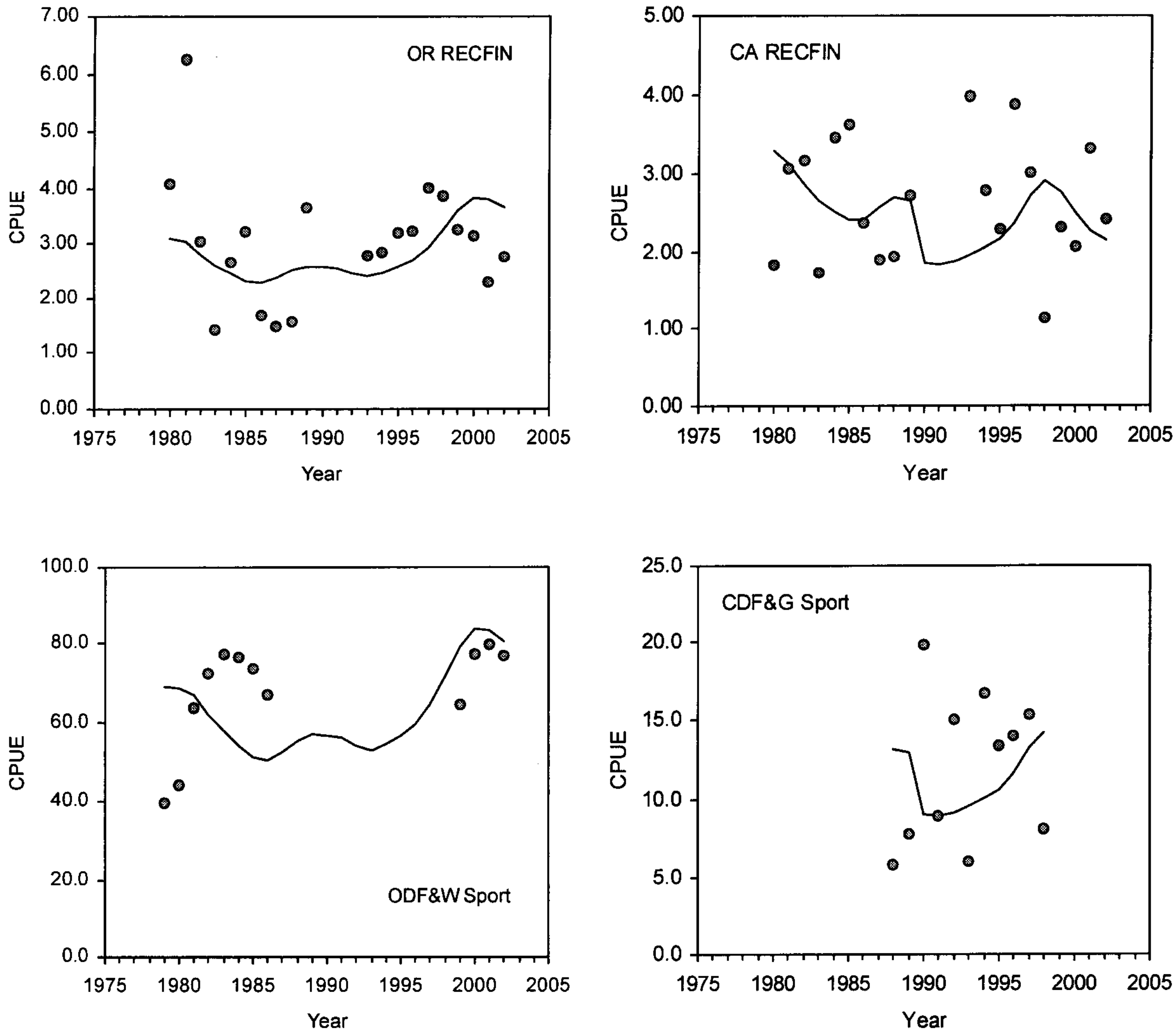


Figure 33. Fit of the base black rockfish stock assessment model to each of the four CPUE time series from recreational fisheries in Oregon and California.

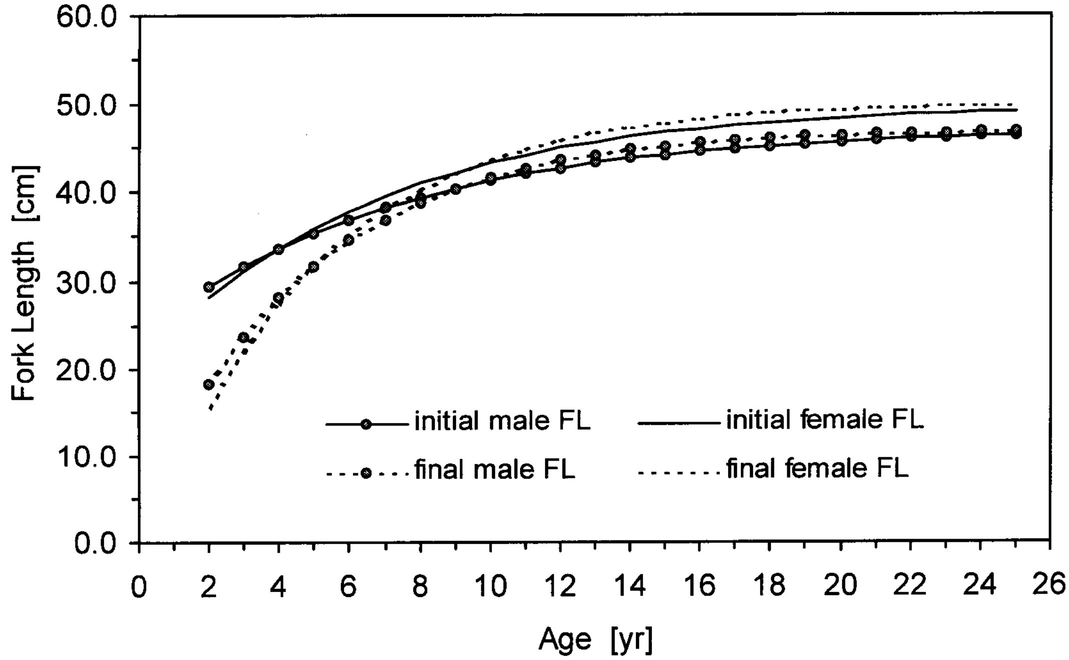


Figure 34. Estimated sex-specific growth of black rockfish from the stock assessment model (final) in comparison with initial estimates (see also Figure 2).

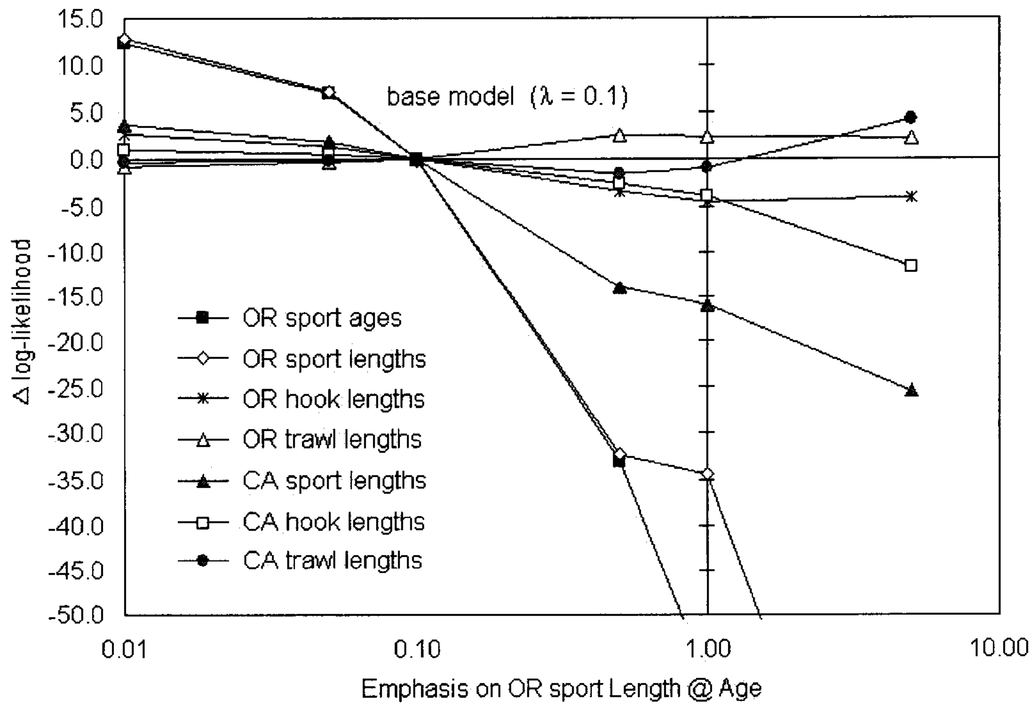


Figure 35. Likelihood profiles for the various components of the model following changes to the weight (emphasis) on the Oregon recreational length-at-age component.

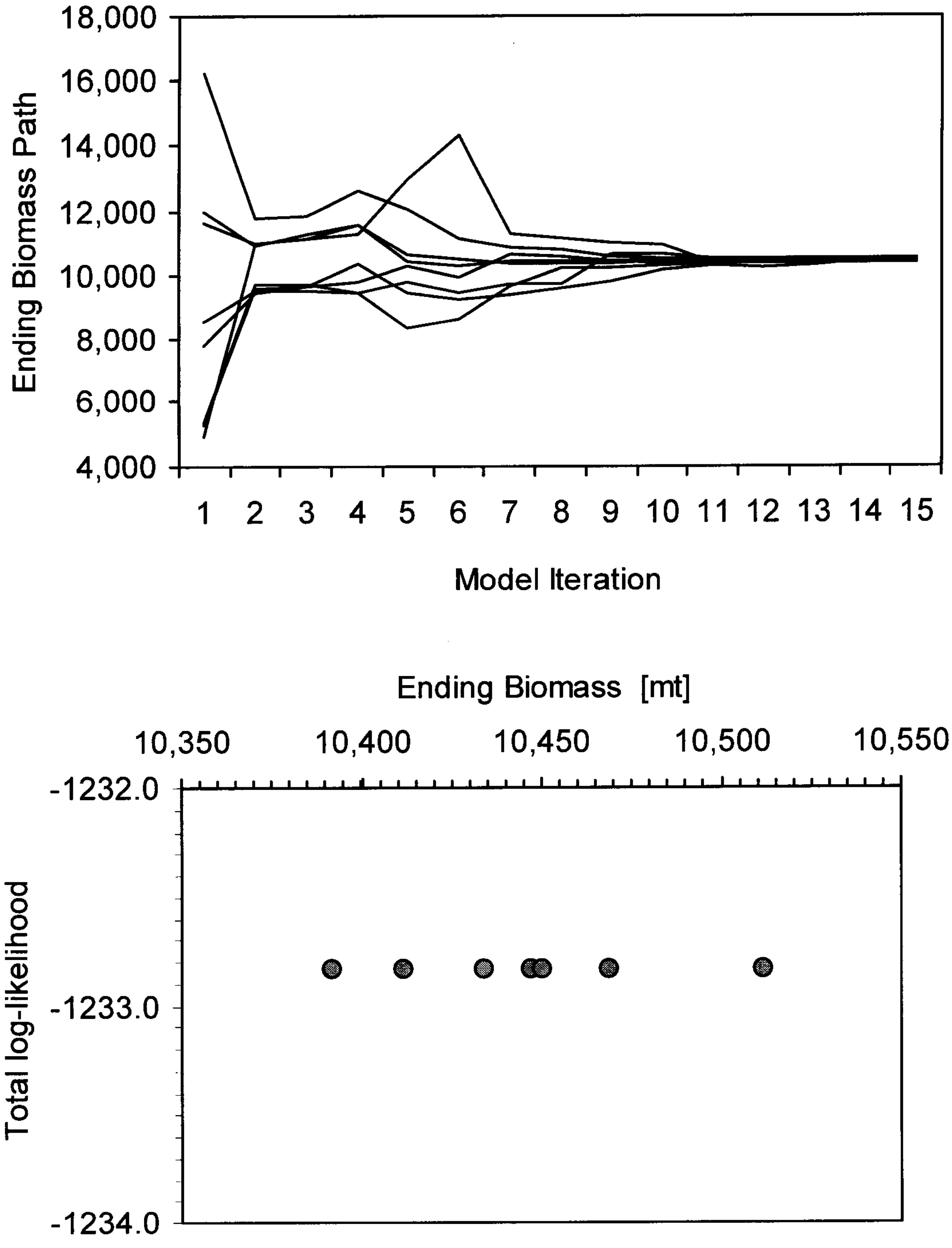


Figure 36. Convergence properties of the base black rockfish stock assessment model.

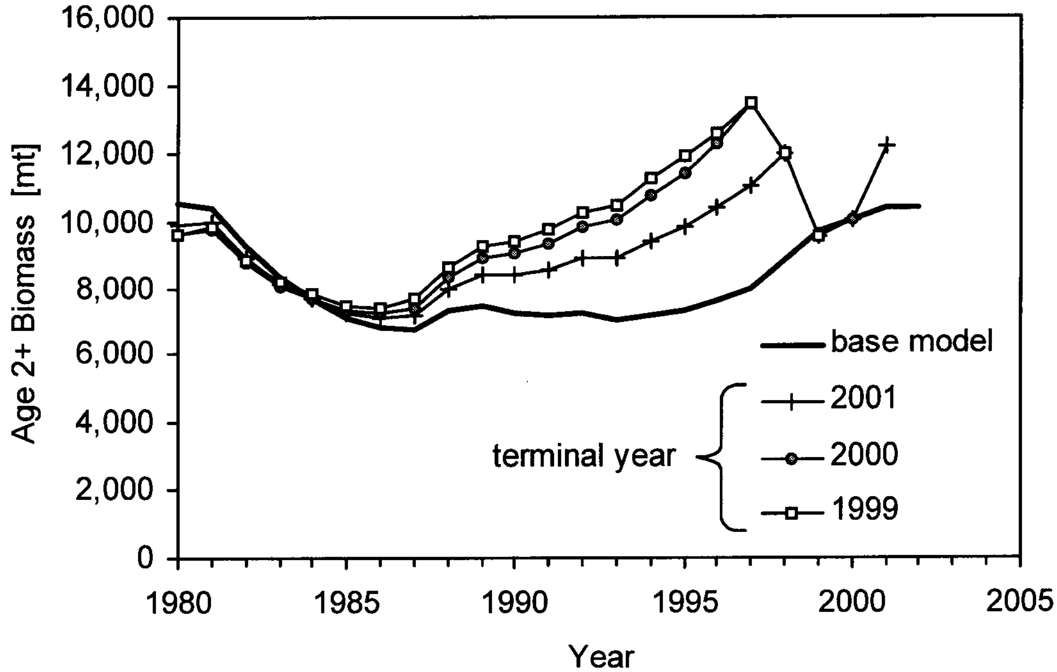


Figure 37. Retrospective analysis of the base black rockfish stock assessment model.

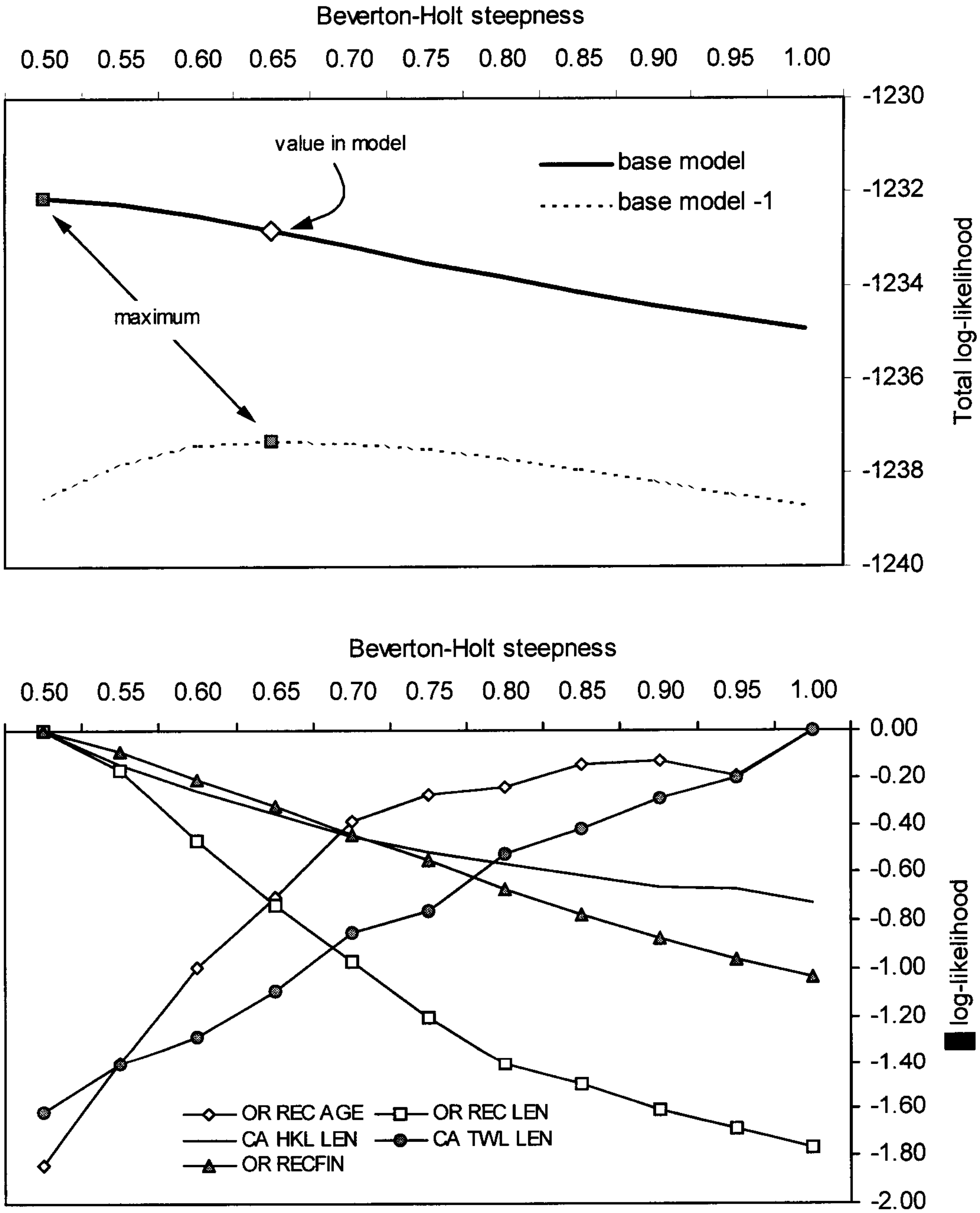


Figure 38. Upper Panel: Likelihood profile of the base assessment model for different fixed values of the Beverton-Holt steepness parameter (**h**). The final base model had steepness fixed at **h** = 0.65. Also shown is a similar profile for the penultimate version of the model (i.e., "base model - 1"). Lower Panel: changes in likelihood for certain components of the model over different fixed values of **h**.

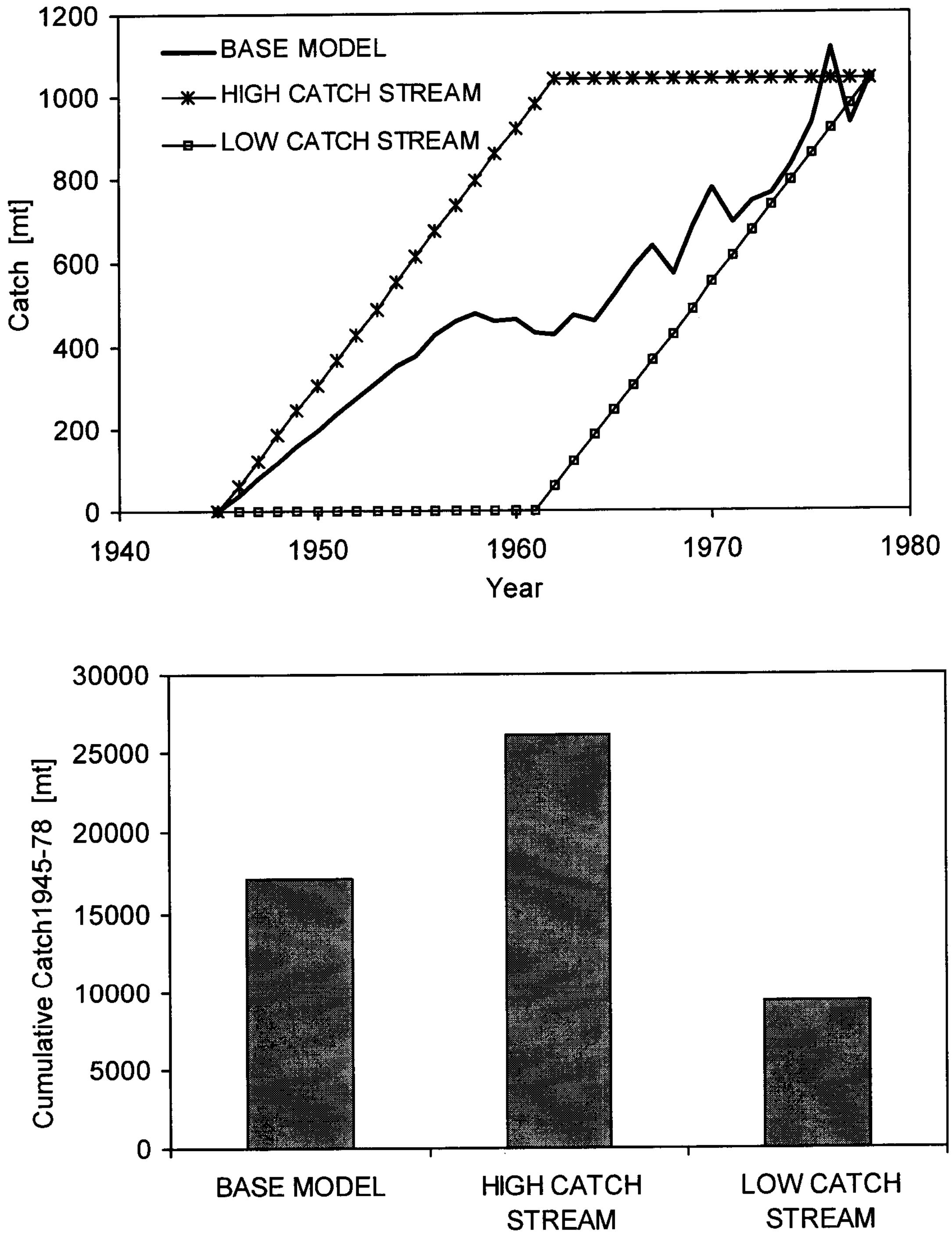
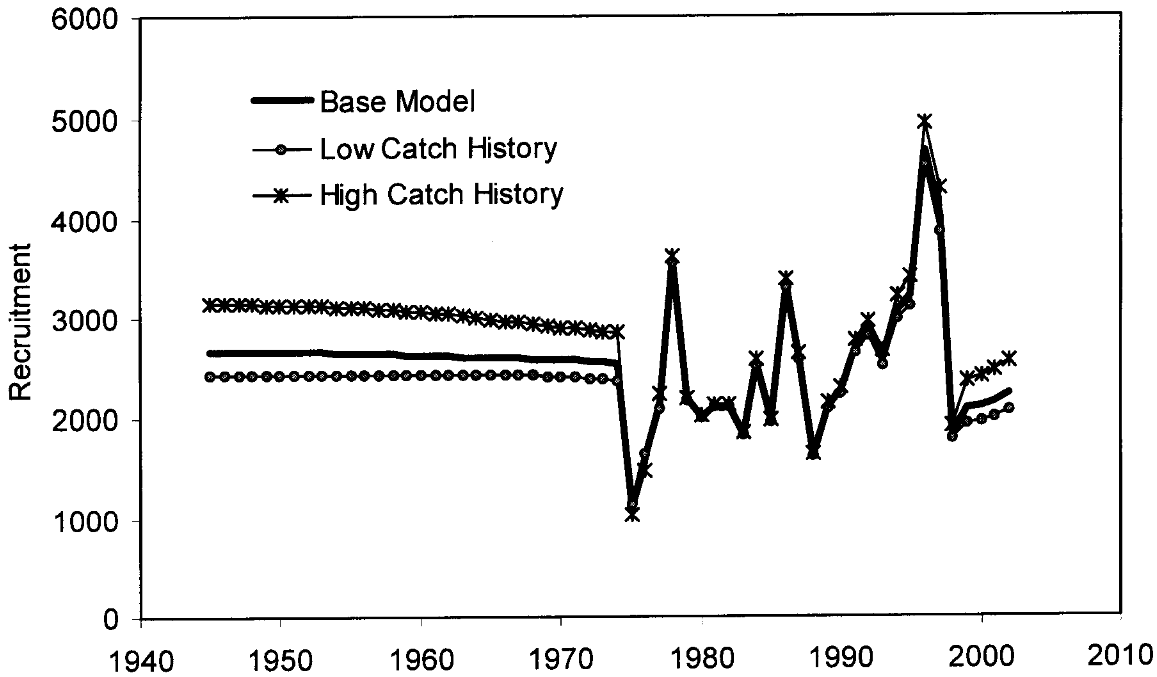


Figure 39. Uncertainty analysis of the effect of different historical catch streams on the base assessment model.



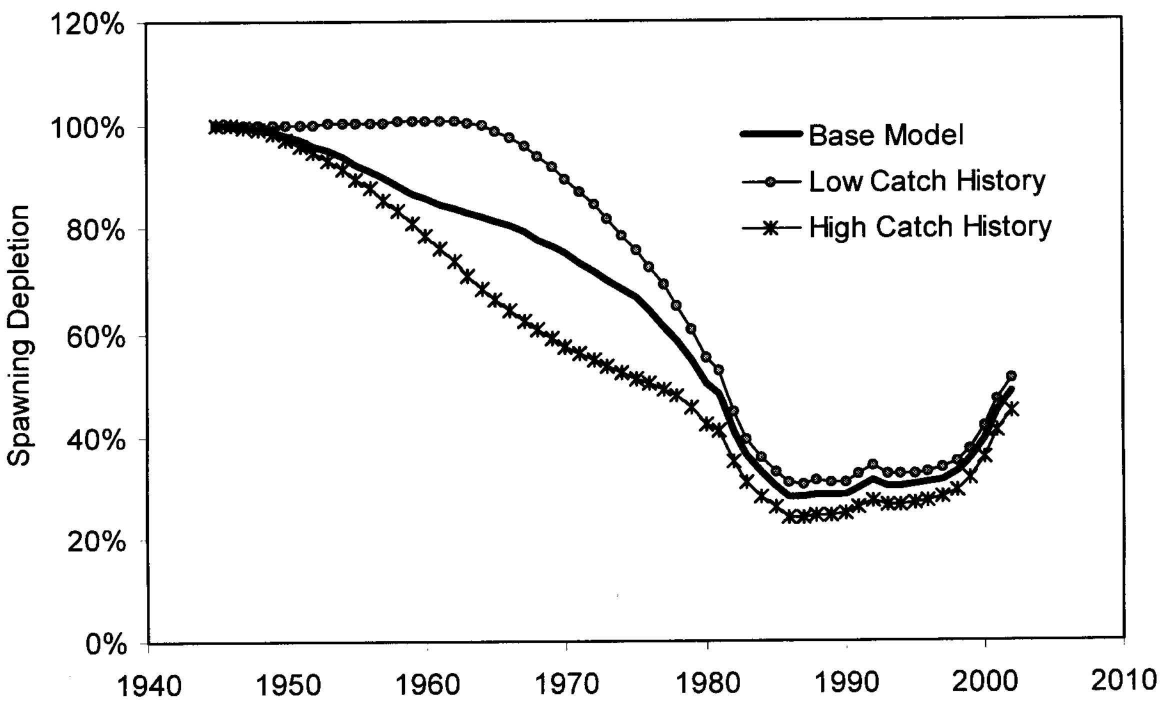


Figure 40. Model outputs under three different scenarios concerning the historical catch of black rockfish prior to 1978 (see Figures 38 & 39).

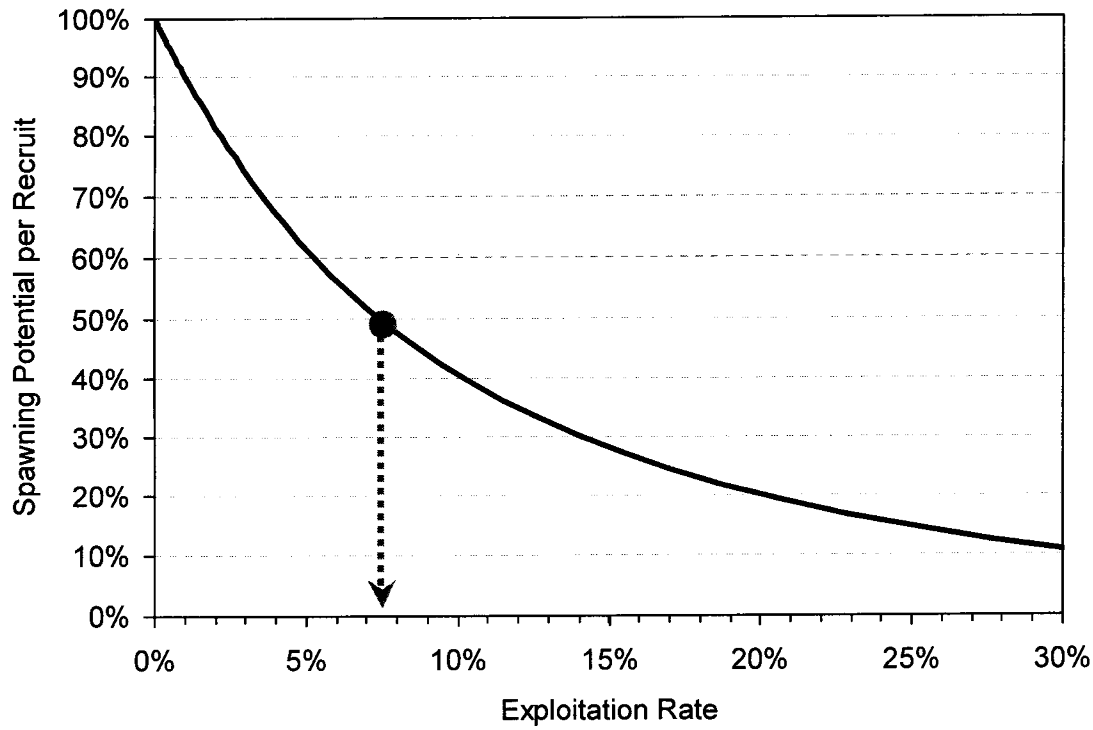


Figure 41. PFMC default harvest rate for *Sebastes* used in black rockfish projections (i.e., the exploitation rate that reduces the spawning potential per recruit to 50% of the unfished condition.

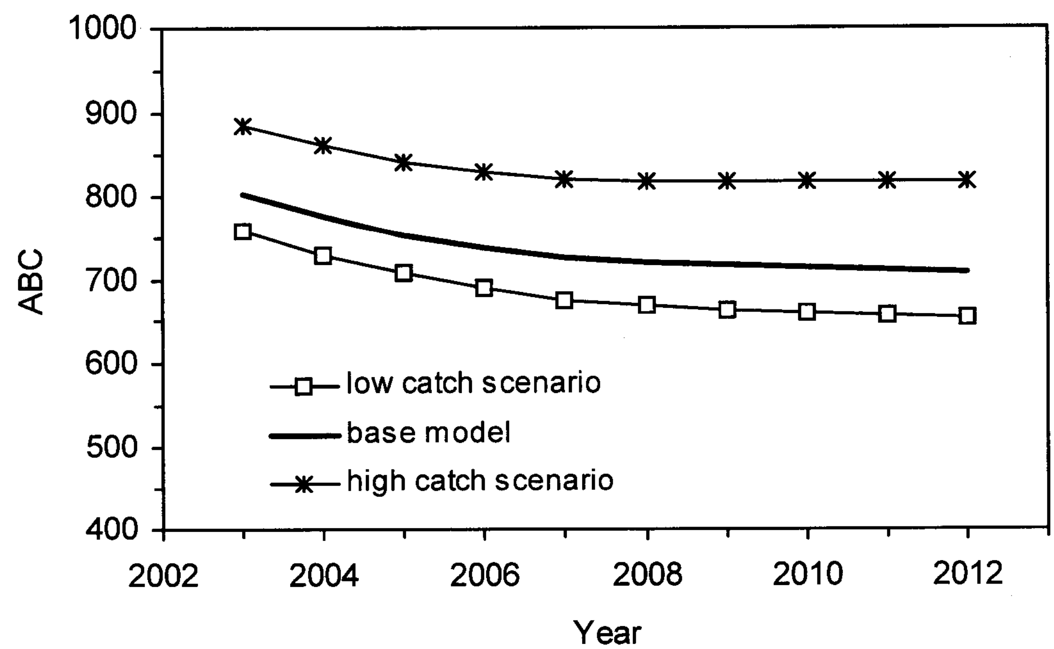


Figure 42. Variability in projected Allowable Biological Catches (ABCs) as a function of differences in historical catch.

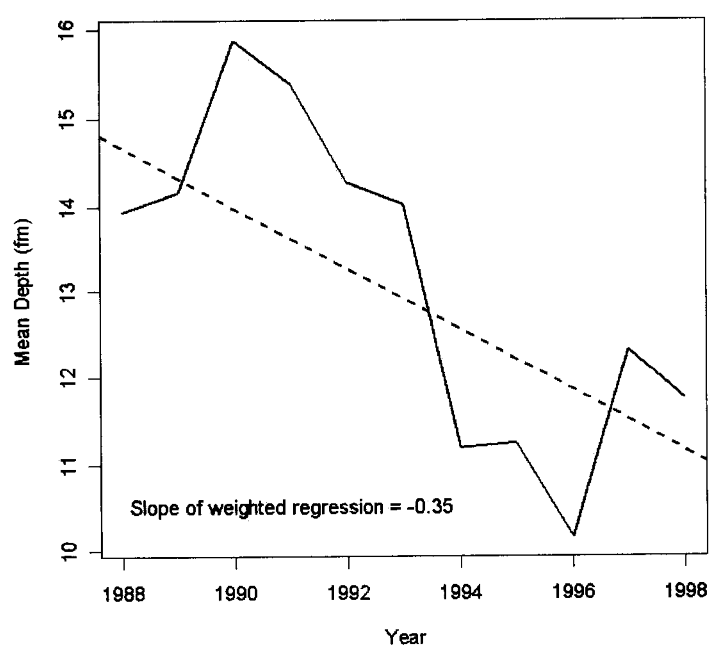
Appendix 1: Evaluation of California recreational CPUE statistics based on data from the CDF&G Commercial Passenger Fishing Vessel survey

For the assessment, catch-per-unit-effort (CPUE) statistics of black rockfish were estimated for the California recreational fishery based on information from the RECFIN and CPFV data bases (see Figures 21 and 23). As suggested by the Stock Assessment Review (STAR) panel, a potential bias in CPUE can arise if the mean depth of fishing changes systematically over time and catch rates are depth-dependent. Therefore, the STAR panel requested the authors investigate: 1) trends in fishing depth over time, 2) the effect of depth on black rockfish catch rate, and 3) changes in mean fish length with depth. The only available information that can explicitly address these three issues is the CPFV data set, because fishing locations and depths are expressly included. The annual mean depth of central California CPFV trips was then modeled using a general linear model of the form:

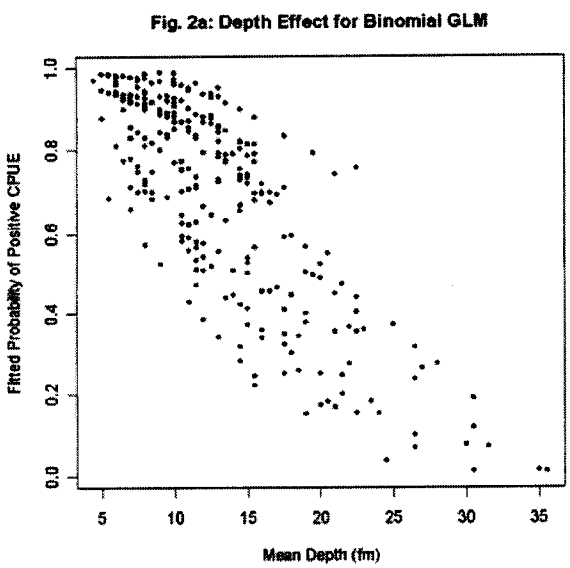
$$\log_e(\text{depth}_{ijkl}) = \text{year}_i + \text{month}_j + \text{location}_k + \text{error term}_{ijkl}$$

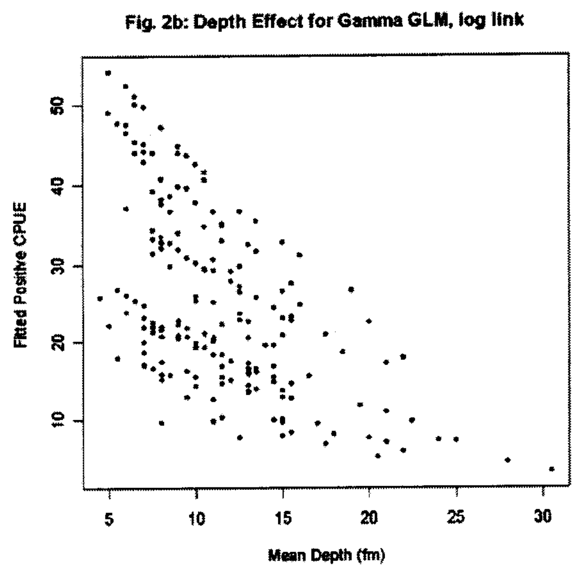
This model was selected by lowest AIC score. Moreover, this criterion provided no evidence of interaction among the three main effects. The first figure illustrates the trend in mean depth of CPFV trips, obtained by back-transformation and bias correction of year coefficients

Fig. 1: Mean Depth of Central California CPFV Trips



from the fitted model. A regression of mean depth versus year, weighted by the number of annual observations, suggests an average decrease in fishing depth of about 0.35 fathoms per year. Next, to determine the effect of depth on catch rate, mean depth was added as a co-variate to the Generalized Linear Models (GLMs) used to calculate the delta-gamma index. Depth information was again obtained from the CPFV data set, which includes the minimum and maximum depths [fathom] at every location visited during sampled fishing trips. The depth covariate was considered significant by the AIC criterion for both the binomial GLM and the gamma GLM. Moreover, based on AIC scores, the inclusion of depth as a covariate justified deletion of the 'location' term from both models. Figures 2a and 2b illustrate the effect of depth on the probability of observing a positive CPUE and the mean CPUE for positive observations, respectively.





Clustering of the fitted probabilities near 1.0 may be due to the fact that the CPFV data were filtered to only include locations where black rockfish were caught on at least five occasions over the observed time period. However, it does appear that fishing effort shifted over time to depths characterized by higher catch rates. For example, a 3 fathom shift to shallower water was observed over the decade extending from 1988-1998, which would be expected to substantially increase the probability of a positive catch (e.g., 0.4 → 0.8). In addition, the shift to shallower fishing depths might increase CPUE by over 50%. In combination, these effects would be expected to bias the unadjusted CPUE statistic high.

Finally, attempts were made to identify changes in mean fish length over time, but most of the length information was processed shoreside, and it was often impossible to assign an accurate location to individual length measurements. This significantly reduced the amount of data that could be identified from specific locations, of which only a small number met the criterion of a minimum of 5 black rockfish caught.

Appendix 2: Stock Synthesis parameter file for the base black rockfish stock assessment model

```
black03-new.txt   LOOP1:  7  LIKE: -1232.82899  DELTA LIKE:       .00023 ENDBIO:     10447.
black.run
black.par
FIRST MODEL:  'BASE' MODEL FROM 2001
    100.000000          .001000     BEGIN AND END DELTA F PER LOOP1
   3   .95                 FIRST LOOP1 FOR LAMBDA & VALUE
   1.200                   MAX VALUE FOR CROSS DERIVATIVE
   1 READ HESSIAN
black.hes
   1 WRITE HESSIAN
black.hes
    .000                   MIN SAMPLE FRAC. PER AGE
   2  25    4  25          MINAGE, MAXAGE,  SUMMARY AGE RANGE
  1945  2002               BEGIN YEAR, END YEAR
  1       12  0  0  0      NPER, MON/PER
  1.00                     SPAWNMONTH
  6  4 NFISHERY, NSURVEY
  2 N SEXES
   10000.  REF RECR LEVEL
  3 MORTOPT
     .120000     .010000     1.000000 'M-FEMALE-YOUNG  '   0     1  0      .000000   .0000 !   1 NO PICK    .000       0.      .0000000
     .200000     .010000     1.000000 'M-FEMALE-OLD    '   0     1  0      .000000   .0000 !   2 NO PICK    .000       0.      .0000000
   10.000000    4.000000    18.000000 'M-FEMALE-INFLECT'   0     1  0      .000000   .0000 !   3 NO PICK    .000       0.      .0000000
     .120000     .010000     1.000000 'M-MALE-YOUNG    '   0     1  0      .000000   .0000 !   4 NO PICK    .000       0.      .0000000
     .120000     .010000     1.000000 'M-MALE-OLD      '   0     1  0      .000000   .0000 !   5 NO PICK    .000       0.      .0000000
    1.000000    4.000000    18.000000 'M-MALE-INFLECT  '   0     1  0      .000000   .0000 !   6 NO PICK    .000       0.      .0000000
 OR SPORT    TYPE:  1
  7 SELECTIVITY PATTERN
   0   2   0    3   4   0     0  AGE TYPES USED
     1.00000        .02 'OR REC CATCHES      '  ! # =  1 VALUE:          .00000
     1.00000        .30 'OR REC AGE COMPS    '  ! # =  2 VALUE:      -169.89859
     1.00000        .30 'OR REC LEN COMPS    '  ! # =  3 VALUE:      -345.09100
      .10000      -1.00 'OR REC LEN@AGE      '  ! # =  4 VALUE:     -2177.15867
  2  2  0  0   0  0  SEL. COMPONENTS
   39.000000   20.000000    55.000000 'Transition lengt'   0     1  0      .000000   .0000 !   7 NO PICK    .000       0.      .0000000
     .001000     .000010     1.000000 'Min size selecti'   0     1  0      .000000   .0000 !   8 NO PICK    .000       0.      .0000000
     .670917     .050000      .950000 'Size@ascend infl'   2     1  0      .000000   .0000 !   9 OK         .000  -29763.      .0001782
     .355588     .010000     4.000000 'Ascending slope '   2     1  0      .000000   .0000 !  10 OK         .000  -19307.      .0001332
     .228483     .001000      .990000 'F-max size selec'   2     1  0      .000000   .0000 !  11 OK         .000   -3684.      .0010530
     .050000     .050000      .850000 'F-descend inflec'   2     1  0      .000000   .0000 !  12 BOUND      .000       0.      .0000000
     .524694     .010000     5.000000 'F-descend slope '   2     1  0      .000000   .0000 !  13 OK         .000    -869.      .0063543
 OR HOOK     TYPE:  2
  7 SELECTIVITY PATTERN
   0   0   0    6   0   0     0  AGE TYPES USED
     1.00000        .02 'OR HOOK CATCHES     '  ! # =  5 VALUE:          .00000
     1.00000        .30 'OR HOOK LEN COMPS   '  ! # =  6 VALUE:       -90.76399
  2  2  0  0   0  0  SEL. COMPONENTS
   39.000000   20.000000    55.000000 'Transition lengt'   0     1  0      .000000   .0000 !  14 NO PICK    .000       0.      .0000000
     .001000     .000000     1.000000 'Min size selecti'   0     1  0      .000000   .0000 !  15 NO PICK    .000       0.      .0000000
     .775690     .050000     2.000000 'Size@ascend infl'   2     1  0      .000000   .0000 !  16 OK         .000   -3701.      .0008169
     .511292     .010000     4.000000 'Ascending slope '   2     1  0      .000000   .0000 !  17 OK         .000   -1380.      .0018067
     .331768     .001000      .990000 'F-max size selec'   2     1  0      .000000   .0000 !  18 OK         .000    -263.      .0102456
     .276182     .050000      .850000 'F-descend inflec'   2     1  0      .000000   .0000 !  19 OK         .000    -870.      .0018683
     .799760     .010000     5.000000 'F-descend slope '   2     1  0      .000000   .0000 !  20 OK         .001     -10.      .2039244
 OR TRAWL    TYPE:  3
  7 SELECTIVITY PATTERN
   0   0   0    8   0   0     0  AGE TYPES USED
     1.00000        .02 'OR TRAWL CATCHES    '  ! # =  7 VALUE:          .00000
     1.00000        .30 'OR TRAWL LEN COMPS  '  ! # =  8 VALUE:       -35.35911
  2  0  0  0   0  0  SEL. COMPONENTS
     .001000     .000000     1.000000 'Min size selecti'   0     1  0      .000000   .0000 !  21 NO PICK    .000       0.      .0000000
     .540660     .050000      .950000 'Size@ascend infl'   2     1  0      .000000   .0000 !  22 OK         .000  -14688.      .0001283
     .574077     .010000    20.000000 'Ascending slope '   2     1  0      .000000   .0000 !  23 OK         .000    -363.      .0048393
 CA SPORT    TYPE:  4
  7 SELECTIVITY PATTERN
   0   0   0  10   0   0     0  AGE TYPES USED
     1.00000        .02 'CA REC CATCHES      '  ! # =  9 VALUE:          .00000
     1.00000        .30 'CA REC LEN COMPS    '  ! # = 10 VALUE:      -179.51464
  2  2  0  0   0  0  SEL. COMPONENTS
   31.000000   20.000000    55.000000 'Transition lengt'   0     1  0      .000000   .0000 !  24 NO PICK    .000       0.      .0000000
     .001000     .000010     1.000000 'Min size selecti'   0     1  0      .000000   .0000 !  25 NO PICK    .000       0.      .0000000
     .100000     .050000      .950000 'Size@ascend infl'   0     1  1      .000000   .0000 !  26 ENV FXN    .000       0.      .0000000
     .175686     .010000     4.000000 'Ascending slope '   2     1  0      .000000   .0000 !  27 OK         .000   -1114.      .0010716
     .264572     .001000      .990000 'F-max size selec'   2     1  0      .000000   .0000 !  28 OK         .000   -2041.      .0010021
     .050000     .050000      .850000 'F-descend inflec'   0     1  2      .000000   .0000 !  29 ENV FXN    .000       0.      .0000000
    1.237727     .010000     8.000000 'F-descend slope '   2     1  0      .000000   .0000 !  30 OK         .001     -15.      .0735644
 CA HOOK     TYPE:  5
  7 SELECTIVITY PATTERN
   0   0   0  12   0   0     0  AGE TYPES USED
     1.00000        .02 'CA HOOK CATCHES     '  ! # = 11 VALUE:          .00000
     1.00000        .30 'CA HOOK LEN COMPS   '  ! # = 12 VALUE:      -124.34002
  2  2  0  0   0  0  SEL. COMPONENTS
   39.000000   20.000000    55.000000 'Transition lengt'   0     1  0      .000000   .0000 !  31 NO PICK    .000       0.      .0000000
     .001000     .000000     1.000000 'Min size selecti'   0     1  0      .000000   .0000 !  32 NO PICK    .000       0.      .0000000
     .686058     .050000     2.000000 'Size@ascend infl'   2     1  0      .000000   .0000 !  33 OK         .000   -4167.      .0017849
     .301537     .010000     4.000000 'Ascending slope '   2     1  0      .000000   .0000 !  34 OK         .000   -5968.      .0007864
     .284097     .001000      .990000 'F-max size selec'   2     1  0      .000000   .0000 !  35 OK         .000    -331.      .0057804
     .050000     .050000      .850000 'F-descend inflec'   2     1  0      .000000   .0000 !  36 BOUND      .000       0.      .0000000
     .301790     .010000     5.000000 'F-descend slope '   2     1  0      .000000   .0000 !  37 OK         .000    -417.      .0054991
 CA TRAWL    TYPE:  6
  7 SELECTIVITY PATTERN
   0   0   0  14   0   0     0  AGE TYPES USED
     1.00000        .02 'CA TRAWL CATCHES    '  ! # = 13 VALUE:          .00000
     1.00000        .30 'CA TRAWL LEN COMPS  '  ! # = 14 VALUE:      -101.46734
  2  0  0  0   0  0  SEL. COMPONENTS
     .001000     .000000     1.000000 'Min size selecti'   0     1  0      .000000   .0000 !  38 NO PICK    .000       0.      .0000000
     .622229     .050000      .950000 'Size@ascend infl'   2     1  0      .000000   .0000 !  39 OK         .000  -12890.      .0002254
     .425514     .010000    20.000000 'Ascending slope '   2     1  0      .000000   .0000 !  40 OK         .000   -2290.      .0010778
```

```
OR RECFI    TYPE:  7
 2 SELECTIVITY PATTERN
  0   0   0   0   0   0    0  AGE TYPES USED
    .000561 -1  1  2 Q, QUANT, LOGERROR=1, BIO=1 or NUM=2
    .000561      .000100  100.000000 'OR-REC CPUE Q    '   2      1  0       .000000     .0000 !  41 OK             .000*********          .0000000
    .000000    -1.000000     .000000 'OR-REC CPUE bioQ'   0      1  0       .000000     .0000 !  42 NO PICK        .000          0.       .0000000
    1.00000          .37 'OREGON RECFIN CPUE  '  ! # = 15 VALUE:          11.11111
   1.000000      .001000   40.000000 'USE SELEX FROM 1'   0      1  0       .000000     .0000 !  43 NO PICK        .000          0.       .0000000
  19.000000      .050000   99.000000 'MIN SIZE TO USE '   0      1  0       .000000     .0000 !  44 NO PICK        .000          0.       .0000000
  59.000000      .010000   99.000000 'MAX SIZE TO USE '   0      1  0       .000000     .0000 !  45 NO PICK        .000          0.       .0000000
ODFG REC    TYPE:  8
 2 SELECTIVITY PATTERN
  0   0   0   0   0   0    0  AGE TYPES USED
    .012387 -1  1  2 Q, QUANT, LOGERROR=1, BIO=1 or NUM=2
    .012387      .000100  100.000000 'ODF&G  CPUE Q    '   2      1  0       .000000     .0000 !  46 OK             .000 -763618.          .0000014
    .000000    -1.000000     .000000 'ODF&G  CPUE bioQ'   0      1  0       .000000     .0000 !  47 NO PICK        .000          0.       .0000000
    1.00000          .32 'ODF&G (BODENMILLER)  '  ! # = 16 VALUE:         8.78999
   1.000000      .001000   40.000000 'USE SELEX FROM 1'   0      1  0       .000000     .0000 !  48 NO PICK        .000          0.       .0000000
  19.000000      .050000   99.000000 'MIN SIZE TO USE '   0      1  0       .000000     .0000 !  49 NO PICK        .000          0.       .0000000
  59.000000      .010000   99.000000 'MAX SIZE TO USE '   0      1  0       .000000     .0000 !  50 NO PICK        .000          0.       .0000000
CA RECFI    TYPE:  9
 2 SELECTIVITY PATTERN
  0   0   0   0   0   0    0  AGE TYPES USED
    .000331 -1  1  2 Q, QUANT, LOGERROR=1, BIO=1 or NUM=2
    .000331      .000100  100.000000 'CA-REC CPUE Q    '   2      1  0       .000000     .0000 !  51 OK             .000*********          .0000000
    .000000    -1.000000     .000000 'CA-REC CPUE bioQ'   0      1  0       .000000     .0000 !  52 NO PICK        .000          0.       .0000000
    1.00000          .34 'CALIFORNIA RECFIN    '  ! # = 17 VALUE:         8.39146
   4.000000      .001000   40.000000 'USE SELEX FROM 4'   0      1  0       .000000     .0000 !  53 NO PICK        .000          0.       .0000000
  19.000000      .050000   99.000000 'MIN SIZE TO USE '   0      1  0       .000000     .0000 !  54 NO PICK        .000          0.       .0000000
  59.000000      .010000   99.000000 'MAX SIZE TO USE '   0      1  0       .000000     .0000 !  55 NO PICK        .000          0.       .0000000
CDFG REC    TYPE: 10
 2 SELECTIVITY PATTERN
  0   0   0   0   0   0    0  AGE TYPES USED
    .001621 -1  1  2 Q, QUANT, LOGERROR=1, BIO=1 or NUM=2
    .001621      .000100  100.000000 'CDF&G  CPUE Q    '   2      1  0       .000000     .0000 !  56 OK             .000*********          .0000000
    .000000    -1.000000     .000000 'CDF&G  CPUE bioQ'   0      1  0       .000000     .0000 !  57 NO PICK        .000          0.       .0000000
    1.00000          .43 'CDF&G (WILSON-VAND)  '  ! # = 18 VALUE:         1.98266
   4.000000      .001000   40.000000 'USE SELEX FROM 4'   0      1  0       .000000     .0000 !  58 NO PICK        .000          0.       .0000000
  19.000000      .050000   99.000000 'MIN SIZE TO USE '   0      1  0       .000000     .0000 !  59 NO PICK        .000          0.       .0000000
  59.000000      .010000   99.000000 'MAX SIZE TO USE '   0      1  0       .000000     .0000 !  60 NO PICK        .000          0.       .0000000
 1 AGEERR: 1: MULTINOMIAL,   0: S(LOG(P))=CONSTANT,   -1: S=P*Q/N
300.000 : MAX N FOR MULTINOMIAL
 3 1=%CORRECT, 2=C.V., 3=%AGREE, 4=READ %AGREE @AGE
    .600000      .300000      .950000 '%AGREE @ 2 (MIN)'   0      1  0       .000000     .0000 !  61 NO PICK        .000          0.       .0000000
    .100000      .100000      .900000 '%AGREE @ 25(MAX)'   0      1  0       .000000     .0000 !  62 NO PICK        .000          0.       .0000000
   1.000000      .001000     4.000000 'POWER            '   0      1  0       .000000     .0000 !  63 NO PICK        .000          0.       .0000000
    .150000      .010000      .300000 'OLD DISCOUNT     '   0      1  0       .000000     .0000 !  64 NO PICK        .000          0.       .0000000
    .000000      .001000      .100000 '%MIS-SEXED       '   0      1  0       .000000     .0000 !  65 NO PICK        .000          0.       .0000000
 0 END OF EFFORT
 0 FIX n FMORTs
 0  MATURITY
 1  GROWTH: 1=CONSTANT, 2=MORT. INFLUENCE
 5.0000 15.0000  AGE AT WHICH L1 AND L2 OCCUR
 1 1=NORMAL, 2=LOGNORMAL
  32.205317   10.000000   40.000000 'FEMALE L1         '   2      1  0   35.900000     .9000 !  66 OK             .000      -57.          .0232936
  47.953661   40.000000   70.000000 'FEMALE L2         '   2      1  0   46.580000     .9000 !  67 OK             .001      -47.          .0109405
    .202184      .100000      .400000 'FEMALE K          '   2      1  0     .149500     .9000 !  68 OK             .000   -34972.          .0000517
    .087900      .010000      .990000 'FEMALE CV5        '   0      1  0     .000000     .0000 !  69 NO PICK        .000          0.       .0000000
    .088200      .010000      .990000 'FEMALE CV15       '   0      1  0     .000000     .0000 !  70 NO PICK        .000          0.       .0000000
  31.883448   10.000000   70.000000 'MALE L1           '   2      1  0   35.390000     .9000 !  71 OK             .000      -71.          .0222675
  45.391235   20.000000   50.000000 'MALE L2           '   2      1  0   44.060000     .9000 !  72 OK             .000      -79.          .0287774
    .197926      .100000      .400000 'MALE K            '   2      1  0     .138400     .9000 !  73 OK             .000   -32650.          .0001236
    .082400      .010000      .990000 'MALE CV5          '   0      1  0     .000000     .0000 !  74 NO PICK        .000          0.       .0000000
    .064500      .010000      .990000 'MALE CV15         '   0      1  0     .000000     .0000 !  75 NO PICK        .000          0.       .0000000
         0  DEFINE MARKET CATEGORIES
 2 ENVIRONMENTAL FXN:     [-INDEX]  [FXN TYPE(1-4)]  [ENVVAR USED]
black.env
 -1  1  1
   1.000000      .050000      .950000 'CA INFLECTION    '   0      1  0       .000000     .0000 !  76 NO PICK        .000          0.       .0000000
 -2  1  1
   1.000000      .050000      .950000 'CA DESC SLOPE    '   0      1  0       .000000     .0000 !  77 NO PICK        .000          0.       .0000000
 4 ESTIMATE N ENVIRON VALUES
  -1945     1989       1
    .950000      .010000      .950000 '1978-89 INFLCT  '   2      1  0       .000000     .0000 !  78 BOUND          .000          0.       .0000000
  -1990     2002       1
    .010000      .010000      .950000 '1990-02 INFLCT  '   2      1  0       .000000     .0000 !  79 BOUND          .000          0.       .0000000
  -1945     1989       2
    .500000      .010000      .950000 '1978-89 SLOPE   '   2      1  0       .000000     .0000 !  80 OK             .000         -1.       .0000000
  -1990     2002       2
    .052562      .010000      .950000 '1990-02 SLOPE   '   2      1  0       .000000     .0000 !  81 OK             .000         -1.       .0000000
19 PENALTIES
     .00000          .30 ' penalty like        '  ! # = 19 VALUE:          -.30374
-1  1.0  1.0
 0 ENVIRONMENT EFFECT ON EXP(RECR)
20  STOCK-RECR
 3 1=B-H, 2=RICKER, 3=new B-H, 4=HOCKEY
 0 disabled option
     .10000         -.40 ' SPAWN-RECRUIT indiv'  ! # = 20 VALUE:          10.46796
     .00001         -.20 ' SPAWN-RECRUIT mean '  ! # = 21 VALUE:         -45.07477
    .243337      .100000     9.000000 'VIRGIN RECR MULT'   2      1  0       .000000     .0000 !  82 OK             .000   -61533.          .0000320
    .650000      .200000     1.000000 'B/H  S/R PARAM  '   0      1  0       .600000     .9000 !  83 NO PICK        .000          0.       .0000000
    .000000     -.200000      .200000 'BACKG. RECRUIT  '   0      1  0       .000000     .0000 !  84 NO PICK        .000          0.       .0000000
    .400000      .200000     1.500000 'S/R STD.DEV.    '   0      1  0       .000000     .0000 !  85 NO PICK        .000          0.       .0000000
    .000000     -.200000      .200000 'RECR TREND      '   0      1  0       .000000     .0000 !  86 NO PICK        .000          0.       .0000000
   1.000000      .500000     3.000000 'RECR. MULT.     '   0      1  0       .000000     .0000 !  87 NO PICK        .000          0.       .0000000
 -1 INIT AGE COMP
   -.266361      .001000   10.000000 'RECR 1945 YC=43 '   0  1945  0       .000000     .0000 !  88 NO PICK        .000          0.       .0000000
   -.266361      .001000   10.000000 'RECR 1946 YC=44 '   0  1946  0       .000000     .0000 !  89 NO PICK        .000          0.       .0000000
   -.266361      .001000   10.000000 'RECR 1947 YC=45 '   0  1947  0       .000000     .0000 !  90 NO PICK        .000          0.       .0000000
   -.266361      .001000   10.000000 'RECR 1948 YC=46 '   0  1948  0       .000000     .0000 !  91 NO PICK        .000          0.       .0000000
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   -.266143      .001000   10.000000 'RECR 1950 YC=48 '   0  1950  0       .000000     .0000 !  93 NO PICK        .000          0.       .0000000
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   -.265680      .001000   10.000000 'RECR 1952 YC=50 '   0  1952  0       .000000     .0000 !  95 NO PICK        .000          0.       .0000000
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-.265372	.001000	10.000000	'RECR 1953 YC=51 '	0	1953	0	.000000	.0000 !	96	NO PICK	.000	0.	.0000000
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CONVERGENCE
LIKE CHANGE: .0002 MAX PARM CHANGE: 118 RECR 1975 YC=73 .00170
CONVERGENCE PATH (LIKE, BIOMASS)

-1232.8303	10463.0
-1232.8303	10463.6
-1232.8302	10467.1
-1232.8300	10469.5
-1232.8299	10466.8
-1232.8292	10455.2
-1232.8290	10447.0

NUMBER OF ESTIMATED PARAMETERS = 61
N CATCHES WITH F ESTIMATED = 342
N SURV OBS WITH EMPH > 0.001 = 63
N EFFORT OBS WITH EMPH > 0.001 = 0
N COMPOSITION OBS WITH NAGES>1 = 113
N COMPOSITION BINS WITH DATA = 2603

PARAMETERS ON BOUNDS

12	.05000	F-descend inflec
36	.05000	F-descend inflec
78	.95000	1978-89 INFLCT
79	.01000	1990-02 INFLCT

PARAMETERS WITH FLAT CURVATURE (BAD SECOND DERIV)

12	.05000	F-descend inflec
36	.05000	F-descend inflec
78	.95000	1978-89 INFLCT
79	.01000	1990-02 INFLCT

PARAMETERS WITH LARGE GRADIENT (FIRST DERIV > .05)

PARAMETER pairs with SCALED HESSIAN or CORRELATION > 0.7

9	10	Size@ascend infl	Ascending slope	-.8175	-.6246
11	13	F-max size selec	F-descend slope	.8753	.6742
12	13	F-descend inflec	F-descend slope	-1.0000	-99.0000
16	17	Size@ascend infl	Ascending slope	-.8235	-.7530
22	23	Size@ascend infl	Ascending slope	-.7061	-.6336
33	34	Size@ascend infl	Ascending slope	-.8541	-.8481
35	37	F-max size selec	F-descend slope	.8908	.5960
36	37	F-descend inflec	F-descend slope	-1.0000	-99.0000
39	40	Size@ascend infl	Ascending slope	-.8205	-.7163
67	68	FEMALE L2	FEMALE K	-.7149	.5311
78	82	1978-89 INFLCT	VIRGIN RECR MULT	-1.0000	-99.0000
78	118	1978-89 INFLCT	RECR 1975 YC=73	-.8208	-99.0000
78	119	1978-89 INFLCT	RECR 1976 YC=74	-.7714	-99.0000
82	118	VIRGIN RECR MULT	RECR 1975 YC=73	-.8198	5.0204
82	119	VIRGIN RECR MULT	RECR 1976 YC=74	-.7722	-.0217
118	119	RECR 1975 YC=73	RECR 1976 YC=74	-.8858	-7.1573
118	120	RECR 1975 YC=73	RECR 1977 YC=75	-.7871	6.8833
119	120	RECR 1976 YC=74	RECR 1977 YC=75	-.9114	-.5821
119	121	RECR 1976 YC=74	RECR 1978 YC=76	-.7427	.0635
120	121	RECR 1977 YC=75	RECR 1978 YC=76	-.8838	-.6237
121	122	RECR 1978 YC=76	RECR 1979 YC=77	-.8478	-.5928
122	123	RECR 1979 YC=77	RECR 1980 YC=78	-.8090	-.5507
123	124	RECR 1980 YC=78	RECR 1981 YC=79	-.7828	-.3088
124	125	RECR 1981 YC=79	RECR 1982 YC=80	-.7601	-.6858

125 126 RECR 1982 YC=80 RECR 1983 YC=81 -.7278 -.6840

BLACK ROCKFISH

STAR Panel Report
Southwest Fisheries Science Center
Santa Cruz, California
April 20-25, 2003

STAR Panel Members:
Thomas Helser, NMFS Northwest Fisheries Science Center, STAR Chair
Farron Wallace, Washington Department of Fish and Wildlife, Rapporteur
Martin Dorn, NMFS Alaska Fisheries Science Center, SSC Representative
David Sampson, Oregon State University
Patrick Cordue, Center For Independent Experts, University of Miami
Peter Leipzig, Fisherman's Marketing Association, GAP Representative
David Thomas, California Department of Fish and Wildlife, GMT Representative

STAT Team Members Present:
Stephen Ralston, NMFS Southwest Fisheries Science Center

Overview

The STAR Panel convened the week of April 21-25, 2003 at the Southwest Fisheries Science Center at Santa Cruz to review a draft assessment report by the STAT Team for black rockfish. A draft report was provided to Star Panel members in advance of the STAR workshop and an update was provided during the meeting. Dr. Stephen Ralston, the sole member of the STAT Team, summarized the draft document including description of the fishery, biology of the species, and available data sources. He also reviewed relevant features, settings, assumptions and results from his initial base model. Following this review, the STAR Panel requested a number of additional detailed data summaries and analyses to evaluate data quality, catch estimation, appropriateness of model assumptions and interpretation of results.

The Panel had considerable discussions with the STAT team concerning the paucity of information to reconstruct historic catches prior to 1978, especially in Oregon, and the methodology used to estimate them. Because trends in abundance indices were essentially flat over the entire assessment period, the model's estimates of depletion were very sensitive to the assumed level of historical catch. This was particularly the case since the initial model formulation did not use size/age composition information to reconstruct estimates of recruitment in the population. In the final analysis, Panel and Team members established what was considered to be the "best" estimate of catch histories, input into the model as a "ramping up" from 0 in 1945 to 500 mt prior to 1978. This also addressed the Panel's concern that the modeled stock may not have had sufficient time since the start of fishing to reach equilibrium.

The Panel questioned the suitability of modeling male and female natural mortality as being equivalent. After review of existing information, Team and Panel members agreed that sex-specific natural mortality rates would best reflect evidence that females are subject to increased natural mortality during their reproductive years. Because of the uncertainty in the relative level of natural mortality, a sensitivity analysis was conducted to find a range of plausible parameter values.

Building upon new assumptions about sex-specific natural mortality and initial conditions associated with catch histories prior to 1978, the STAR Panel requested an alternative model that estimates recruitment for the years 1975-1998 based on age-composition information. This allows the model freedom to find alternative explanations (depletion trajectories) of the data instead of being constrained by constant recruitment and initial equilibrium conditions associated with fixed rates of historic removals. This model also included a two time-period selectivity for the California sport fishery, which was most consistent with changes in length compositions and flat CPUE indices.

Based on the deliberations above, the STAR Panel and STAT Team arrived at developing a new baseline model with the primary components: recruitment is estimated 1978-1998; sex-specific natural mortality, including increase in age-specific natural mortality for females; and a two time-period selectivity curve for the California sport fishery. As previously mentioned, because depletion is very sensitive to the assumed level of historical catch, the Panel recommend bracketing this uncertainty by contrasting lower and higher catches trajectories (and therefore accumulated catches) during the early time series. The Panel concludes that this assessment is based on the best available data and provides the Council insight into black rockfish stock status and captures the range of uncertainty. The Panel commends the Team for their professionalism, dedication, hard work and cooperation with Panel requests.

Analyses requested by the STAR Panel.

1) Contrast RecFIN indices using species coefficients from early (1980-1991) and late (1991-Present) time periods. Panel members expressed concerns that the RecFIN index generated by applying a new statistical methodology to weight trips for subsequent Delta-GLM standardization may be sensitive to changes in species composition. Prior to completion of this request, a parallel analysis of the RecFIN data used in the bocaccio assessment indicated no changes in index trajectory. The Panel did not believe it necessary to continue further evaluation of changing species coefficients on the black rockfish index.

2) Compare and contrast CPUE among specific sites visited by the northern California CPFV fishery. Panel members wanted to explore the data to see if there was any evidence of serial depletion among reefs. If fishers were fishing down and then moving on to reefs with greater production, then the CPUE index could remain level, when in fact, the population was declining.

3) Analyze the CPFV data to determine if there has been a spatial change in CPFV site targeting. This analysis was motivated by the observation that mean length in the California sport fishery had declined over time, while mean length in the Oregon fishery had not. The panel sought to evaluate the possibility that such a pattern is due to declining population abundance causing a shift in size or an on-shore shift in fishing patterns in recent years. Although time was not available to do a full analysis, preliminary inspection of the data suggested that there may have been a shift in CPFV effort to shallower fishing sites.

4) Analyze the RecFIN catch data to see if there is an increasing trend of "nearshore" species composition in recent years. Again, the panel sought to evaluate the possibility that the pattern in item (3) is due to declining population abundance causing a shift in size or an on-shore shift in fishing patterns in recent years. Is there an increasing trend of trips directed at nearshore species? The assessment is highly dependent on trends in fishery-dependent abundance indices.

5) Tabularize all annual changes in State and Federal regulations influencing the commercial and recreational black rockfish fisheries. Both State and Federal regulations restricting nearshore rockfish harvest may influence black rockfish catch and CPUE. Interpretation of the CPUE indices is problematic when there are changes in regulations that might influence fishing behavior.

6) Link California and Oregon trawl selectivity. There are no apparent biological or gear differences between the California and Oregon trawl fisheries. However, a model run with linked selectivity degraded fit to the California trawl length comps. Selectivity was left separate.

7) Conduct sensitivity analysis with knife-edge selectivity at age (1-8) and "dome shaped" selectivity for the historical catch. The base model initially presented by the STAT team had mistakenly specified historical catch selectivity to be set to knife-edge at age 1 (-1 in synthesis Input file). Modeling of historical catch was modified such that knife-edge selectivity was no longer required.

8) Tabularize annual age and length sampling by port and year for the Oregon Sport fishery. Concern was expressed that only the Garibaldi fishery was sampled prior to 1990 and data did not represent the total catch taken by the Oregon Sport fishery. Because this was the case, it was agreed to truncate the earlier time series of data.

9) Plot mean length over time by cohort. Information indicated an abrupt decline in mean size at age of black rockfish in the Oregon sport fishery. This plot showed an apparent decline in mean size at age and was especially evident beginning in the early 1990's. However, this corresponded to a change in age readers, so it is not clear whether this trend was due to misspecification of ages or real.

10) Plot mean length time series for RecFIN and Oregon and California sport length data with associated sample sizes. These data were pooled by State and concern was expressed that the two data collection programs may measure different segments of the fishery.

11) Plot empirical CVs for length-at-age from the ODFW data instead of the fitted data. The Panel was concerned that the fit to the length composition was very sensitive to the CVs associated with each age used as input into the model. Results showed that a difference in CV estimates between the two estimation methods was inconsequential. Based on empirical analysis, CVs for young and older ages were higher than middle ages; a pattern that Synthesis cannot model. CVs for young and oldest fishes were then estimated from a regression applied to ages 5-14 of the truncated Oregon time series of ages.

12) Explain the derivation of the catch history for each of the fisheries. The Panel noted an unusually large catch for the Oregon trawl fishery in 1978, the first year of the model period. The STAT team explained the derivation and an alternative procedure was developed which gave a more plausible estimate.

The panel was concerned about the initial equilibrium assumptions in the model. Before 1978, the model assumes that a constant annual "historical catch" has caused the population to reach an equilibrium age structure in 1978. This creates two problems. First, there may not have been sufficient time, since the beginning of the fisheries, for the population to have reached "equilibrium", and second, the appropriate level of "historical catch" is unknown.

Model estimates of depletion are very sensitive to the assumed level of historical catch. The Panel recognized the early catch history was highly uncertain due to lack of information (little or no species composition samples). The Panel worked with the STAT team to develop a plausible catch history, which avoided the need to assume historical catch and equilibrium conditions in the first year of the assessment.

13) Estimate selectivity for two time periods (early period before 1990) for the California sport fishery. The systematic pattern of residuals suggested change in selectivity at or about 1990. This could help explain decline in mean length of sport catch in California. There was no apparent change in CPUE during this time period.

14) Provide alternative model runs using sex-specific natural mortality. Sensitivity analysis indicated the "best" model fit was when male natural mortality was fixed at 0.12 and female initial natural mortality was fixed to 0.12 and increased to 0.20 at age 10. This outcome is plausible and was comparable to other independent analysis (catch-curve, Hoenig 1983).

15) Construct an alternative model that estimates recruitment for years 1975-1998 and compare to the constant recruitment model. The Panel recommended that the model be allowed freedom to find alternative explanations of the data (different depletion trajectory) instead of being constrained to the explanation implied by constant recruitment and initial equilibrium conditions.

16) Using the final base model, profile on steepness to evaluate biomass sensitivity and fit to likelihood components. Although results show little model sensitivity, in terms of relative change in total log likelihood, the profile likelihood did find a broad peak at 0.65-0.7. Furthermore, evidence from other rockfish studies indicate steepness should be much lower than 1.0. The meta-analysis in Dorn (19xx) leads us to believe that a range between 0.52 - 0.67 is most appropriate for rockfish. Panel endorsed using a steepness value at 0.65, which was coincident with the best model fit.

17) Complete three model runs using final base model with two alternative catch streams to bracket the uncertainty in historical catch.

Final Base-Run Model(s) included:

<u>Data</u>
Reconstructed time series of catch histories
Excluded ODFW length and age composition data preceding 1990
Uses ODFW mean length-at-age data
Use all of the available RecFIN length composition data (Oregon and California)
Use all of commercial length composition data (trawl, hook-and-line for each State)
Use all available CPUE indices (ODFW sport, RecFIN by State and CPFV for California)

<u>Model</u>
Profile on sex-specific natural mortality rates
Include age specific step increase in female natural mortality
Use a two-period selectivity model for the California sport fishery
Begin the model(s) in 1945 at equilibrium and assume no historical catch prior to 1945
Model(s) include estimated versus constant recruitment

<u>Final Base Model</u>
Fix steepness at 0.65
For males, fix natural mortality at 0.12

For females, fix initial natural mortality to 0.12 and step up to 0.20 at age 10

Technical Merits and/or deficiencies in assessments
The STAT Team is commended for the extraordinary amount of effort put into this assessment and responsiveness to STAR Panel requests. Their approach to developing a CPUE index using RecFIN data was innovative and novel. Any perceived deficiencies in the assessment are likely the result of inadequate or poor data.

Complete analysis of raw data sets is required to fully understand and present the properties, dynamics and uncertainty of CPUE indices. The Oregon CPUE index was prepared from summarized information, which did not allow full evaluation by either the analyst or the Panel. Full documentation and descriptions (sample protocols, size and stratification, etc.) of other data sets were somewhat incomplete. The Panel recognizes a need for a systematic process (step-wise regression) to fully evaluate what effects could have been modeled in a CPUE index.

Areas of disagreement regarding STAR Panel recommendations
None

Unresolved problems and major uncertainties
Model results indicate that black rockfish biomass decline precipitously before 1980. Depletion is very sensitive to early catch history because the indices are noisy, relatively flat and follow the declining biomass period. Two alternatives catch streams are used to bracket this uncertainty, but this may not capture the full range of uncertainty. Natural mortality estimates remains uncertain and are confounded with selectivity. As with most assessments, there was model sensitivity to steepness.

Recommendations for future research
Fishery independent survey(s) and biological data collection programs provide necessary components for stock assessment that is severely lacking for nearshore rockfish species. Currently, there are no fishery independent surveys in Oregon or California. Furthermore, observation of the CPFV fishery in northern California ports was discontinued. This program provided data extremely important for modeling stock status for a number of species including black rockfish. Future assessment for nearshore species is largely dependent upon developing fishery independent surveys and continuing fishery data collection programs.

Need for pre-assessment meeting(s) to evaluate data. Time constraints make it difficult for the stock assessment analysts to develop population dynamics models and achieve a full familiarity with all data sources. Pre-STAR assessment meetings with personnel familiar with the various data sources and technical experts on modeling would greatly facilitate well developed methods, documentation and understanding of all data sources.

Develop consistent methods and data sources to estimate catch histories. Work needs to be done to refine how catch history is used in the model (how best to begin the model with appropriate initial conditions) so there is sensible initial depletion that is consistent with the data and is plausible. Paucity of real information on historic catches across numerous rockfish assessments creates the need to estimate data gaps between fisheries and over years. Consistent statistical or extrapolation procedures should be developed across numerous rockfish complexes.

Further analysis is needed to reconcile whether there have been changes in growth and investigate other possible causes of changes in mean length at age. This overlaps with the need to test and resolve possible differences in ageing over time (change in age-readers).

This and other rockfish assessments depend upon fishery-dependent CPUE indices either due to the lack of research survey information or the difficulties encountered when sampling rocky habitats with bottom trawls. Recent attention to this problem has focused on the Northern cod stock collapse and the use/misuse of fishery-dependent CPUE indices. The RecFIN CPUE index used in this assessment as in others should be fully evaluated to verify its proper use as an index of abundance. There are technical aspects of the statistical methods used to weight the trips in the Delta-GLM standardization methods that should be more fully investigated as well.

CPFV data should be more fully explored to evaluate serial depletion among reefs. Perhaps such an approach could allow reefs to be random effects in a mixed effect depletion analysis that attempts to estimate the likely variation in depletion of CPUE.

Further investigation should be done to evaluate stock separation or a stock model with two spatial regions.

Cowcod Rebuilding Review

John L. Butler[1], Tom Barnes[2], Paul Crone[1] and Ray Conser[1]

[1]National Marine Fisheries Service, Southwest Fisheries Science Center, La Jolla, CA.
[2]California Department of Fish and Game, Southwest Fisheries Science Center, La Jolla, CA.

Objectives of Review

The primary objective of the Review was to provide a thorough examination of fishery-related cowcod removals that followed strict harvest restrictions that went into effect in 2000. Further, this examination is presented in the context of the yields (e.g., ABCs, OYs, etc.) recommended by the Pacific Fishery Management Council (PFMC). Indices of abundance were updated in cases where recent data were available; however, the time series will be made available as part of the oral presentation only, given these auxiliary data have not been evaluated in an inclusive (stock) framework and are best interpreted qualitatively at this time (see Appendix). That is, it is important to note that this Review did not include population modeling exercises and thus, should not be considered a formal stock assessment. In this regard, the Science and Statistical Committee (SSC) of the PFMC has recommended that cowcod be assessed formally again in 2004-05, with assessment-related duties assigned to researchers from the Southwest Fisheries Science Center in La Jolla, CA. Finally, in this Review, we focused on sample information associated with recognized data sources and arguably, have developed the most accurate time series of cowcod removals possible at this time.

Introduction

Cowcod (*Sebastes levis*) are distributed from Oregon to central Baja California, Mexico, are common off southern and central California, and are much less common off northern California and Oregon. This species generally inhabits a wide range of depths from 40 to 366 m (22-203 fm), with highest concentrations restricted to roughly 100 to 250 m (55-140 fm). Adults are usually associated with rocky outcrops. Larvae and juveniles are planktonic for up to three months and likely disperse long distances before settling to the bottom. The prolonged pelagic phase suggests a single biological population; however, the existence of multiple populations cannot be discounted definitively. Cowcod are long lived, slow growing, become sexually mature at a relatively old ages (12 y) and have a range of plausible natural mortality rates (M=0.065-0.085y^{-1}) that are relatively low for species of rockfish in general.

Management History

Prior to 2000, commercially harvested cowcod were managed under "other rockfish," with an ABC of 3,603 MT recommended for the combined statistical areas of Conception, Monterey and Eureka (PFMC, 1998). Recreational fishery regulations limited California anglers to 15 rockfish per day prior to 2000, with no 'sub-limit' restrictions for cowcod within the overall 15-rockfish limit. In 1999, the first assessment of cowcod indicated that the stock was overfished (Butler et al., 1999), which resulted in the adoption of specific management measures by the PFMC. In 2000, commercial fishers were limited to 1 cowcod per landing and bag limits for recreational fishers were 1 cowcod and 10 rockfish in the 'south' and 'north' management areas (see Table 1 for description of management areas). In addition, the PFMC created a Cowcod Conservation Area, where most bottom fishing was prohibited deeper than approximately 36 m (20 fm), see

Table 1. In 2001, cowcod became a 'prohibited' species for both recreational and commercial fishers.

The cowcod rebuilding analysis (Butler and Barnes, 2000) indicated that achieving B_{MSY} (i.e., $B_{40\%}$) for the south area could be achieved in 95 y, with initial total removals of 2.4 MT based on a fishing mortality rate (F) of 0.01. Ultimately, the PFMC adopted rebuilding plans for two geographic areas ('north' and 'south') that were partitioned at Point Conception, CA (Table 1). Catch limits for the south area were based on the rebuilding analysis and the OY was set at 2.4 MT, with an ABC of 5 MT that represented equilibrium-based yield estimates. Catch limits for the north area were set at 2.4 MT, with an ABC of 19 MT that was roughly equivalent to landings made in recent years.

Data Sources for Removals

Removals are defined here as landings (i.e., estimated through port sampling programs) and bycatch/discard (i.e., estimated via observer sampling programs); however, it is important to note that it was not possible to determine objective estimates of bycatch/discard for some fisheries. Henceforth, removal estimates are presented in the context of the naming convention above.

Commercial landings of cowcod were generated from the CalCOM data base (Pearson, 2003) in a similar fashion as was done in the previous assessment (Butler et al., 1999). Additionally, bycatch-related estimates of cowcod were generated from sample data associated with the spot prawn fishery off southern California (Reilly and Geibel, 2002a and 2002b) and various other commercial fisheries that exploit groundfish populations off the U.S. Pacific coast (see Table 4.4-1 in PFMC, 2003). Recreational landings of cowcod were estimated from the RecFIN data base (RecFIN, 2003), LA Times Newspaper (LA Times, 2003), and CPFV logbook data using similar methods as were used in the previous assessment (Butler et al., 1999).

It was possible to generate estimates of recreational fishery-related (Commercial Passenger Fishing Vessel, CPFV) discard from data collected through a recently implemented observer sampling program conducted collaboratively by the California Department of Fish and Game (CDFG) and Marine Recreational Fishery Statistics Survey (MRFSS). Also, note that no estimates of cowcod discard were currently available from the recently implemented observer sampling program for the groundfish trawl fishery off the U.S. Pacific coast, but given groundfish (including cowcod) trawl landings off southern California (the species primary concentration) have declined markedly since the late 1990s when further restrictions to quotas were established for this fishery, levels of discard were assumed negligible.

Results and Conclusions

Most importantly, this Review indicated that total removals of cowcod have declined in accordance with the new harvest stipulations enacted in 2000. Removal estimates of cowcod for both commercial and recreational fisheries are presented in Table 2. Total removals for the two management areas (north and south of Point Conception) were below the ABC/OY, with the exception of the south area in 2000. This was largely the result of additional removals (bycatch) by the spot prawn trawl fishery off southern California that were accounted for in this Review, but not in previous assessments of the population. Regardless, in statistical terms, the additional yield of 12% (i.e., 0.6 MT above the 5 MT OY) is within the bound of error associated with these estimates, given the substantial variability surrounding the recreational fishery statistics alone, which typically represented the majority of the total removals of cowcod, i.e., variance estimates associated with recreational fishery sample data were able to be derived.

The stringent harvest restrictions in place since 2000 appear to have been generally effective in constraining total removals of cowcod to levels that were within the rebuilding-based OYs. Additionally, it is expected that the population would be further protected as a result of establishment of the Rockfish Conservation Areas that were set aside beginning in 2003 (see Table 1); however, the potential reduction in removals due to these area closures was not considered in this Review. Finally, conclusions drawn here were based strictly on the assumption that the available sources of data were inclusive and did not include potentially influential biases, e.g., sample information was representative of the statistical populations of interest, unreported removals of cowcod were minimal, etc.).

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Table 1. Cowcod and shelf rockfish regulations (2000-02) and description of Cowcod Conservation Areas.

		Cowcod stock	Recreational fishery regulations			
Year	**Area[1]**	**ABC/OY (mt)**	**Cowcod bag limit**	**Rockfish bag limit**	**Gear restrictions**	**Shelf rockfish open season**
2000	**North**	19 / <5	1 (2/boat)	10	1 line / 3 hooks	Jan-Feb + May-Dec
	South	5 / <5	1 (2/boat)	10	1 line / 3 hooks	Mar-Dec
2001	**North**	19 / 2.4	Prohibited	10	1 line / 2 hooks	Jan-Feb + Jul-Dec
	South	5 / 2.4	Prohibited	10	1 line / 2 hooks	Mar-Dec
2002	**North**	19 / 2.4	Prohibited	10	1 line / 2 hooks	Jan-Feb + Jul-Aug
	South	5 / 2.4	Prohibited	10	1 line / 2 hooks	Mar-Oct

		Commercial fishery regulations						
Year	**Area[1]**	**Cowcod landing limit**	**LE-FG shelf rockfish season**	**LE-FG shelf rockfish limit (lb)**	**LE-Trawl shelf rockfish season**	**LE-Trawl shelf rockfish limit (lb)**	**OA shelf rockfish season**	**OA shelf rockfish limit (lb)**
2000	**North**	1 fish	Jan-Feb + May-Dec	500/mo + 1000/mo May-Jul	All year	500/mo + 1000/mo May-Jul	Jan-Feb + May-Dec	200/mo
	South	1 fish	Mar-Dec	500/mo + 1000/mo May-Jul	All year	500/mo + 1000/mo May-Jul	Mar-Dec	200/mo
2001	**North**	Prohibited	Jan-Feb + Jul-Sep	500/mo + 1000/mo Jul-Sep	All year	500/mo + 1000/mo May-Oct	Jan-Feb + Jul-Sep	200/mo
	South	Prohibited	Mar-Sep	500/mo + 1000/mo Jul-Sep	All year	500/mo + 1000/mo May-Oct	Mar-Sep	200/mo
2002	**North**	Prohibited	Jan-Feb	200/mo	Jan-Jun	500/mo + 1000/mo May-Jun	Jan-Feb	200/mo
	South	Prohibited	Mar-Jun	1000/mo	Jan-Jun	500/mo + 1000/mo May-Jun	Mar-Jun	500/mo

[1] Areas are defined as:
North: **2000** is $40^0 10'$-36^0; **2001** is $40^0 10'$-$34^0 27'$; and **2002** is $40^0 10'$-$34^0 27'$.
South: **2000** is south of 36^0; **2001** is south of $34^0 27'$; and **2002** is south of $34^0 27'$.

Table 1. Continued.

Cowcod Conservation Areas have been in place since 2000.
The coordinates of the Cowcod Conservation Areas (CCAs) are:
(1) The Western CCA is an area south of Point Conception that is bound by straight lines connecting all of the following points in the order listed:
33°50′ N. lat., 119°30′ W. long.;
33°50′ N. lat., 118°50′ W. long.;
32°20′ N. lat., 118°50′ W. long.;
32°20′ N. lat., 119°37′ W. long.;
33°00′ N. lat., 119°37′ W. long.;
33°00′ N. lat., 119°53′ W. long.;
33°33′ N. lat., 119°53′ W. long.;
33°33′ N. lat., 119°30′ W. long.;
and connecting back to 33°50′ N. lat.,119°30′ W. long.
(2) The Eastern CCA is a smaller area west of San Diego that is bound by straight lines connecting all of the following points in the order listed:
32°42′ N. lat., 118°02′ W. long.;
32°42′ N. lat., 117°50′ W. long.;
32°36′42″ N. lat., 117°50′ W. long.;
32°30′ N. lat., 117°53′30″ W. long.;
32°30′ N. lat., 118°02′ W. long.;
and connecting back to 32°42′ N. lat., 118°02′ W. long.

Recreational and commercial fishing for groundfish is prohibited within the CCAs, except that recreational and commercial fishing for rockfish and lingcod is permitted in waters inside 20 fm (36.9 m). It is unlawful to take and retain, possess, or land groundfish inside the CCAs, except for rockfish and lingcod taken in waters inside the 20–fm (36.9 m) depth contour, when those waters are open to fishing. Commercial fishing vessels may transit through the Western CCA with their gear stowed and groundfish on board only in a corridor through the Western CCA bounded on the north by the latitude line at 33°00′30′′ N. lat., and bounded on the south by the latitude line at 32°59′30′′ N. lat.

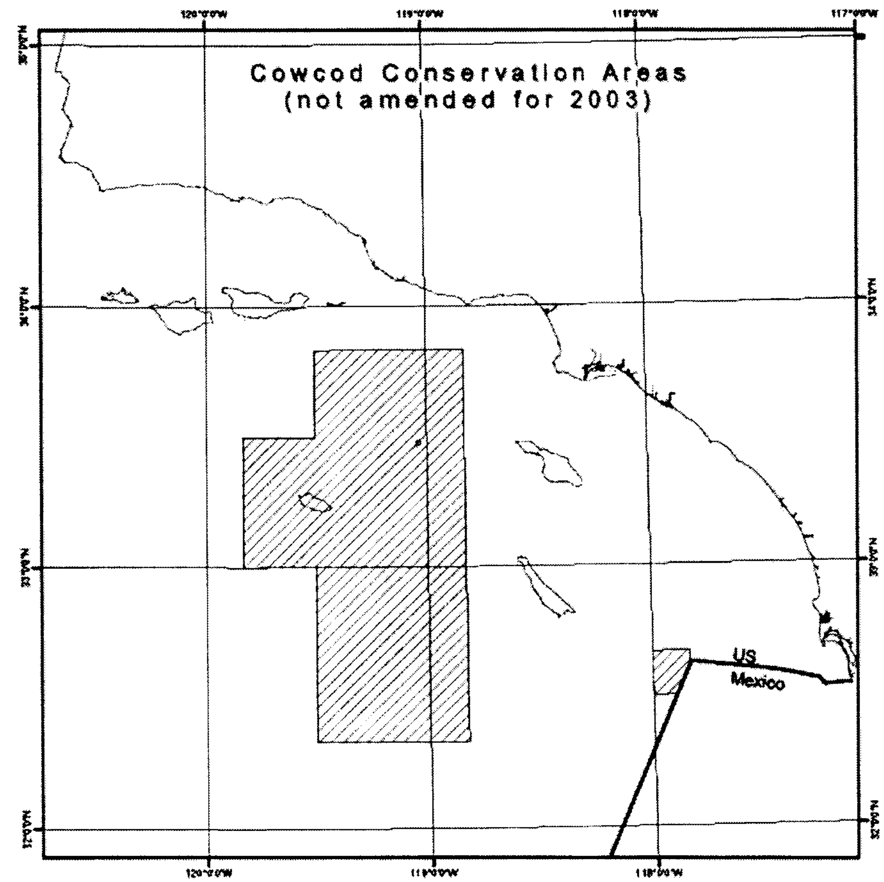

Table 2. Cowcod removals (mt) off the U.S. Pacific coast from 2000-02. See Data Sources for Removals for further details regarding the estimates.

Year	Area[1]	ABC/OY[2]	Commercial[3]	Recreational[4]	Other[5]	Total
2000	**North**	19 / <5	0.45	1.73	0.44	2.62
	South	5 / <5	0.29	4.49	0.82	5.60
2001	**North**	19 / 2.4	0.03	0.00	0.44	0.47
	South	5 / 2.4	0.00	0.00	0.82	0.82
2002	**North**	19 / 2.4	0.02	0.09	0.44	0.55
	South	5 / 2.4	0.03	0.49	0.82	1.34

[1]Areas are defined as:
North: **2000** is 40°10'-36°; **2001** is 40°10'-34°27'; and **2002** is 40°10'-34°27'.
South: **2000** is south of 36°; **2001** is south of 34°27'; and **2002** is south of 34°27'.

[2]ABC/OY denotes Acceptable Biological Catch/Optimum Yield adopted by management (PFMC).

[3]Commercial removals reflect groundfish trawl landings only. No estimates of discard were available.

[4]Recreational removals reflect sport-related landings. Estimates of discard from the Commercial Passenger Fishing Vessel (CPFV) fleet were negligible and had no appreciable impact on magnitudes of removal estimates presented above.

[5]Other removals reflect estimates of bycatch from various commercial fisheries (see Data Sources for Removals).

Population Indices used in the 1999 Cowcod Stock Assessment

Appendix

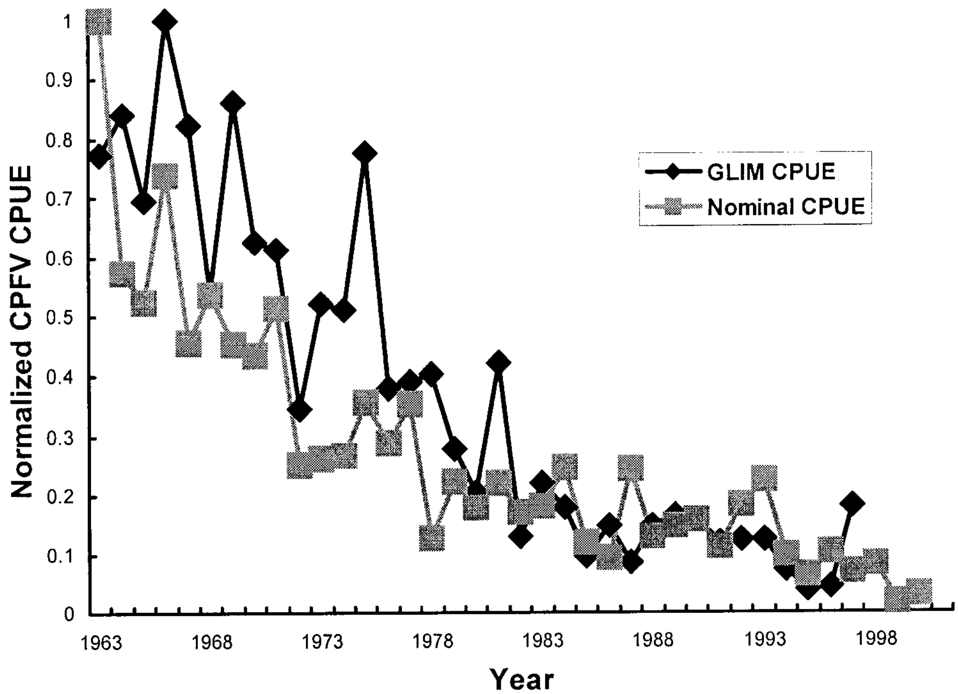

Figure A1. Catch per unit effort in Commercial Passenger Fishing Vessel (CPFV) Logbooks from 1964 to 2000. The GLIM CPUE is a General Linear Model of the catch per unit effort (CPUE) weighted by habitat area in fished CDFG blocks (See Butler et al. 1999 for details). The Nominal CPUE is the average number of fish per angler day for all blocks south of Pt. Conception and north of the Mexico-US border. Both series have been normalized for presentation purposes.

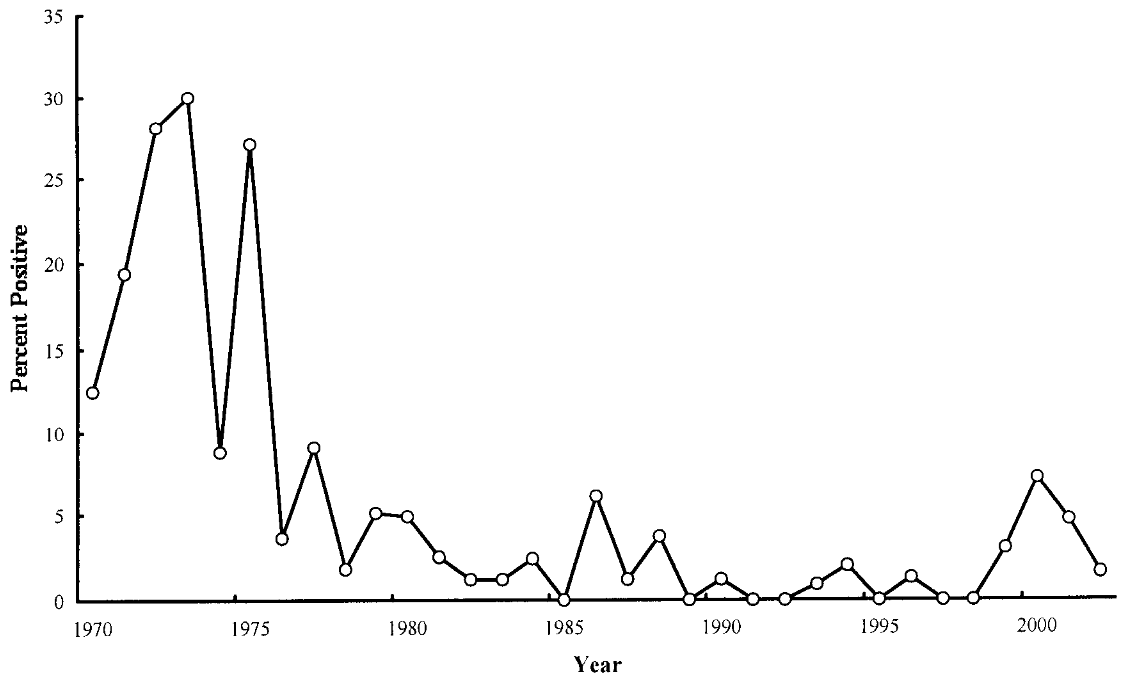

Figure A2. Proportion of otter trawl samples taken by Los Angeles and Orange County Sanitation Districts that included cowcod juveniles (Percent Positive) from 1970 to 2002.

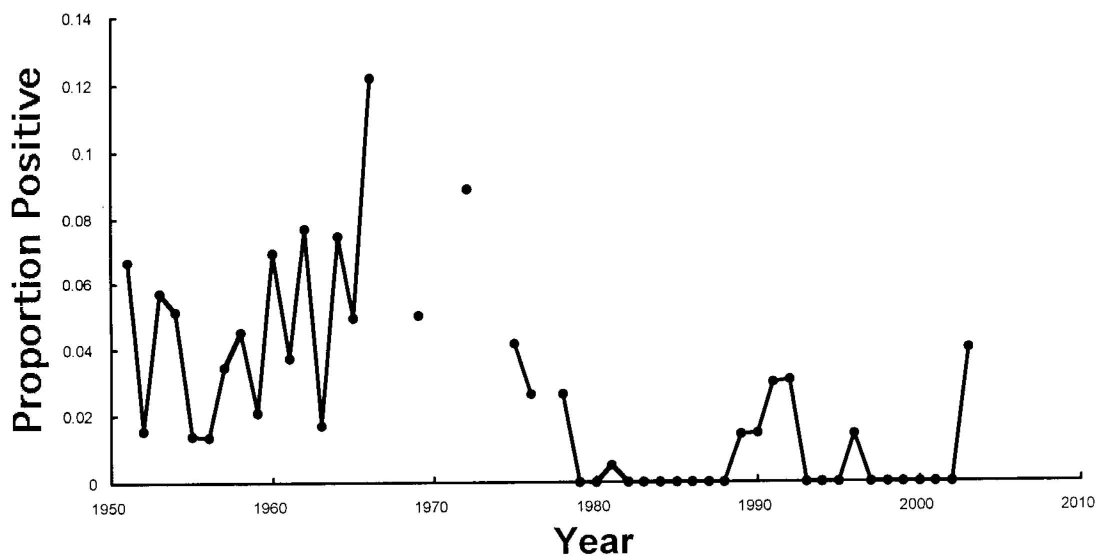

Figure A3. Proportion of CalCOFI plankton tow stations in the Southern California Bight that included cowcod larvae (Percent Positive) from 1951-2003.

SPECIES	AREA	YEAR	Sample Size (no. locations)	CPUE (no./angler day)	*CV*	EFFORT (Total)	REMARKS
Cowcod	North	2000	29	0.0000	na	?	
Cowcod	North	2001	60	0.0000	na	?	
Cowcod	**North**	**2002**	**93**	**0.0021**	**0.56**	**?**	**Roughly, 1 fish (caught) per 476 angler-days of fishing**
Cowcod	North	2003	8	0.0000	na	?	
Cowcod	**South**	**1999**	**189**	**0.00005291**	**1.00**	**?**	**Roughly, 1 fish (caught) per 18,900 angler-days of fishing**
Cowcod	South	2000	283	0.0000	na	?	
Cowcod	South	2001	125	0.0000	na	?	
Cowcod	South	2002	209	0.0000	na	?	
Cowcod	South	2003	190	0.0000	na	?	

Additional Notes:

(1) Sample sizes reflect individual 'locations' within 'trips'

(2) In total, 6 cowcod were caught (kept or returned) over the 3+-year survey

(3) In terms of actual discards (i.e., 'returned' to the water), only 1 cowcod (from a single location within a single trip) was actually discarded over the 3+-year survey

DRAFT

(dated: June 3, 2003)

STAR Lite Panel NWFSC Montlake Lab, Seattle

Date: May 28-29, 2003

Name and Affiliation of Panelists.

Stephen Ralston NMFS, SWFSC, SSC Member, Panel Chair
Ray Conser, SWFSC, SSC Member
Michael Dalton, CSU Monterey Bay, SSC Member
Martin Dorn AFSC, SSC Member
Tom Jagielo WDFW, SSC Member
Han-Lin Lai NWFSC, SSC Member
Brian Culver WDFW, GMT Member
Tom Ghio, GAP Member

This report summarizes the work of a Stock Assessment Review (STAR) panel that met to evaluate the suitability of three stock assessments for use in management by the Pacific Fishery Management Council. The panel was operating under the "Terms of Reference for Expedited Stock Assessment Updates," which was developed by the Council's Scientific and Statistical Committee (SSC). The panel was composed of 6 members of the SSC's Groundfish Subcommittee, with additional representatives from the Groundfish Management Team (GMT) and Groundfish Advisory Panel (GAP). The purpose of Expedited Stock Assessment Updates, as stated in the Terms of Reference is to review stock assessments:

> "where a model has already been critically examined and the objective is to simply update the model by incorporating the most recent data. In this context a model refers not only to the population dynamics model *per se*, but to the particular data sources that are used as inputs to the model, the statistical framework for fitting the data, and the analytical treatment of model outputs used in providing management advice, including reference points, the allowable biological catch (ABC) and optimum yield (OY)."

The three stock assessments that were reviewed by the panel were for darkblotched rockfish (*Sebastes crameri*), yellowtail rockfish (*Sebastes flavidus*), and cowcod (*Sebastes levis*).

Stock Assessment: Darkblotched rockfish

STAT team: Jean Rogers

Comments on the technical merits and/or deficiencies of the update

Data. Significant changes since the last assessment (see Figure 1 of the original STAT team document) include: 1) an updated and revised fishery catch data time series, including new estimates of the darkblotched rockfish catch in foreign fisheries (Rogers *et al.*, In Press), 2) new fishery length and age composition information, 3) a new NMFS triennial survey data point, 4) new AFSC slope survey data, and 5) new NWFSC slope survey data.

Model. The Panel found the original STAT team document to be difficult to follow with respect to model nomenclature. The Panel worked with the STAT team to establish the following model identification scheme to facilitate the Panel discussion:

Model 1: The original STAT team model (Rogers *et al.* 2000).
Model 2: The original STAR Panel approved model (Rogers *et al.* 2000).
Model 3: The model used for the rebuilding analysis (with fixed parameters) (labeled as "2001" in the original STAR Lite document) (see Methot and Rogers 2001).
Model 4: The Methot and Rogers (2001) model with parameters estimated.
Model 5: Model 4 with new catch statistics and weighted length compositions.
Model 6: Model 5 extended to 2002 (labeled as "2003 fit" in original STAT document).
Model 7: Model 3 (with fixed parameters) extended to 2002 (with new catch time series and weighted length compositions).

The Panel discussion focused on Model 6. Questions asked by the Panel included:

1) Why were the new fishery age compositions not included in Model 6? An investigation conducted by the STAT team revealed that age reading issues led to concerns about the validity of the new age data. In particular, Figure 2 of the STAT team document compared the new length at age data with the old growth curve, and showed evidence of a bias in length at age. There appears to be approximately a 1 to 2 year age discrepancy between the old and new data. With the new data, fish are generally larger at age. Investigations by the STAT team were not able to resolve whether the discrepancy could be attributed to a change in growth (environmental hypothesis) or a change in age reading (age reading drift). The panel concurred with the STAT team that the NWFSC slope survey data should be considered a new data source, and therefore cannot be used in an expedited assessment update.

2) Why were the new NWFSC slope data not included in Model 6? The STAT team had concerns about the validity of the NWFSC slope survey data for darkblotched rockfish, given: a) an anomalously high value in 2000 (over 6 times the 1999 value), b) year to year inconsistencies in the NWFSC slope survey length composition data, and c) inconsistencies between the NWFSC slope survey and the AFSC slope survey. The panel concurred with the STAT team that the NWFSC slope survey data should not be used in the model pending a full review of this issue.

3) What is the effect of weighting the fishery length composition information? The Panel requested the STAT team to run a model without weighting the length compositions (comparable to the way data were prepared for the previous model used for management). The result of this model run was presented in Table 18 of the revised STAT team document. The model without re-weighting the fishery length compositions resulted in a lower ending biomass, but it was not possible to evaluate changes in the model's fit to the data. The Panel concurred with the STAT team, and agreed that using the weighted length compositions is a model improvement. The Panel recommended that the weighted data should be used in the model.

4) What is the effect of the change in the assumed value of M for darkblotched rockfish? The STAT team brought to the Panel's attention a newly published estimate of darkblotched rockfish natural mortality rate and completed some exploratory analysis using the new estimate (Table 17 of the revised STAT team document). The Panel noted that, in the spirit of the Terms of Reference for Expedited Stock Assessments, an important parameter value such as M should not be changed without a full review. The Panel recommended using the previous value of M in the new assessment.

5) Should the new model use revised estimates of discard based on the new observer information? The Panel requested the STAT team to do a model run where catch in the years 2000, 2001, and 2002 was doubled, to approximate estimates of discards from the new observer data. The results of this model run were presented in Table 18 of the revised STAT team document. Surprisingly, estimates of stock size increased with the new model run. The model thus appears to be sensitive to the level of discard. The panel recommends that new observer information be used to provide improved estimates of discard in the next full stock assessment.

6) The rebuilding analysis in the initial version of model 6 examined by the STAR panel was based on an estimate of virgin spawning biomass using average recruitment from 1963-96 and re-sampled recruitments from 1983-96 during the rebuilding period (i.e., the environmental hypothesis of Methot and Rogers 2001). The panel asked for and received from the STAT team a set of three analyses that utilized more recent recruitment estimates as the basis for rebuilding calculations. Specifically, these scenarios were: (a) B_0 based on 1963-1999 recruitments and rebuilding recruitments re-sampled from 1983-99, (b) B_0 based on 1963-2000 recruitments and rebuilding recruitments re-sampled from 1983-2000, (c) and B_0 based on 1963-2001 recruitments and rebuilding recruitments re-sampled from 1983-2001 (Table 16 of revised STAT team document). Because Model 6 estimates strong recruitments of age 1 fish in 2000 and 2001 (Figure 13) the Panel expected an increase in allowable catch through the progression of scenarios (a) → (b) → (c). However, the rebuilding output from scenario (b) showed lower catches than did the (a) model, which perplexed both the Panel and the STAT team. Pending resolution of this specific issue, the STAR panel reached a consensus that the (a) and (c) scenarios were likely to bracket the uncertainty in the assessment and the (b) scenario (B_0 based on 1963-2000 recruitments and rebuilding recruitments re-sampled from 1983-2000) could be construed as a base model. The STAT team assured the Panel they would report back concerning this issue.

Explanation of areas of disagreement among panelists and between the Panel and STAT team.

There were no substantive areas of disagreement, either among panelists or between the Panel and the STAT team. The Panel appreciated the responsiveness of the STAT team to issues brought up by the Panel, and thanked the STAT team for conducting model runs during the course of the STAR Lite meeting to resolve questions from the Panel. Specifically, the Panel complimented the STAT team for exploratory work done prior to the Panel meeting concerning: (1) the use of NWFSC slope survey data, (2) evaluating discrepancies in the most recent age data, (3) sensitivity analysis to a revision in the natural mortality rate, and (4) the effect of weighting length composition data by landings. In addition, the Panel appreciated the STAT team's analysis of three issues during the review, i.e., (1) evaluation of different time series of recruitments to use in the rebuilding analysis (see #6 above), (2) the affect of increased estimates of discard in recent years (#5 above), and (3) the effect of weighting compositional data by catch (#3 above).

Recommendation regarding the adequacy of the updated assessment for use in management.

The Panel found the updated assessment (specifically model 6) adequate for use in management, however, certain issues were identified that should be considered at the time of the next full stock assessment and review. These include: 1) An investigation of darkblotched age reading to resolve discrepancies in age reading data. This could possibly involve the re-reading of a substantial portion of the age structures. 2) Examination of the NWFSC slope survey data for its utility in assessment modeling. This could involve inter-calibration of the NWFSC slope survey with the AFSC slope survey. 3) Evaluation of the appropriate value of natural mortality (M) to use in the assessment model. In light of the newly published material on darkblotched rockfish natural mortality (Gunderson et al.2003), this issue needs to be revisited. 4) Incorporation of new estimates of discard based on the new observer data.

Stock Assessment: Yellowtail rockfish

STAT team: Han-Lin Lai[1], Jack Tagart, Jim Ianelli, and Farron Wallace

Comments on the technical merits and/or deficiencies of the update

The U.S. yellowtail rockfish fishery is divided into two areas (Fig. 1), north and south of Cape Mendocino. The northern area is further split into the Eureka/South Columbia area between Cape Mendocino and Cape Falcon; the North Columbia area from Cape Falcon to Cape Elizabeth; and the Southern Vancouver area from Cape Elizabeth to the U.S. boundary of the EEZ. The last full assessment of yellowtail in the northern area occurred in 2000.

Data. Information, particularly biological data, are scarce for the area south of Cape Mendocino. Since the last assessment, there have been several revisions to the historical estimates of landed catch. Three sets of fishery dependent data on catch of yellowtail were extended from the 2000 assessment and were used in the update (Tables 1-4, Lai *et al.*, 2003):

Pacific Fisheries Information Network (PacFIN) data from 1981-2002.
Non-Canadian foreign catch data from 1966-1976.
Canadian data from 1967-2002.

Nontrawl and recreational catch represent less than 5% of total landings and were not included in the update or in previous assessments. The fishery dependent data were used to construct three sets of time series for each area:

1. YT2000 (used in the 2000 assessment).
2. YT2003R (same as YT2000 but updated with 1999-2002 data on catch).
3. YT2003N (includes all changes in the time series 1967-2002).

The panel unanimously considers YT2003N to be the best time series of catches to use in the yellowtail rockfish assessment.

Three abundance indices were used in the update, i.e., the NMFS triennial trawl surveys 1977-2001, the yellowtail rockfish bycatch CPUE from the whiting fishery 1978-1999, and the trawl logbook CPUE statistic from 1988-1999. The latter two CPUE indices were not extended by the STAT team because of major changes that have occurred in the whiting and trawl fisheries since 1999, and a single year has been added to the survey data. Using all three abundance indices was the preferred approach by the STAR panel for the 2000 assessment. The three indices were also pooled (unweighted) to form a single coastwide abundance index.

The STAR panel discussed updating the CPUE abundance indices, which was an area of disagreement between the STAT team and the STAR panel. The STAT team cited changes in the fishery since 1999 as the rationale for not updating the CPUE indices. However, the panel

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[1]Han-Lin Lai represented the STAT team at the meeting and did not contribute to the preparation of the Panel's report on yellowtail rockfish.

thought that the time-variant nature of catchability in the model should account for the recent changes in management, which could be captured under the current formulation.

Age composition data from 1977-2002 were used in the update. Unlike the situation with darkblotched rockfish, the Panel was confident in the accuracy of the aging data used in the yellowtail rockfish assessment. Conversely, the maturity-at-age data is from the 1980s and is somewhat outdated. Also, small sample sizes in the 2001-02 commercial age data are a serious issue that could create significant problems for future stock assessments.

Model. The stock assessment model used for the update is essentially the same as that used for the assessment in 2000. This model uses a complex set of prior weighting factors to ensure smooth curves and dome-shaped selectivity.

The panel discussed implications of using different values for the weighting factors and alternative assumptions in the model regarding catchability. The STAT team cited work that was done in prior assessments to identify a robust set of weights, and these were used in the updated assessment. The catchability coefficients for the CPUE indices are assumed to be time dependent and stochastic, while the survey catchability is constant. However, placing tight constraints on interannual variability in triennial survey catchability, while simultaneously placing weak constraints on the catchabilities of the logbook and whiting bycatch time series, effectively reduces the influence of the latter two indices to a negligible level. Given the high amount of residual variance that is evident between the model and the triennial survey data, the Panel questioned the philosophy adopted by the STAT team and the previous STAR panel.

Statistics (Table 25) and figures (Figs. 7-11) show that the model's fit is reasonable. The residual plots with the pooled data for all years appear to follow a normal distribution. On the other hand, some anomalies appear in the residual plots for different years, for example 2001. The panel judged the overall fit of the model to be acceptable but the panel suggested showing 95% confidence intervals around plots of abundance statistics (e.g. Fig. 7) to determine, for example, whether the 1998 value for the survey index is noise.

The model shows a declining trend in biomass but spawning biomass has been relatively stable since 1990. However, the number of females has been declining since 1995 and low recruitment could have serious effects in the future.

The panel discussed the potential strength of the 1998 year class. These fish (age 4) were recruited into the fishery in 2002 but low selectivity in both the commercial fishery and the survey made estimates of the strength of the 1998 year class imprecise. The panel considered several alternative hypotheses about the low observed selectivity of the age 4 fish, including discard and differences between mid-water and bottom trawling. The panel underscored the need to fully implement data from the observer program into the stock assessment process as soon as possible.

Harvest Projections The arithmetic average of recruitment was used to calculate virgin biomass, B_0. Other variables in the harvest projections (Table 26) used the geometric average for recruitments from 1967-2002. A rationale for the use of geometric averages was to be consistent with lognormal assumptions in the model. The panel discussed the implications of using geometric averages for the projections. In particular, the use of geometric means for recruitment in the projections may give a low impression of actual recruitment, especially if recruitment is highly variable. Nonetheless, the panel accepted use of geometric means for recruitment in the harvest projections, with some reservations. Given a constant level of recruitment, ten year projections based on an F50% harvest rule show a reduction of SPR to 50% of unfished SPR.

The panel requested plots of biomass projections in Table 26; these show a slight decline in the near future based on current low recruitment, followed by an upward trend with long run average recruitment.

The panel discussed the investigation of constant catch policies in the harvest projections. However, an analysis with constant catch policies was not possible with the current model configuration. Future work should consider further model development to analyze constant catch policies.

Explanation of areas of disagreement among panelists and between the Panel and STAT team.

There were no significant areas of disagreement among the panelists, or between the STAT team and the STAR panel. The panel would like to commend the STAT team for a well organized, thorough, and complete analysis.

Recommendation regarding the adequacy of the updated assessment for use in management.

Model projections appear to use conservative estimates for recruitment and upper bounds on catch. Even so, projected abundance remains outside the precautionary zone. Also, new observer-based bycatch rates may mean larger area closures that would be expected to keep yellowtail landings below the levels of catch used in the harvest projections.

The panel is concerned about the scarcity of data for yellowtail south of Cape Mendocino. The panel also recommends that sampling effort for biological data in all areas of the yellowtail fishery, and maturity-at-age and length-weight in particular, should be updated. The panel is concerned about the effects that small sample sizes for commercial catch-at-age data for 2001-02 will have on future stock assessments. Similarly, the panel was concerned about the small number of samples for the survey catch-at-age data in 2001 for the North Columbia area. The panel recommends that future sampling effort be increased to address these concerns.

Overall, the updated stock assessment for yellowtail maintains the *status quo* from the last full assessment in 2000. In particular, this assessment meets the SSC's terms of reference for expedited stock assessment updates. The STAR panel endorses the use of the updated stock assessment for yellowtail in management of the 2004 fishery.

Stock Assessment: Cowcod

STAT team: John Butler, Tom Barnes, Paul Crone, and Ray Conser[2]

Comments on the technical merits and/or deficiencies of the update

Cowcod were last assessed in 1999. Based on that assessment, cowcod were declared overfished, and a rebuilding plan was developed. In addition, the council established a Cowcod Conservation Area (CCA) in 2000 in southern California, where bottom fishing was prohibited in waters deeper than 20 fm. John Butler presented the Cowcod Rebuilding Review. The objective of the review was to gauge the success of the rebuilding plan in reducing fishing mortality, and to evaluate trends in stock indices since the 1999 assessment. The assessment model was not rerun, nor was the rebuilding analysis updated.

Data.

Fishery removals – Estimates of fishery removals were updated to 2002. Rebuilding plan restrictions on fishing have kept landings below the OYs in both northern and southern areas, except an estimated catch of 5.6 t in the southern area in 2000 which exceeded the 5.0 t OY. These removals were primarily a result of bycatch in the spot prawn trawl fishery, which was not accounted for in 1999 assessment.

A preliminary analysis of commercial passenger fishing vessel (CPFV) discard of cowcod using observer data suggests that discard of cowcod occurs very infrequently (at least while observers are onboard). The STAR panel requested that discard information be included in the update.

Revised population indices – Three abundance indices used in the 1999 assessment were updated: CPUE from commercial passenger fishing vessel logbooks (1964-2000), an otter trawl survey by Los Angeles and Orange County Sanitation Districts (1970-2002), and spawning biomass index based on larval counts in CalCOFI plankton tows (1951-2003).

Due to new bag limits and gear restrictions, and changes in fishing behavior in response to management restrictions, fishery CPUE will no longer provide a useful index of cowcod abundance. In particular, CPUE indices after 1999, which are very low, should not be used to infer that the population has continued to decline. The index from the otter trawl survey, which samples mainly juvenile cowcod, was higher in 1999-2002 than at any time in the previous decade. This suggests that recruitment of cowcod may have increased since the 1999 assessment. The CalCOFI index shows an increase in 2003, but information for 2003 is incomplete, and this result should be considered highly preliminary. Altogether, these indices suggest a slight improvement in cowcod status since the 1999 assessment. Evaluating what this potential increase implies for stock rebuilding will require quantitative population modeling.

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[2]Ray Conser did not contribute to the development of the Panel's report on cowcod.

Explanation of areas of disagreement among panelists and between the Panel and STAT team.

There were no significant areas of disagreement between the Panel and the STAT team. The Panel appreciates the efforts of the STAT team in providing an update to the rebuilding plan for cowcod.

Recommendation regarding the adequacy of the update.

GLM models with more appropriate error structure for fishery and survey CPUE data, such as the delta-gamma and delta-lognormal, have been used successfully in other West Coast stock assessments (i.e., black rockfish and bocaccio), and these should be evaluated the next time the cowcod stock is assessed. The most recent bocaccio assessment also developed a novel approach to extracting informative records from non-specific recreational fishery CPUE databases that might be applied usefully to cowcod. We note that the fishery CPUE index used in the previous assessment was derived from aggregated data. A better approach would be to fit the GLM to the individual records.

Monitoring cowcod rebuilding will require new surveys or augmentation of existing surveys, particularly since fishery CPUE statistics can no longer be considered a valid population index. Recent efforts to develop non-extractive survey techniques for rockfish (i.e., the Love and Yoklavich submersible survey, and a proposed acoustic/ROV survey) are promising developments. Since these surveys produce habitat-specific estimates of abundance, better habitat mapping is needed to produce overall population estimates for stock assessment.

Enhanced ichthyoplankton surveys have the benefit of maintaining continuity with existing time series used in the assessment, and may increase the precision of the index at low population levels. The Panel, therefore, encourages the Southwest Fisheries Science Center to continue the enhanced ichthyoplankton sampling the CCA that it has conducted over the last several years. Also, the newly developed hook-and-line fixed gear cooperative research survey in Southern California is another promising development for assessing rockfish populations in the region.

The panel notes that the value of an index for stock assessment is strongly related to the length of the time series. Once sufficient work has been done to the assess the merits of these new approaches, there should be a winnowing process, and a long-term commitment by NMFS and the council to establishing time series that are effective in monitoring rockfish abundance trends in southern California.

Finally, the panel notes that there are no abundance indices for areas outside of southern California and that the original stock assessment was for the Southern California Bight only. Nonetheless, management action taken by the Council for areas north of Point Conception is likely to have a major impact on fisheries outside of the assessed area. Consequently, it is essential that a more spatially comprehensive view of the cowcod stock be developed in the next assessment. In the interim, the Council may wish to re-examine its approach to setting a cowcod ABC in the north.

DRAFT

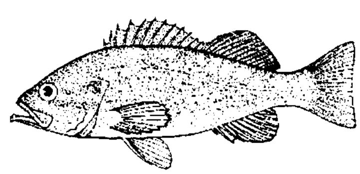
Status of the Yellowtail Rockfish Resource in 2003

Han-Lin Lai[1], Jack V. Tagart[2], James N. Ianelli[3], and Farron R. Wallace[2]

[1] National Marine Fisheries Service
Northwest Fisheries Science Center
2725 Montlake Blvd. E
Seattle, Washington 98112

[2]Washington Department of Fish and Wildlife
600 Capitol Way N.
Olympia, Washington 98501-1091

[3]National Marine Fisheries Service
Alaska Fisheries Science Center
7600 Sand Point Way NE
Seattle, Washington 98115



May 29, 2003

Executive Summary

The status of yellowtail rockfish was last assessed in 2000. This report presents the scheduled update on the status of stocks under the process of 2003 STAR-lite.

Stocks: The Pacific Fishery Management Council (PFMC) manages the U.S. fishery as two stocks separated at Cape Mendocino, California (40°30'N). This report presents the "coastwide" stock extending from Cape Mendocino to approximately 49°N. Traditionally, this coastwide stock is divided into three unit stocks: Southern Vancouver stock from Cape Elizabeth (47° 20'N) to approximately 49°N, Northern Columbia stock from Cape Falcon (45° 46'N) to Cape Elizabeth (47° 20'N), and Eureka/South Columbia stock from Cape Mendocino (40° 30'N) to Cape Falcon.

Catches: Due to redistribution of rockfish species composition and the new estimation algorithm, the catch data in the three stock areas were different from that reported in the last assessment. Based on the revised catch data, U.S. coastwide total catch reached a plateau at around 9,000 mt in 1978-1983 and then declined due to trip limits imposed in 1985. Annual U.S. landings decreased to 1,454 mt in 2002.

Data and assessment: The following new information were included in the analysis: (i) 2001 NMFS survey abundance index and catch at age (sex-combined), (ii) the revised catch series by using new estimation methods, and (iii) catch at age and weight-at-age data by sex for 1999-2002. However, the domestic trawl CPUE index from 1988 to 1999 and the whiting fishery bycatch index from 1978 to 1999 were kept as they were assessed in 2000 because the changing fishery regulations make have altered the statistical properties of these abundance indices. Also, the area specific matureogive and age transition matrix were kept as they were assessed in 2000 due to insufficeint new data. The stock assessment model is an age-structured model written with AD Model Builder software in 2000. The reference model is to fit the newly revised catch series of the coastwide stock.

Unresolved problems and major uncertainties: There were concerns on usefulness of auxiliary abundance indices and their time-variant catchabilities as the stock was assessed in 2000. These concerns remain even if the whiting bycatch index and CPUE index were not updated and were treated to be non-informative. The survey indices fluctuated over the surveys, which may be the cause of flat trend in estimates of biomass. The effects of low age-4 recruitment in 1995-2002 on future management have yet to be evaluated. Concerns are also on low precision and potential bias for parameter estimation in 2002, especially the recruitment.

Reference points: Assuming constant recruitment, equal to the average of 1967-2000 (13.0 million fish), the estimates of unfished biomass (B_0) is 115,493 mt, unfished spawning biomass (SPB_0) is 33,329 mt, target level spawning biomass ($SPB_{40\%}$) is 13,332 mt, overfishing threshold spawning biomass ($SPB_{25\%}$) is 8,332 mt and the recommended fishing mortality rate ($F_{50\%}$) is 0.091.

Stock biomass: The estimated coastwide biomass in year 2002 was 63,388 mt with a 26% CV. The estimated 2000 biomass was 66,933 mt in this assessment, compared with 69,400 mt estimated in the last assessment. In general, the trends of total biomass and population size in number of fish are declining. Total biomass in 2002 is 46% of the 1967. The spawning biomass is estimated to be 155% of the target spawning biomass ($SPB_{40\%}$).

Recruitment: There is no obvious spawner-recruit relationship. Median (1967-2002) annual recruitment is 10.2 million fish at age 4, with average recruitment reaching 13.0 million. The recruitments since 1995 were close to the historical low level.

Exploitation status: Annual fishing mortality peaked in 1982 (F = 0.17). From 1983 to 1996, F fluctuated in the range of 0.06 to 0.17. However, F was in range of 0.04 to 0.09 after 1996, due to more restricted regulations on other overfished rockfishes.

Management performance: In 2001 and 2002, US total catches have not exceeded Council ABC's.

Forecasts: Under the Council's $F_{50\%}$ policy and assuming the constant recruitment (equal to the geometric mean of 1967-1997), the profile of 3-yr mean yield is 3,133 mt at 25-percentile, 3,971 mt at 50-percentile, and 5,034 mt at 75-percentile. The projected coastwide 3-yr average yield for 2004-2006 is 3,966 mt. The Council adopted ABC/OY for 2001-2003 was 3,146 mt. Council ABC and OY determinations need to account for the expected harvest by Canadian fishers.

Recommendations: (1) Increase sampling effort for age, length, weight, and maturity data; (2) Estimate new discard rate with the new observer data; (3) Investigate the effects of current low recruitment events on the future perspective of fisheries; (4) Include all landings in stock assessment; (5) Assess the status of stock in area south of Cape Mendocino.

1.0 Introduction

Yellowtail rockfish (*Sebastes flavidus*) are found throughout the northeast Pacific Ocean. Their range reportedly extends from San Diego, California to Kodiak and Admiralty Island, Alaska (Hart, 1975), although Eschmeyer et al. (1983) report the species is rare south of Point Conception, California (approximately 34° 25' N. latitude). Their center of abundance is from Oregon to British Columbia (Alverson et al., 1964, Westrheim, 1970; Gunderson and Sample, 1980). Yellowtail rockfish are reported to occur at depths of 0 to 549 m (0 to 300 fm) (Hart, 1975). Commercial fishermen typically harvest yellowtail rockfish with bottom and midwater trawls fished at depths of 110 to 201 m (60 to 110 fm) (Fraidenburg, 1980; Tagart and Kimura, 1982).

Yellowtail rockfish recruit to the commercial fishery at 4 years of age (Tagart, 1988). The oldest recorded yellowtail rockfish is a 64-year-old male (Shaw and Archibald, 1981). Yellowtail rockfish reach their maximum size at approximately 15 years of age. The largest recorded yellowtail rockfish was 70 cm female caught by bottom trawl from PMFC area 3A in 1996. Females begin to mature at 27 cm to 37 cm (4 to 6 years of age) with the size at 50% maturity ranging from 37 cm to 45 cm (6 to 11 years old) (Westrheim 1975; Gunderson et al. 1980; Echeverria 1987; Tagart 1991). Males mature at a slightly smaller size and younger age than females. First maturity for males occurs at 30 cm (4 years old), with 50% maturity at 34 cm to 41 cm (5 to 9 years of age).

Several studies have been conducted for stock identification for yellowtail rockfish in the range of their distribution. Wishard et al. (1980) and McGauley (1991) found no variability among the samples collected along the western coast of northern America and concluded that their findings were consistent with the homogenous stock hypothesis. Tagart, Phelps and Stanley (personal communication) found that there were significant differences between samples from Oregon and those taken elsewhere; in addition, northern Washington samples were different from southern Washington samples. However, samples from northern Washington were not different from Canadian samples, and there were no detectable differences among Canadian samples. Stanley et al. (1992) found a cline in the prevalence of a monogenean gill parasite (*Monogenea sebastis*) with decreasing prevalence from north (80-100%) to south (0-10%), which was interpreted by Tagart et al (2000) as implying that the coast-wide yellowtail rockfish population was probably composed of separate stocks.

During the early development period of the rockfish fishery there was little attention paid to quantifying the species composition of the landings. It wasn't until the early 1960s that coastal states began to report landings by species (Niska, 1976; Tagart and Kimura, 1982). Estimation of amount of yellowtail rockfish landed by the foreign fleets during 1960's and 1970's remains a problem (Rogers 2002). In 1977, the U.S. extended fisheries jurisdiction out to 200 nautical miles. Yellowtail rockfish off Oregon and Washington were the main target of the expanding fishery in the late 1970's. The development of the yellowtail rockfish fishery provoked improvements in fishing strategies and fishing gear, such as three-seam, triple-bridle trawls to increase the vertical opening of the net, and improvements in roller gear needed to access rockfish habitat.

The Pacific Fishery Management Council (PFMC) manages the U.S. fishery as two stocks separated at Cape Mendocino, California (40°30' N). Tagart (1991) suggested that the U.S. fishery north of Cape Mendocino could be divided into three stocks (Figure 1): the Eureka/South Columbia stock extending from 40° 30' N (Cape Mendocino) to 45° 46' N (Cape Falcon); the Northern Columbia stock extending north from Cape Falcon to 47° 20' N (Cape Elizabeth); and, the Southern Vancouver stock reaching north from Cape Elizabeth to approximately 49° N (the southern boundary of PMFC area 3D). The Canadian Department of Fisheries and Oceans (DFO) manages their fishery as two unit stocks; a "boundary" stock equivalent to the Southern Vancouver stock mentioned above and a "coastal stock" from PMFC area 3D to the northern Canada/U.S. border (Stanley, 1993).

Yellowtail rockfish co-occur with canary, widow rockfish and several other rockfishes (Nagtegaal 1983; Tagart 1987; Rogers and Pikitch 1992). Association with these and other rockfish species has substantially altered fishing opportunity for yellowtail rockfish. Canary rockfish stocks are currently at very low levels of abundance and have been declared overfished by National Marine Fisheries service. In order to achieve the necessary reduction in the canary rockfish catch, the Council adopted stringent management measures in 2000. Harvest of Canary rockfish and their co-occurring species was limited.

2.0 Changes and Responses to STAR Panel Report, 2000

In this section, we use "the Panel" for the 2000-STAR Panel.

2.1 Commercial Landings

Due to redistribution of rockfish species composition and the new estimation algorithm, the catch data in the three stock areas were different from that reported in Tagart et al. (2000). In order to compare the effects of this change, three catch series: (i) YT2000 that is equivalent to that used in Tagart et al. (2000), (ii) YT2003R that is YT2000 updated with catches in 1999-2002, and (iii) YT2003N that consists of the newly revised series retrieved from PacFIN on March 15, 2003, the revised Canadian catches in INPFC area 3C, and the new estimates of 1967-1976 foreign catches.

2.2 Reference Model

According to the STAR-lite process, the analysis has to maintain the continuity of stock assessment modeling so that the management is consistent with the previous stock assessment cycle. Therefore, the configurations of referenced coastwide model used in Tagart et al. (2000), that is, RefCst, are unchanged. In this model, survey, whiting bycatch, and domestic CPUE indices are treated as relative abundance estimates. The survey-only and fishery-only models in the previous assessment are not carried out.

2.3 Whiting bycatch and Domestic Trawl CPUE indices

2.3.1 No update for these two indices

Tagart et al. (1997) included the study by A. Hoffmann, which indicates that these two series of abundance indices were not informative due to various problems. Due to concerns of canary bycatch, the Council adopted restrictive limits and required mid-water gear for the targeted yellowtail fishery in 2000. This resulted in significant changes in the CPUE indices such that the time series preceding 2000 is not comparable with most recent years and consequently, these two indices were not updated after 1999.

The weighting factor (λ) that controls allowable change in catchability of logbook CPUE is set at 0.16 as recommended by the Panel because it reflects the externally estimated variance of these CPUE data.

2.3.2 Time-variable catchabilities for whiting bycatch index and logbook CPUE

The Panel cautioned against uncritically allowing time-varying catchability, however some careful consideration of time-varying catchability should be made for both fishery and survey. Thus, these time-variable catchabilities are used in this analysis. These two index series were discontinued after 1999 and the effects would diminish over time.

2.4 Survey Catchability

At the request of the Panel, survey catchability is to be estimated in the model rather than fixed at 0.2. It is worthwhile to note here that the current estimate of survey catchability is around 0.2 (versus 0.19 in 2000) using either YT2003R or YT2003N.

2.5 Stock Boundary

Yellowtail rockfish is a trans-boundary resource between US and Canada. The Panel felt the survey data from Canada should be included, particularly for the stock off the west coast of Vancouver Island. At the time of this analysis, survey data in INPFC area 3D was not available to STAT. Other biological data were provided by Rick Stanley (DFO, Nanaimo) but has yet to be analyzed.

In some years, the triennial survey did not cover the entire S. Vancouver area. Therefore the same value for catchability should not be used for the two areas. To accomplish this, the S. Vancouver area should be split into a US and Canadian portion and undertake a major modification of the current stock assessment model. This task might be investigated in a full stock assessment but is inconsistent with the intent of the STAR-lite process.

Regarding the possibility of moving the southern boarder line of N. Columbia area from Cape Falcon to Cape Lookout, this suggestion was explored and we found that (i) the change makes little difference in estimating survey indices (Mark Wilkins, pers. comm.), and (ii) provokes difficulties in aggregating fishery data.

The Panel suggested that yellowtail rockfish catches in Monterey and Conception areas should be looked at to determine their significance to the estimation of coast-wide abundance. This analysis also found that there were yellowtail rockfish catches taken by trolls, fixed gears and recreational fisheries. However, with limited and/or no biological data, the assessment is difficult. Furthermore, there is a problem distributing recreational catches into stock areas. This is an area for future research.

2.6 Growth and Maturity

Tagart et al. (2000) attributed the observed change in size-at-age to changes in growth rather than changes in selectivity. The Panel recommended to model growth by cohort, rather than by year. The Panel raised the question on that the maturity ogive was developed from data that was now ten years old. There was insufficient research to obtain maturity samples. No change is made in this analysis.

2.7 Retrospective analysis

The Panel noted substantial retrospective change in estimates of stock size. For example, the 1997 total biomass was estimated to be 86,460 mt by the 2000 assessment, but was reduced to 43,887 mt when 1998-1999 catch data and 1997 age data were removed from the analysis. The Panel concluded that the assessment model is sensitive to the most recent survey estimates and will remain that way until surveys are done on a more than three-year basis. With the addition of 2001 survey, the biomass trend is flat, and it is likely that the high 1998 survey index was noisy.

In this analysis, the model fits to YT2000 catch series can be viewed as a retrospective analysis, in contrast to the uses of YT2000R catch series. As shown below, the estimates of age-4 recruitment and biomass in 2000 using YT2003R were lower than the estimates using YT2000. Also, the estimate of age-4 recruitment in 2002 seems unusually high, probably due to no data available beyond 2002 to track the progress of age-4 yellowtail rockfish observed in 2002.

2.8 Recruitment Variance

A question asked by the Panel was: "How much do deviations from a constant recruitment rather than a recruitment curve effect the long term trend on recruitment?" Tagart et al. (2000) found that $\lambda_4 = 1.0$ did not impose undue constraint on the recruitment, and thus, $\lambda_4 = 1.0$ was used in this analysis.

2.9 Spawner-Recruit Relationship and harvest forecast

The Panel suggested further examination of the rockfish spawner/recruitment meta-analysis. It is very difficult to make a reasonable and conclusive decision to resolve this issue by examining the results in Dorn (2000).

The Panel discussed: (i) whether average recruitment or recruitment in equilibrium should be used in the calculation of B_0, (ii) whether or not to use a long-term average recruitment (geometric mean, 1967-1999) in the 10-yr projections, and (iii) if used, whether or not the expected future yields would be inflated? Tagart et al. (2000) found that the use of long-term average recruitment had no significant impact on 3-year forecast of ABC. Nevertheless, there is a need to evaluate the alternatives in the future assessment; for example, using the average of the most recent years may be reasonable given the current low level of recruitment.

3.0 Data

3.1 Catch Data

Since the last stock assessment (Tagart et al. 2000), there have been multiple revisions to the historical estimates of landed catch. The Oregon State Department of Fish and Game (ODFG) and California State Department of Fish and Game (CDFG) have revised the catch data submitted to PacFIN database due to improvement of species composition estimates for rockfish and revision of their stratification schemes. A new algorithm was adopted to estimate the catches of yellowtail rockfish in Canada (R. Stanley, pers. Comm.). Rogers (2002) revised estimated catches for foreign trawl fisheries during the period of 1966-1976. Consequently, the historic catch time series is different from that used in the 2000 assessment. The revised catch series are provided in Tables 1 (Coastwide), 2 (South Vancouver), 3 (North Columbia), and 4 (Eureka/South Columbia).

The catches of yellowtail rockfish from Washington and Oregon from 1981 to 2002 were obtained from the PacFIN database on March 15, 2003. Estimated catches from California fisheries were provided by Don Pearson (NMFS/SWFC) from 1980 to 1998 and by Brenda Erwin (CDFG) from 1999 to 2002 (for methods and software refer to Pearson and Erwin 1997). The retained and discarded catches of yellowtail rockfish from at-sea whiting fishery from 1997 to 1999 were provided by Martin Loefflad (NMFS/AFSC Observer Program) and from 1999 to 2002 by Becky Renko (NMFS/NWR). The estimated catches from Canada were provided by Rick Stanley (Canadian Department of Fisheries and Oceans, DFO).

Landings of yellowtail rockfish from the shrimp trawl fishery in 1981-2002 were taken from the PacFIN database. Prior to 1981, the landings from shrimp trawl fishery were taken from Tagart et al. (2000). Yellowtail rockfish catch taken by the shore-based whiting fishery was estimated from reported landings on fish tickets in the PacFIN database. Fish tickets were filtered for a whiting catch greater than or equal to 5000 pounds. All yellowtail rockfish landings on these fish tickets were assumed to be from the directed shore-based whiting fishery. The estimated shore-based whiting fishery catch was subtracted from the domestic trawl yellowtail rockfish catch.

Discarded catch from the domestic trawl fishery is assumed to represent 16% of the total catch, i.e., total domestic catch equals domestic landed catch divided by 0.84. This represents the PFMC assumed discard rate in this fishery based on a study by Pikitch (1987). As in Tagart et al. (2000), we assume no discard prior to 1985 because trip limit was not imposed then by PFMC. The report of the first year West Coast Groundfish Observer Program indicated little change on the assumed 16% discard rate (NWFSC 2003).

Based on the revised catch data, U.S. yellowtail rockfish total catch reached a plateau at around 9,000 mt in 1978-1983 (Table 1; Fig. 2). When yellowtail rockfish trip limits were imposed in 1985, catch declined remarkably. Annual U.S. landings decreased to 1454 mt in 2002. Since 2000, the proportion of annual catch from the N. Columbia and Eureka/S.Columbia areas decreased, while the proportion in S. Vancouver area increased, especially in the Canadian section of S. Vancouver area. The proportion of coastwide catches (exclude recreational catches and catches taken in the south of Cape Mendocino) taken by U.S. fishery decreased over year and was less than 80% since 2000.

In Eureka/S.Columbia and N. Columbia areas, yellowtail rockfish were also taken by hook and line, pot, net, and trolls (Tables 3 and 4). These catches represent small amounts and were not factored into the past or the current analysis. Recreational catches of yellowtail rockfish were recorded in the RecFIN database. However, the recreational catches cannot be split among the three stock areas and the precision of these estimates require further evaluation. Therefore, they were not included in this analysis.

3.2 Abundance Indices

Three types of abundance index, NMFS triennial trawl survey index, domestic trawl CPUE, and whiting bycatch index, were used in the past two stock assessments (Tagart et al. 1997; Tagart et al. 2000). Tagart et al. (1997) included a critical evaluation carried out by A. Hoffmann on the assumptions associated with the uses of abundance indices. The necessary assumptions for these indices are: (1) the indices are normally distributed, (2) the indices are independent of each other, (3) the indices are homogeneous, (4) the proportionality constant does not change from year to year, and (5) for an index of abundance-at-age, the proportionality constant does not change from age to age within a year. The evaluation concludes that NMFS triennial trawl survey is the most credible among the three indices.

3.2.1 NMFS Triennial Trawl Survey

The NMFS trawl surveys took place at three-year intervals from 1977 to 2001 (Gunderson and Sample 1980; Weinberg et al. 1984; Coleman 1986 and 1988; Zimmermann et al. 1994; Wilkins and Weinberg 2002). A post-stratification of the INPFC Columbia area, split at Cape Falcon, was conducted by Mark Wilkins (pers. comm.) to obtain estimates of biomass for three stocks (Table 5). However, the STAR panel recommended that Columbia area be split at Cape Lookout based on the estimated weight per unit area (Tagart et al. 2000; Fig. 20). Post stratification into four areas resulted in less reliable density estimates. A re-evaluation (Fig. 3) suggests that moving the stock boundary to Cape Falcon seems less important. Furthermore, such a split requires the redistribution of landings, which is difficult for the current data system. The survey does not extend into Canada every year, hence, biomass trends in the S. Vancouver area were assumed to follow the observed trend for estimates from the U.S. Vancouver area.

Following 1977, and in each successive survey through 1986, the NMFS increased the density of survey track lines in designated high density or rockfish sampling areas in an attempt to improve the precision of rockfish biomass estimates (Figure 3). In 1977, high density sample areas had track lines 9.3 km (5 nm) apart; in 1980 and 1983 spacing was reduced to 5.6 km (3 nm); and in 1986 high density track lines were placed at intervals of 3.7 km (2 nm). Despite higher density sampling in 1980 and 1983, the precision of estimates did not increase as expected. The high density track-line sampling design was abandoned after 1986.

The survey-to-survey fluctuation of estimated biomass suggests that the vulnerability of yellowtail rockfish to the survey may vary over time. During the 1980 survey, 43 stations were sampled twice two weeks apart and the CPUE changed from 1.0 to 16.8 kg/km. This may indicative of a schooling mobile species that can change distribution (and availability to trawl gear) in a relatively short period of time (Dark et al. 1982).

Historically, the highest survey yellowtail rockfish catch rates were in the S. Vancouver area (Figure 4, Table 5). Survey catch in these areas in 1989 and 1998 resulted in above average biomass estimates for the entire coast. There was no obvious trend for the coastwide estimated of yellowtail rockfish biomass due to declines in the Eureka/S.Columbia and increase in the S. Vancouver areas in recent years. These trends should be interpreted cautiously because the variability associated with the biomass estimates is high (average CV ranges from 0.34 to 0.60, with year specific CVs as high as 0.90).

3.2.2 Whiting Bycatch Index

The whiting bycatch index (Table 6, Fig.) was computed from NMFS observer data from the at-sea whiting fishery (joint venture, domestic catcher processor and mothership), 1978-1999. However, this abundance index was not updated in this analysis because of changing whiting season and fishing ground and the conclusion of the evaluation (Tagart et al. 1997).

Tow-by-tow yellowtail rockfish catches taken incidentally in the targeted whiting fishery were converted to index values using a ratio estimator of yellowtail rockfish catch to whiting catch (Rogers and Lenarz, 1993):

$$I = \left(\frac{C_h}{F_h}\right)\left(\frac{\sum_{i=1}^{n} y_i}{\sum_{i=1}^{n} h_i}\right) \qquad (1)$$

where, C_h is the annual whiting catch, F_h is the annual whiting fishing mortality, y_i is the catch of yellowtail rockfish on tow i and , h_i is the whiting catch on tow i. Qualified tows were those between 43.5 to 48 degrees N. latitude. The ratio estimator was scaled by annual estimates of whiting catch-per-effort as determined in the 1999 whiting stock assessment (Dorn, 1999). A single time series of coast-wide index was constructed for the period 1978 to 1999.

The variance for the index given the ratio of yellowtail to whiting catch (r) is estimated using the delta method assuming that the covariance between r and F_h is zero:

$$\hat{V}(I) = \hat{V}\left(\frac{rC_h}{F_h}\right) = \left(\frac{C_h}{F_h}\right)^2 \hat{V}(r) + \left(\frac{-rC_h}{F_h^2}\right)^2 \hat{V}(F_h) \qquad (2)$$

The variance for F_h is estimated by Dorn (1999) and fixed at CV of 0.15. The variance of the ratio (r) is:

$$\hat{V}(r) = \frac{(N-n)}{(nN)}\left(\frac{1}{\bar{h}^2}\right)\left(\frac{\sum_{i=1}^{n}(w_i - rh_i)^2}{n-1}\right) \qquad (3)$$

This index series fluctuated without apparent trend (Fig. 5, upper panel). However, the indices since 1994 were among the lowest of the entire series.

3.2.3 Domestic Trawl CPUE

As mentioned above, the domestic trawl CPUE data violate the required assumptions for an abundance index. Nevertheless, we continue to employ the index as we did in the past two assessments. The domestic trawl CPUE data for 2000-2002 may not be comparable to 1988-1999 because the harvest of yellowtail rockfish has been limited by regulations implemented to protect overfished canary rockfish. Therefore, the time-series of CPUE data from 1988 to 1999 was used without update in this analysis.

Yellowtail rockfish CPUE indices were constructed from Washington, Oregon and California domestic trawl fishery logbook. Tow-by-tow hailed weight of retained catch was adjusted to fish ticket weight. The adjusted weight and skippers' estimate of tow duration was used to compute CPUE (lbs/hour). If skippers failed to hail catch and yellowtail rockfish were recorded on the landing receipt, the data were excluded from the analysis. The data were further restricted to those vessels which landed yellowtail in at least 9 of the 12 years between1988 and 1999. Only non-whiting fishery roller and bottom trawl tows with greater than 50lbs of yellowtail catch were included in the analysis. Tow data from depth strata with limited yellowtail catch (<50 and > 125 fathoms) and tows south of Cape Mendocino, 40° 30'N Latitude, were also excluded.

Four separate indices were computed, one for each of the three presumptive stocks and one for a coast-wide stock (Table 7, Fig. 5). Data were treated similarly for each index. After filtering, approximately 20% of the tow-by-tow data was used in the analysis, resulting in 13,022 tows used to generate the coast-wide index, 5,260 tows for the Eureka/S.Columbia index, 5,218 tows for the N. Columbia index and 2,544 tows for the S. Vancouver index.

The CPUE data were analyzed with a General Factorial General Linear Model (GLM). Main-effects included year, vessel, season (December-March, April-July, and August-November), depth (25 fathom intervals between 50 and 125 fathom) and latitude (20 minute intervals). Data were analyzed for the period 1988 to 1999 for all indices except the S. Vancouver. Limited sample size restricted the S. Vancouver index to 1989 to 1999.

Analysis was limited to main effects (i.e., no interaction terms). With the exception of depth interval, all main-effects were found to be highly significant (P<1%). Depth interval was significant at the P<5% level for all but the N. Columbia index. Index values were estimated from the marginal means for the Year factor. The Coast-wide index shows a slight decrease from 1988 to 1999, while the Eureka/S.Columbia index indicates a steep decline (Table 7). The N. Columbia and S. Vancouver indices are without apparent trend. There was a fairly wide variance on the estimates of the marginal means, with CVs (coefficient of variation: standard deviation divided by the mean) ranging from 19 to 63% for the coast-wide index; the average CV was 27%.

3.3 Biological Data

3.3.1 Sample sizes for Ageing

Tables 8-11 summarize the number of biological samples and number of otoliths collected from market catches of yellowtail rockfish. The data from 1977 to 1998 were compiled by Tagart et al. (2000) and 1999 to 2002 were from the PacFIN biological database. Don Pearson (NMFS/SWFC) and Brenda Erwin (CDFG) provided data for samples from the California commercial trawl fishery. In 2002, no samples were collected for Eureka/S.Columbia area. Rick Stanley (Canadian DFO/PBS) supplied updated Canadian biological data for the period 1980 to 1999. Table 12 summarizes the number of survey tows made in the stock areas, number of tows sampled for collecting otoliths and number of otoliths aged for each year.

3.3.2 Age Composition in Commercial Landings and Surveys

The method of computing catch at age for the Canadian, ODFW, and WDFW data was given in Tagart (1991). Don Pearson (NMFS/SWFC) and Brenda Erwin (CDFG) provided the estimates of catch at age for the California fishery. The estimates of catch at age in number of fish from 1977 to 2002 were summarized in Tables 13-16. In Eureka/S.Columbia area, age data were not available in 1978 and 2002 (Table 16). Coastwide catch-at-age data reflect a pattern of irregular occurrence of dominant year classes in the fishery. Apparently strong year classes can be observed for 1949, 1962, 1968, 1974 and 1984 (Tagart et al. 2000). The pattern is detectable in each of the sub-stocks, with some modest differences.

Catch expanded estimates of the number of fish-at-age from the NMFS trawl survey were provided by Mark Wilkins (NMFS/AFSC) (Table 17). In 1997, ages were determined using the "surface age reading method". These data are therefore incompatible with the break-and-burn ageing method applied to samples from all subsequent surveys. While we display the age distribution, it is not used in fitting our model. The coast-wide (Eureka/S.Columbia to S. Vancouver) age distribution is reasonably consistent, but the area-specific data are noisier. Fish are recruited to the trawl survey as young as age 1, but typically aren't caught with regularity until age 4. The modal age appears to be between 5 and 12 years old. The 1998 survey showed a bimodal age distribution (well illustrated for the Coast-wide stock) with peaks at age 9 (1989 year class) and ages 11 and 12 (the 1986-1987 year classes). The 2001 survey age distributions continue to reflect the dominant 1989 and 1990 year classes that were first detected during the 1995 survey; however, the current survey age distributions suggest that recruitment has been much reduced in recent years.

3.3.3 von Bertalanffy Equation and Length-Weight Relationships

The parameters of von Bertallanffy equation were estimated from ageing data collected from commercial landings. Table 18 lists the estimates of L_∞, K, and t_0 by sex and year (pre-1987 and 1987-2002). Note that, because there were no age data in 1978 and 2002 in Eureka/S.Columbia area, the coastwide growth equations in these two years were based on the age data collected in the S. Vancouver and N. Columbia areas. Estimated length/weight parameters (a and b), where Weight = a (length) ^{b} are unchanged from the prior assessment. Tagart et al. (1997) found no year and season effects on the parameter estimates. The parameter values are a = 0.0214 and b= 2.920. The length/weight relationship is the same for both sexes.

3.3.4 Weight-at-age

The predicted weights at age were derived from the estimated von Bertalanffy equation (Table 18) and the length-weight relationship described above. Tables 19-22 list the predicted weights-at-age respectively for Coastwide, S. Vancouver, N. Columbia, and Eureka/S.Columbia areas by sex and year.

3.3.5 Maturity-at-age

We estimated the proportion mature-at-age for female yellowtail rockfish based on logistic functions $p_t = 1/\left(1+e^{at+b}\right)$ from (Tagart, 1991). The estimated parameters (a, b) were (-0.960, 9.273) for the N. Columbia and (-1.006, 10.990) for U.S. Vancouver area. The parameter values from the N. Columbia stock were used for the Coast-wide and the Eureka/S.Columbia area. The proportion of female that reached sexually maturity is given in Table 23.

3.3.6 Natural mortality

Fraidenburg (1981) made the first estimate of yellowtail rockfish natural mortality (M=0.25), using surface aged otolith for samples collected from PMFC area 3A (N. Columbia stock). Leaman and Nagtegall (1987) estimated a yellowtail rockfish natural mortality rate of M=0.07 for a lightly exploited stock from Northern British Columbia aged using the break-and-burned method. Tagart (1991) reprised Fraidenburg's estimate after re-aging Fraidenburg's specimens using the break-and-burn aging method. Tagart's estimated yellowtail rockfish natural mortality rate was M=0.11. Using the Stock Synthesis model, Tagart profiled the fit to fishery age data across a range of constant natural mortality rates, demonstrating that the best fit occurred when M=0.11. However, female yellowtail rockfish appeared to show an increasing mortality with age (senescent mortality hypothesis), while males did not.

Tagart (1991) evaluated the assumption that natural mortality was constant for all ages using the stock synthesis model. Male natural mortality was assumed to be constant for all ages at M=0.11. Female natural mortality was allowed to rise linearly from age 6 at M=0.11 to a model determined maximum at age 25+. Tagart concluded that the senescent mortality hypothesis fit the fishery age data well, and was a better biological explanation for the disappearance of older age females than the alternative hypothesis that the older females were not vulnerable to the fishery. Because the natural mortality rate is confounded in age-structured models with fishery selectivity, there has been an active debate on whether female natural mortality is actually increasing with age, or whether the apparent disappearance of older age females is related to fishery selectivity In this analysis, we continue to use the senescent female mortality hypothesis the approach introduced in Tagart (1991) and used in all subsequent yellowtail rockfish assessments.

3.3.7 Ageing Error

Since 1991, the WDFW age reader has routinely provided replicate age assignments for every forth fish in a sample. These data were used to estimate age reading error. The mean difference and its standard deviation (s) between the first and second age assignment for each fish aged were calculated (Table 24, Figure 6). We then regressed ($s=\alpha Age+\beta$) the standard deviation of the difference against the first assigned age (*Age*) (R^2=0.80, N=22, α=0.055, β=0.429). We used the predicted standard deviation at age from the regression (Table 24) and an assumed normal probability distribution to calculate the probability of recording an assigned age for a given "true age". The matrix of probabilities is known as the ageing error matrix. A more detailed description of the method is given in Tagart et al (2000).

4.0 Model

This stock assessment was defined to be an update from the last assessment (Tagart et al. 2000). According to the STAR-lite process, the model and its features were not to be changed. Therefore, this analysis concentrated on the reference models for coastwide (i.e., RefCst in Tagart et al. 2000), S. Vancouver (RefVan), N. Columbia (RefCol), and Eureka/S.Columbia (RefEur). The models that used fishery data only (Fishon) and survey data only (Srvon) were not carried out in this analysis.

Because historical landings of yellowtail rockfish were revised after the last stock assessment, two commercial catch series were fitted into the models in order to compare with the results presented in Tagart et al. (2000). The catch series presented in 2000 stock assessment was named YT2000. The catch series YT2003R appended the new catch from 1999 to 2002 to YT2000. Notice that the old 1999 catch was replaced by the current value from PacFIN database. The catch series YT2003N contained the new catch series from 1981 to 2002 retrieved from PacFIN database, Canadian catches estimated from a new algorithm, and the foreign catches from 1967 to 1976 (Rogers 2002). See Tables 1-4.

4.1 General Description of Model

A detailed model description is given in Appendix A. The program was coded in AD Model Builder, which is given Appendix B. Therefore, the program is not list in this report. The important features of the model are provided in Sec. II (Input Control Variables) of the Appendix A. To summarize:

(1) Catchability - proportion between index and exploitable biomass

   (i) Fishery catchabilities are dependent on previous year with the random deviation from previous year being log-normally distrbuted.

   (ii) Survey catchability is constant over years.

   (iii) Catchabilities of whiting bycatch index and logbook CPUE vary over years by specifying $\lambda_{14} = \lambda_{15} \approx 20$.

(2) Dome-shaped selectivity

   (i) Fishery selectivity is sex-specific. Survey selectivity is not sex-specific.

   (ii) Curvature penalty (second difference) is imposed to ensure a smooth curve (λ_5, λ_6, λ_7).

   (iii) Dome-shaped constraints include selectivity should be increasing for fish $\leq$ age-5 (λ_2, λ_8) and be constant for fish $\geq$ age-16.

   (iv) Impose penalty to minimize difference between male and female selectivity (λ_4).

(3) Natural mortality

   (i) Natural mortality (M) of male is 0.11 and is constant over ages.

   (ii) Natural mortality of female is 0.11 for ages 4-6, and then, increases linearly to the estimated maximum M at age 25.

(4) Variance for trawl CPUE is to be estimated (λ_2).

(5) An ageing error matrix is postulated to be used for both fishery and survey age compositions (versus using identity matrix, i.e., no ageing error).

(6) Historical (i.e., pre-1967) fishing mortality (F) is assumed to be 10% of F at 1967.

Other important features and interpretation of model fits were summarized by the weighting factors in the component likelihoods (Sec. VII, Appendix A). Ageing error for both the survey and fishery age composition data was incorporated by use of an ageing error matrix. The age data were modeled as multinomial random variables. The sample size used for the multinomial component of the likelihood (which effectively scales the variance for the age composition data) was set to the number of age samples actually taken in each year rather than to the number of fish actually aged. Similarly, the sample size used for the multinomial component of the likelihood for the survey age composition data was set to the number of hauls from which age data were collected. Following the previous stock assessments and the reports of STAR Panels in 1997 and

2000, the coastwide model with three series of abundance indices (i.e., RefCst in Tagart et al. 2000) is used in this analysis, with comparisond among the three different catch series.

5.0 Results

5.1 Coastwide Model Fits

Despite reasonable model fits to the whiting bycatch index and domestic trawl CPUE shown in Fig. 7, the predicted indices and their catchability demonstrated similar trends. The survey catchability was assumed to be constant over the years with an estimate of 0.2 (Table 25), implying that the observed high abundance in 1999 survey might be a noise. The trend of estimated survey abundance index was flat in 1977-2002. Because the model was configured to treat survey index as the most scientifically creditable index, the two predicted fishery dependent indices may be mis-leading.

Standardized residuals, $\sqrt{n}(p_j - \hat{p}_j)/(\hat{p}_j(1-\hat{p}_j))$ where n = sample size, between observed and fitted age proportions (p_j and $\hat{p}_j$ respectively) for the fishery and survey were within $\pm$2 S.D (Figures 8-10). The scatter plots of residuals from three catch time series (YT2000, YT2003R, and YT2003N) were too close to is distinguished. In fact, YT2003R and YT2003N produced almost the same results as shown in the estimates described below. Likelihoods from abundance indices and age compositions contributed the majority of the total likelihood (131 vs. 148, Table 25).

5.2 Biomass

The population biomass (and number) has decreased continuously since 1994 (Fig. 11). Coastwide total biomass in 2002 was at 46% of the biomass in 1967 for YT2003R and YT2003N (Table 25). While total biomass decreased and age-4 recruitments were low since 1995, female spawning biomass (SPB) has been flat after 1990. This is probably due to stronger recruitments observed in late 1980s and early 1990s remained in the current population (Fig. 11). The 2002 SPB and the last 5-yr average SPB were similar, around 154% (YT2003N) of the 40% equilibrium SPB (Table 25). The CV of estimated biomass is in the range from 5% to 26% (Fig. 11). The CV was 9% for 1967 biomass, decreased to about 5% for the period of 1975-1979, and then increased. The CV exceeded 20% since 1998 and was 26% in 2002.

Recruitment

Total recruitment (age-4 females and males) in 1995-2002 was almost at historical low level (Fig. 11). Note that the 2002 estimated recruitment might not be realistic because there were no data to make a reasonable fit to the age-4 data observed in 2002. The high estimate of recruitment in the terminal year of data series was also found in Tagart et al. (2000) and in many stock assessment situations. The last 5-yr average female recruitment (1998-2002) was 45% of historical average recruitment (1967-2002) and was about 57% of median recruitment (Table 25). The CV of estimated age-4 recruitment fluctuated from 9% in 1967 to 99% in 2002. The high CV in 2002 can be expected because 2002 is the final year of observation. Thus, caution should be paid to use this estimate in projection.

5.4 Selectivity and mortality rates

The fishery and survey selectivity coefficients were dome-shaped, peaked at ages 12 and 14 respectively (Fig. 12). Instantaneous natural mortality rate (M) was 0.11 for male and ages 4-6 female. The M for female age 25 was 0.25 (Table 25). Fully vulnerable fishing mortality rate (F) at age 12 decreased since 2000 (Fig. 12). The estimated F in 2002 was different for the model fits to YT2003R and YT2003N, however, 2002 fishing mortality was lower than the historical average (Table 25). Because of the uncertainty due to estimation of population parameters in 2002 (especially recruitment), caution should be paid to interpreting the estimated F in 2002.

5.5 Harvest Projection

Given the uncertainty of the biomass estimates and the similarity of estimates between YT2003R and YT2003N, the best choice is based on the most current catch series, YT2003N. Based on the recruitment and spawning biomass estimates from our models, we could not estimate a significant spawner/recruit relationship for yellowtail rockfish (Fig. 11). Therefore, we can not estimate yellowtail rockfish F_{MSY}, and thus, we utilize the proxy yield-per-recruit fishing mortality rates for yield projections. In 2000, the PFMC adopted revised target exploitation rates based on an $F_{50\%}$ spawner-per-recruit (SPR) fishing mortality rate. The $F_{50\%}$ is a proxy for the unknown F_{MSY} and is the equilibrium fishing mortality rate that drives the spawning biomass-per-recruit to 50% of the unfished spawning biomass-per-recruit. In conducting their review, the Council's advisors noted that the Pacific coast rockfishes were not as productive as previously believed. Rockfish are expected to show density dependence in recruitment such that, exploitation at the $F_{50\%}$ fishing mortality rate will actually drive spawning biomass to approximately 40% of the unfished spawning biomass-per-recruit. Thus, the target spawning biomass level is $SPB_{40\%}$ (Tagart et al. 2000).

In the projection part of stock assessment model (Sec. IX, Appendix A), the estimation of unfished total biomass (B_0) and unfished spawning biomass (SPB_0) were based on the following assumptions: (i) the age-4 recruitment in the projection years (2004-2013) is equal to the geometric mean of the estimated age-4 recruitment in 1967-2002; (ii) The weight-at-age and area specific proportion mature-at-age are equal to that estimated for 2002; (iii) The model estimated male and female fishery selectivities are used; and (iv) The 2003 landing is equal to 2002 landing, and thus, the estimated 2002 population number at age is projected accordingly to the beginning of 2004.

Yield is projected for 10 years (2004-2013) based on YT2003N at the Council's $F_{50\%}$ SPR rate. The cumulative probability profiles for the coastwide expected yield in 2004 and the projected 3-yr mean yield (2004-2006) were shown in Fig. 13. The expected yield in 2004 is 3,372 mt at 25-percentile, 4,322 mt at 50-percentile, and 5,539 mt at 75-percentile. The projected 3-yr mean yield is 3,133 mt at 25-percentile, 3,971 mt at 50-percentile and 5,034 mt at 75-percentile (Fig. 13). In the last assessment (Tagart et al. 2000), the 3-yr mean yield (2001-2003) was about 3,600 mt, 4,500 mt, and 5,400 mt respectively for the three specified percentiles.

There was an issue that B_0 and SPB_0 estimates using geometric mean tend to be lower than arithmatic mean. Therefore, an additional projection was done independent of the stock assessment model by using the arithmatic mean from 1967 to 2000 to assure that there are at least three age classes have entered the fisheries from each cohort. The projected yield at $F_{50\%}$ is 4,320 mt in 2004, 3,896 mt in 2005 and 3,630 mt in 2006, the resultant 3-yr average yield at $F_{50\%}$ is 3,966 mt (Table 26), which is almost equal to the value at 50-percentile (3,971 mt) using the geometric mean in the stock assessment model. Therefore, the use of geometric or and arithmatic mean is not an issue for the population of yellowtail rockfish.

Table 26 also gives the estimates obtained from Tagart et al. (2000). However, the comparison between the last and current assessment is not meaningful because they are based on two completely different data sets. The 3-yr mean yield for 2001-2003 estimated from the last assessment is 4,495 mt (Tagart et al. 2000). The Council adopted ABC/OY for 2001-2003 was 3,146 mt/yr. The ABC/OY decision should account for Canadian catch in S. Vancouver area.

The projected total biomass in the future (2004-2013) at $F_{50\%}$ would be similar to the 2002 level (Fig. 14 and Table 25), however, the projected $SPB_{50\%}$ would decrease sharply from 2004 to 2006. Suspiciously, the projected $SPB_{50\%}$ becomes stable after 2006 considering that the mean recruitment in 1998-2002 is only 45% of the assumed recruitment, arithmatic mean from 1967 to 2002 (6,515 mt; Table 25).

5.6 Coastwide versus Stock-Specific Stock Assessment

Although the trend of total biomass from combined stocks (S. Vancouver, N. Columbia, and Eureka/S.Columbia) was similar to the coastwide estimates, differences were observable over the years. (Fig. 15). Using YT2003N catch series, total biomass of combined stocks were lower than coastwide in the early years but were higher after 1980. For individual stocks (lower panel of Fig. 15), the little differences in total biomass estimated by using YT2003R and YT2003N were found in S. Vancouver and N. Columbia Areas. However, in Eureka/S.Columbia area, the total biomass estimated from YT2003R was consistently lower than YT2003N.

Age-4 recruitments estimated from YT2003R and YT2003N were similar for coastwide, combined, and the three individual stocks (Fig. 16). However, age-4 recruitments estimated from coastwide stock were lower than the combined stocks since 1997.

The projected biomass estimates for combined stocks are similar but not the same as the coastwide stock (Tables 25 and 26). Using catch series YT2003N, estimated total biomass in 2002 was distributed 50% to the S. Vancouver area, 35% to the N. Columbia area, and 15% to the Eureka/S.Columbia area (Table 25). However, the distribution of total catch in 2002 was 82% for S. Vancouver area, 10% for N. Columbia area, and 8% for Eureka/S.Columbia area (Tables 1-4). In S. Vancouver area, 62% of landings were taken by US fleets in 2002, comparing to 71% in 2001 and 80% in 2000. In 2002, total catch was 6% of total biomass in S. Vancouver area, 1% in N. Columbia area, and 1.6% in Eureka/S.Columbia area.

6.0 Discussion

Reiterate our management concern: Although spawning biomass has remained nearly constant since the early 1980's, the total biomass has generally declined since the 1960's. Furthermore, both the number of males and females in the population has declined severely during the late 1990's. This decline in numbers was probably due to poor recruitment in recent years (Fig. 11). If these trends continued, the spawning biomass is unlikely to maintain at relatively constant level estimated since 1980's.

Because of low precisions in estimated recruitment (CV from 30 to 99%) and estimated 2002 total biomass (CV = 26%), these effects of these lowly precised stimates on population projection and on ABC/OY determination have to be evaluated. Further research is needed to determine whether the decision based on the projection is rick prone or risk averse.

There is diminishing sampling efforts for collecting age data in 2001 and 2002, especially no age data were collected in 1978 and 2002 for the Eureka/S. Columbia area. Because growth of yellowtail rockfish in the south is slower than the north (Tables 18-22), borrowing data from northern stocks for the Eureka/S. Columbia stock is dangerous. The three state agencies used different designs to colloect biological samples. Futhermore, the CDFG does not list yellowtail rockfish in its priority for biological sampling. The species is listed as one of shelf rockfish complex, which is in low priority and to be sampled if time and budget allowed. It is urgent to have the three state agencies to take uniformed sampling protocol.

There are substantial amount of zero-tows in triennial survey. Futher research is needed to explore alternative method for estimating survey indices, such as delta-GLM and other zero-inflated linear model. The length-weight relationship and maturity-at-age used in this analysis are dated. It is desired to update the information with new data, especially histological method for maturity stage of the species has to be carried out.

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Table 1. Estimated catches of yellowtail rockfish, 1963-2002, for coastwide. US total include discard but does not include Hook & line, misc., net, pot, and trolls.

	Hook&					US Domestic Trawl		US Shrimp Trawl		US At-Sea Whiting		Shoreside Whiting		US DomesticTrawl Disc.		US TOTAL	
Year	Line[b]	Misc.[b]	Net[b]	Pot[b]	Trolls[b]	2000[a]	2003	2000[a]	2003	2000[a]	2003	2000[a]	2003	2000[g]	2003[g]	2000[a]	2003
1963						827.9	827.9 a	14.0	14.0 a							841.9	841.9
1964						497.0	497.0 a	3.8	3.8 a							500.8	500.8
1965						482.2	482.2 a	6.9	6.9 a							489.1	489.1
1966						589.1	589.1 a	88.4	88.4 a		2845.0					677.5	3522.5
1967						626.1	626.1 a	146.9	146.9 a	416.0	1956.0 e					1189.0	2729.0
1968						1542.4	1542.4 a	144.4	144.4 a	784.0	1187.0 e					2470.8	2873.8
1969						1975.7	1975.7 a	141.7	141.7 a	588.0	786.0 e					2705.4	2903.4
1970						662.9	662.9 a	140.7	140.7 a	189.0	1031.0 e					992.6	1834.6
1971						672.9	672.9 a	136.0	136.0 a	113.0	434.0 e					921.9	1242.9
1972						1137.5	1137.5 a	281.3	281.3 a	475.0	716.0 e					1893.8	2134.8
1973						844.7	844.7 a	401.5	401.5 a	1717.0	770.0 e					2963.2	2016.2
1974						334.4	334.4 a	413.2	413.2 a	640.0	654.0 e					1387.6	1401.6
1975						727.3	727.3 a	306.9	306.9 a	542.0	222.0 e					1576.2	1256.2
1976						3295.8	3295.8 a	462.9	462.9 a	55.0	235.0 e					3813.7	3993.7
1977						4242.2	4242.2 a	598.5	598.5 a	24.3	24.3 a					4865.0	4865.0
1978						7334.0	7334.0 a	907.8	907.8 a	220.9	220.9 a					8462.7	8462.7
1979						7655.9	7655.9 a	1303.9	1303.9 a	213.9	213.9 a					9173.7	9173.7
1980						7079.0	7079.0 a	1286.7	1286.7 a	298.4	298.4 a					8664.1	8664.1
1981						7942.6	8095.2 b	993.9	864.4 b	247.4	247.4 a					9183.9	9207.0
1982	181.9				38.7	7951.5	8180.5 b	678.0	613.2 b	555.3	555.3 a		13.8 d			9184.8	9362.8
1983	0.1					8331.0	8110.7 b	659.1	395.5 b	509.5	509.5 a		15.8 d			9499.6	9031.5
1984	0.0					4799.3	4752.2 b	249.9	173.5 b	343.8	343.8 a		0.0 d			5393.0	5269.5
1985	3.8	0.2			0.1	2980.2	2996.7 b	258.0	82.9 b	203.9	203.9 a		6.3 d	567.7	570.8	4009.8	3860.6
1986	9.1				0.5	3600.4	3601.0 b	898.3	421.5 b	587.9	587.9 a		1.2 d	685.8	685.9	5772.4	5297.6
1987	12.5				0.4	3769.9	3588.4 b	958.2	264.0 b	565.8	565.8 a		0.0 d	718.1	683.5	6012.0	5101.7
1988	6.4				0.1	5232.2	5232.9 b	293.6	287.3 b	467.2	467.2 a		16.2 d	996.6	996.7	6989.6	7000.4
1989	6.9	1.1			0.1	3862.8	3867.9 b	553.5	541.4 b	180.6	180.6 a	3.5	3.5 d	735.8	736.7	5336.1	5330.1
1990	34.8	2.1	0.4		0.1	3536.7	3549.2 b	410.3	366.5 b	120.8	120.8 a	12.1	12.1 d	673.7	676.0	4753.5	4724.6
1991	139.4	0.1	0.1		0.4	2939.4	2976.0 b	397.5	291.1 b	340.8	340.8 a	35.6	35.6 d	559.9	566.9	4273.2	4210.4
1992	203.7	0.6			0.6	4810.1	4863.4 b	403.3	311.3 b	638.5	638.5 a	53.5	53.5 d	916.2	926.4	6821.6	6793.1
1993	177.5				9.0	3980.6	4073.0 b	719.6	421.1 b	308.6	308.6 a	93.7	93.7 d	758.2	775.8	5860.7	5672.2
1994	143.6	2.5		0.1	3.8	4425.4	4616.6 b	375.2	186.0 b	617.2	617.2 a	195.4	195.4 d	842.9	879.4	6456.1	6494.5
1995	84.6	1.4	0.1	0.5	13.6	4024.0	4794.4 b	217.1	161.3 b	790.2	790.2 a	270.9	270.9 d	766.5	913.2	6068.7	6930.1
1996	204.8			0.4	82.7	4225.1	4632.4 b	295.2	414.4 b	631.0	631.0 a	387.5	387.5 d	804.8	882.4	6343.6	6947.6
1997	165.5			0.2	98.4	1439.4	1712.4 b	119.1	122.7 b	403.0	403.0 c'	87.8	87.8 d	274.2	326.2	2323.5	2652.1
1998	214.3	0.2		2.2	58.4	1988.8	2559.6 b	124.5	235.8 b	529.1	529.1 c'	123.1	123.1 d	378.8	487.5	3144.3	3935.1
1999	89.9				3.3	1805.5	2436.7 b	59.7	91.3 b	1124.0	684.1 c	265.1	265.1 d	343.9	464.1	3598.2	3941.4
2000	6.1				2.1		2917.9 b		76.0 b		555.6 c		177.6 d		555.8		4282.9
2001	4.5				4.3		1773.2 b		61.7 b		125.0 c		47.5 d		337.8		2345.1
2002	2.9				4.1		1040.8 b		12.7 b		190.7 c		12.1 d		198.2		1454.5

Data retrieved from PacFIN database by using the program, ann_arid_woc_grg.sql.
a: Yellowtail Stock Assessment 2000, Jack Tagart et al.
b: Retrived from PacFIN on Mar. 15, 2003, due to changes made by California.
c: Provided by Becky Renko, based on NORPAC database
c': Provided by Martin Loefflad, based on NORPAC database
d: Estimated from fish tickets for whiting catch equal or greater than 5000 lbs.
e: Foreign Catches: Jean Roger (2003)
f: Provided by Rick Stanley, updated by new estimation algorithm
g: Assume 16% discard
h: Exclude Hook&line, Misc.,Net, and Trolls

Table 1. Continued.

	Canada Domestic Trawl		Canada Shrimp Trawl		Canada At-Sea Whiting		CANADA TOTAL		US+CAN TOTAL	
Year	2000[a]	2003	2000[a]	2003	2000[a]	2003	2000[a]	2003	2000[a]	2003[h]
1963									841.9	841.9
1964									500.8	500.8
1965									489.1	489.1
1966									677.5	3522.5
1967	25.0	1.4 f					25.0	1.4	1214.0	2730.3
1968		f							2470.8	2873.8
1969	187.0	21.7 f					187.0	21.7	2892.4	2925.1
1970	37.0	10.2 f					37.0	10.2	1029.6	1844.8
1971	11.0	9.7 f					11.0	9.7	932.9	1252.6
1972	16.0	11.3 f					16.0	11.3	1909.8	2146.0
1973	22.0	20.5 f					22.0	20.5	2985.2	2036.7
1974	25.0	16.9 f					25.0	16.9	1412.6	1418.5
1975	27.0	5.6 f					27.0	5.6	1603.2	1261.8
1976	127.0	50.2 f	13.5	13.5 a			140.5	63.7	3954.2	4057.4
1977	200.0	236.7 f	32.8	32.8 a			232.8	269.5	5097.8	5134.5
1978	228.0	48.1 f	16.8	16.8 a	120.0	120.0 a	364.8	184.9	8827.5	8647.6
1979	146.0	48.6 f	1.4	1.4 a	187.0	187.0 a	334.4	237.0	9508.1	9410.7
1980	50.0	38.2 f	1.1	1.1 a	142.0	142.0 a	193.1	181.3	8857.2	8845.4
1981	25.0	20.7 f	0.9	0.9 a	120.0	120.0 a	145.9	141.6	9329.8	9348.6
1982	122.0	114.8 f			320.0	320.0 a	442.0	434.8	9626.8	9797.6
1983	17.0	16.6 f			347.0	347.0 a	364.0	363.6	9863.6	9395.1
1984	23.0	19.8 f			350.0	350.0 a	373.0	369.8	5766.0	5639.2
1985	103.0	94.7 f			264.0	264.0 a	367.0	358.7	4376.8	4219.3
1986	450.0	429.9 f			311.0	311.0 a	761.0	740.9	6533.4	6038.5
1987	505.0	500.7 f			330.0	330.0 a	835.0	830.7	6847.0	5932.4
1988	267.0	280.1 f			334.0	383.8 f	601.0	663.9	7590.6	7664.3
1989	260.0	260.0 f			985.0	790.0 f	1245.0	1050.0	6581.1	6380.2
1990	264.0	228.6 f			398.0	338.0 f	662.0	566.6	5415.5	5291.1
1991	350.0	349.5 f		0.5 f	414.0	513.4 f	764.0	863.4	5037.2	5073.8
1992	512.0	504.1 f			436.0	958.9 f	948.0	1463.0	7769.6	8256.1
1993	833.0	834.9 f		1.6 f	829.0	776.0 f	1662.0	1612.5	7522.7	7284.7
1994	328.0	319.9 f			682.0	822.9 f	1010.0	1142.8	7466.1	7637.3
1995	626.0	623.0 f			159.0	158.0 f	785.0	781.0	6853.7	7711.1
1996	1009.0	1033.0 f			980.0	980.3 f	1989.0	2013.4	8332.6	8961.0
1997	342.0	377.6 f		0.0 f	206.0	206.0 f	548.0	583.7	2871.5	3235.8
1998	497.0	554.1 f			210.0	209.8 f	707.0	763.9	3851.3	4699.0
1999	850.0	912.5 f			65.0	64.5 f	915.0	977.0	4513.2	4918.5
2000		1044.2 f				37.9 f		1082.1		5365.0
2001		806.5 f				167.8 f		974.3		3319.4
2002		904.4 f						904.4		2359.0

Table 2. Estimated catches of yellowtail rockfish, 1963-2002, for S. Vancouver stock. US total includes discard.

	US Domestic Trawl		US Shrimp Trawl		US At-Sea Whiting		US Shoreside Whiting		US DomesticTrawl Disc.		US TOTAL	
Year	2000[a]	2003	2000[a]	2003	2000[a]	2003	2000[a]	2003	2000[g]	2003[g]	2000[a]	2003
1963												
1964												
1965												
1966						1248.0 e						1248.0
1967	34.7	34.7 a			302.0	892.0 e					336.7	926.7
1968	951.5	951.5 a			544.0	497.0 e					1495.5	1448.5
1969	1372.6	1372.6 a	3.5	3.5 a	587.0	400.0 e					1963.1	1776.1
1970	466.8	466.8 a			185.0	521.0 e					651.8	987.8
1971	365.1	365.1 a			107.0	223.0 e					472.1	588.1
1972	456.8	456.8 a			268.0	380.0 e					724.8	836.8
1973	276.4	276.4 a	5.4	5.4 a	332.0	94.0 e					613.8	375.8
1974	50.2	50.2 a	36.8	36.8 a	629.0	485.0 e					716.0	572.0
1975	66.0	66.0 a	37.9	37.9 a	135.0	0.0 e					238.9	103.9
1976	883.2	883.2 a	54.9	54.9 a	55.0	0.0 e					993.1	938.1
1977	1340.2	1340.2 a	39.5	39.5 a	0.0						1379.7	1379.7
1978	1212.4	1212.4 a	94.9	94.9 a	0.0						1307.3	1307.3
1979	1361.3	1361.3 a	316.7	316.7 a	0.0						1678.0	1678.0
1980	2028.1	2028.1 a	229.7	229.7 a	37.9	37.9 a					2295.7	2295.7
1981	2904.0	2847.3 b	236.8	236.8 a	56.7	56.7 a					3197.5	3140.8
1982	3342.2	2886.8 b	84.9	84.9 a	381.2	381.2 a					3808.3	3352.9
1983	2891.2	2735.8 b	255.5	255.5 a	267.6	267.6 a					3414.3	3258.9
1984	980.4	1013.2 b	59.6	59.6 a	70.2	70.2 a					1110.2	1143.0
1985	943.4	943.4 b	46.4	46.4 a	48.9	48.9 a			179.7	179.7	1218.4	1218.4
1986	1544.0	1544.0 b	42.8	42.8 a	94.6	94.6 a			294.1	294.1	1975.5	1975.5
1987	1192.8	1192.8 b	14.6	14.6 a	61.0	61.0 a			227.2	227.2	1495.6	1495.6
1988	1680.4	1680.4 b			96.8	96.8 a			320.1	320.1	2097.3	2097.3
1989	1520.9	1520.9 b			49.5	49.5 a			289.7	289.7	1860.0	1860.0
1990	1447.6	1447.6 b	0.0		39.1	39.1 a			275.7	275.7	1762.5	1762.5
1991	943.2	945.2 b	4.0	4.0 b	42.8	42.8 a	2.0	2.0 d	179.7	180.0	1171.7	1174.1
1992	1222.7	1222.7 b	0.0		208.7	208.7 a			232.9	232.9	1664.3	1664.3
1993	1611.8	1611.8 b	14.3	14.3 b	14.1	14.1 a			307.0	307.0	1947.2	1947.2
1994	1580.4	1580.2 b	18.2	18.2 b	177.9	177.9 a			301.0	301.0	2077.5	2077.2
1995	1309.5	1340.3 b	24.6	24.6 b	136.8	136.8 a	13.3	0.1 d	249.4	255.3	1733.6	1757.1
1996	1268.5	1288.7 b	61.0	61.0 b	433.7	433.7 a			241.6	245.5	2004.8	2028.9
1997	497.1	507.9 b	1.6	1.6 b	180.6	180.6 c'	3.9	3.9 d	94.7	96.7	777.9	790.8
1998	679.2	717.3 b	2.8	2.8 b	365.5	365.5 c'	25.0	25.0 d	129.4	136.6	1201.9	1247.3
1999	713.6	604.1 b	0.9	0.9 b	907.6	467.7 c	44.1	21.6 d	135.9	115.1	1802.1	1209.4
2000		889.3 b				393.9 c		47.2 d		169.4		1499.7
2001		765.6 b		1.3 b		41.7 c		15.1 d		145.8		969.6
2002		715.6 b		0.8 b		180.7 c		2.1 d		136.3		1035.5

Data retrieved from PacFIN database, using ann_arid_woc_grg.sql.
a: Yellowtail Stock Assessment 2000, Jack Tagart et al.
b: Retrived from PacFIN on Mar. 15, 2003.
c: Provided by Becky Renko, based on NORPAC database
c': Provided by Martin Loefflad, based on NORPAC database
d: Estimated from fish tickets for whiting catch equal or greater than 5000 lbs
e: Foreign Catches: Jean Roger (2003)
f: Provided by Rick Stanley, updated by new estimation algorithm
g: Assume 16% discard
h: Exclude Hook&line, Misc.,Net, and Trolls

Table 2. Continued.

	Canada Domestic Trawl		Canada Shrimp Trawl		Canada At-Sea Whiting		CANADA TOTAL		US+CAN TOTAL	
Year	2000[a]	2003	2000[a]	2003	2000[a]	2003	2000[a]	2003	2000[a]	2003
1963										
1964										
1965										
1966										1248.0
1967	25.0	1.4 f					25.0	1.4	361.7	928.1
1968		f							1495.5	1448.5
1969	187.0	21.7 f					187.0	21.7	2150.1	1797.8
1970	37.0	10.2 f					37.0	10.2	688.8	998.0
1971	11.0	9.7 f					11.0	9.7	483.1	597.8
1972	16.0	11.3 f					16.0	11.3	740.8	848.1
1973	22.0	20.5 f					22.0	20.5	635.8	396.3
1974	25.0	16.9 f					25.0	16.9	741.0	588.9
1975	27.0	5.6 f					27.0	5.6	265.9	109.5
1976	127.0	50.2 f	13.5	13.5 a			140.5	63.7	1133.6	1001.8
1977	200.0	236.7 f	32.8	32.8 a			232.8	269.5	1612.5	1649.2
1978	228.0	48.1 f	16.8	16.8 a	120.0	120.0 a	364.8	184.9	1672.1	1492.2
1979	146.0	48.6 f	1.4	1.4 a	187.0	187.0 a	334.4	237.0	2012.4	1915.0
1980	50.0	38.2 f	1.1	1.1 a	142.0	142.0 a	193.1	181.3	2488.8	2477.0
1981	25.0	20.7 f	0.9	0.9 a	120.0	120.0 a	145.9	141.6	3343.4	3282.4
1982	122.0	114.8 f			320.0	320.0 a	442.0	434.8	4250.3	3787.7
1983	17.0	16.6 f			347.0	347.0 a	364.0	363.6	3778.3	3622.5
1984	23.0	19.8 f			350.0	350.0 a	373.0	369.8	1483.2	1512.8
1985	103.0	94.7 f			264.0	264.0 a	367.0	358.7	1585.4	1577.1
1986	450.0	429.9 f			311.0	311.0 a	761.0	740.9	2736.5	2716.4
1987	505.0	500.7 f			330.0	330.0 a	835.0	830.7	2330.6	2326.3
1988	267.0	280.1 f			334.0	383.8 f	601.0	663.9	2698.3	2761.2
1989	260.0	260.0 f			985.0	790.0 f	1245.0	1050.0	3105.0	2910.1
1990	264.0	228.6 f			398.0	338.0 f	662.0	566.6	2424.5	2329.0
1991	350.0	349.5 f		0.5 f	414.0	513.4 f	764.0	863.4	1935.7	2037.4
1992	512.0	504.1 f			436.0	958.9 f	948.0	1463.0	2612.3	3127.3
1993	833.0	834.9 f		1.6 f	829.0	776.0 f	1662.0	1612.5	3609.2	3559.8
1994	328.0	319.9 f			682.0	822.9 f	1010.0	1142.8	3087.5	3220.1
1995	626.0	623.0 f			159.0	158.0 f	785.0	781.0	2518.6	2538.1
1996	1009.0	1033.0 f			980.0	980.3 f	1989.0	2013.4	3993.8	4042.2
1997	342.0	377.6 f		0.0 f	206.0	206.0 f	548.0	583.7	1325.9	1374.5
1998	497.0	554.1 f			210.0	209.8 f	707.0	763.9	1908.9	2011.1
1999	850.0	912.5 f			65.0	64.5 f	915.0	977.0	2717.1	2186.5
2000		1044.2 f				37.9 f		1082.1		2581.9
2001		806.5 f				167.8 f		974.3		1943.8
2002		904.4 f						904.4		1940.0

Table 3. Estimated catches of yellowtail rockfish, 1963-2002, for N. Columbia (PSFMC Area 3A) stock. US total include discard but does not include Hook & line, pot and trolls.

	Hook&			US Domestic Trawl		Shrimp Trawl		At-Sea Whiting		Shoreside Whiting		US DomesticTrawl Disc.		US TOTAL	
Year	Line[b]	Pot[b]	Trolls[b]	2000[a]	2003	2000[a]	2003	2000[a]	2003	2000[a]	2003	2000[g]	2003[g]	2000[a]	2003[h]
1963				678.9	678.9 a	14.0	14.0 a							692.9	692.9
1964				493.0	493.0 a	3.8	3.8 a							496.8	496.8
1965				338.2	338.2 a	6.9	6.9 a							345.1	345.1
1966				563.1	563.1 a	3.4	3.4 a		1597.0 e					566.5	2163.5
1967				457.4	457.4 a	10.7	10.7 a	114.0	1063.0 e					582.1	1531.1
1968				490.9	490.9 a	16.5	16.5 a	240.0	522.0 e					747.4	1029.4
1969				519.1	519.1 a	28.0	28.0 a	1.0	383.0 e					548.1	930.1
1970				115.1	115.1 a	3.4	3.4 a	4.0	510.0 e					122.5	628.5
1971				132.8	132.8 a	13.4	13.4 a	6.0	211.0 e					152.2	357.2
1972				521.7	521.7 a	15.6	15.6 a	207.0	320.0 e					744.3	857.3
1973				470.3	470.3 a	123.6	123.6 a	1385.0	508.0 e					1978.9	1101.9
1974				247.2	247.2 a	163.1	163.1 a	11.0	103.0 e					421.3	513.3
1975				582.3	582.3 a	150.9	150.9 a	407.0	156.0 e					1140.2	889.2
1976				2411.6	2411.6 a	232.4	232.4 a	0.0	186.0 e					2644.0	2830.0
1977				2817.0	2817.0 a	361.3	361.3 a	4.6	4.6 a					3182.9	3182.9
1978				5681.3	5681.3 a	314.5	314.5 a	117.2	117.2 a					6113.0	6113.0
1979				5726.4	5726.4 a	573.4	573.4 a	97.0	97.0 a					6396.8	6396.8
1980				4623.2	4623.2 a	657.8	657.8 a	232.7	232.7 a					5513.7	5513.7
1981				4186.9	4304.0 b	470.7	366.0 b	130.4	130.4 a					4788.0	4800.4
1982				3558.0	4033.2 b	376.1	300.1 b	161.0	161.0 a					4095.1	4494.3
1983				4404.0	4410.1 b	311.9	88.3 b	196.2	196.2 a					4912.1	4694.6
1984				2543.2	2433.1 b	132.3	68.3 b	185.9	185.9 a					2861.4	2687.3
1985				1316.5	1316.5 b	130.9	20.8 b	106.9	106.9 a		2.7 d	250.8	250.8	1805.0	1697.7
1986				1642.3	1642.3 b	610.1	180.9 b	410.7	410.7 a			312.8	312.8	2975.9	2546.7
1987				1913.1	1914.3 b	600.7	35.1 b	368.4	368.4 a			364.4	364.6	3246.6	2682.4
1988				2856.5	2884.5 b	177.8	171.5 b	285.0	285.0 a		14.9 d	544.1	549.4	3863.4	3905.4
1989				1464.3	1484.6 b	336.5	324.4 b	87.0	87.0 a	3.5	3.5 d	278.9	282.8	2170.2	2182.3
1990				1311.0	1321.7 b	274.9	231.1 b	22.8	22.8 a	10.2	10.2 d	249.7	251.8	1868.6	1837.6
1991	0.9			1122.8	1152.1 b	270.5	164.1 b	173.2	173.2 a	27.6	27.6 d	213.9	219.4	1808.0	1736.4
1992	0.1			1516.5	1568.8 b	222.1	130.1 b	410.8	410.8 a	38.6	38.6 d	288.9	298.8	2476.9	2447.1
1993	0.2		0.1	1384.6	1462.4 b	616.6	318.1 b	227.7	227.7 a	76.2	76.2 d	263.7	278.6	2568.8	2362.9
1994	0.6	0.1		1655.2	1798.9 b	315.7	122.4 b	381.3	381.3 a	144.2	144.2 d	315.3	342.6	2811.7	2789.4
1995	0.1			1716.6	1986.6 b	162.6	65.9 b	651.4	651.4 a	181.0	194.1 d	327.0	378.4	3038.6	3276.5
1996	1.2		0.2	1661.2	1932.9 b	135.5	2.3 b	197.3	197.3 a	271.7	271.7 d	316.4	368.2	2582.1	2772.3
1997	0.9			573.6	674.3 b	95.8	75.9 b	220.3	220.3 c'	69.6	69.6 d	109.3	128.4	1068.6	1168.5
1998	1.0			785.8	1128.3 b	67.8	85.0 b	163.6	163.6 c'	81.9	81.9 d	149.7	214.9	1248.8	1673.7
1999	0.1			645.7	1234.5 b	40.1	51.9 b	216.4	216.4 c	191.2	213.6 d	123.0	235.1	1216.4	1951.6
2000	0.1				1663.1 b		47.4 b		161.7 c		114.9 d		316.8		2303.9
2001	0.3				784.8 b		25.8 b		83.2 c		22.6 d		149.5		1065.9
2002	0.1		0.1		179.3 b		6.6 b		6.0 c		8.5 d		34.2		234.5

a: Yellowtail Stock Assessment 2000, Jack Tagart et al.
b: Retrived from PacFIN on Mar. 15, 2003.
c: Provided by Becky Renko, based on NORPAC database
c': Provided by Martin Loefflad, based on NORPAC database
d: Estimated from fish tickets for whiting catch equal or greater than 5000 lbs.
e: Foreign Catches: Jean Roger (2003)
g: Assume 16% discard
h: Exclude Hook&line, Misc.,Net, and Trolls

Table 4. Estimated catches of yellowtail rockfish, 1963-2002, for Eurika-S. Columbia (PSFMC Areas 1C, 2A, 2B, 2C) stock. US total include discard but does not include Hook & line, misc., net, pot and trolls.

	Hook&					US Domestic Trawl		Shrimp Trawl		At-Sea Whiting		Shoreside Whiting		US DomesticTrawl Disc.		US TOTAL	
Year	Line[b]	Misc.[b]	Net[b]	Pot[b]	Trolls[b]	2000[a]	2003	2000[a]	2003	2000[a]	2003	2000[a]	2003	2000[f]	2003[f]	2000[a]	2003[h]
1963						149.0	149.0 a	0.0	0.0 a							149.0	149.0
1964						4.0	4.0 a	0.0	0.0 a							4.0	4.0
1965						144.0	144.0 a	0.0	0.0 a							144.0	144.0
1966						26.0	26.0 a	85.0	85.0 a							111.0	111.0
1967						134.0	134.0 a	136.2	136.2 a		1.0 e					270.2	271.2
1968						100.0	100.0 a	127.9	127.9 a		168.0 e					227.9	395.9
1969						84.0	84.0 a	110.2	110.2 a		3.0 e					194.2	197.2
1970						81.0	81.0 a	137.3	137.3 a							218.3	218.3
1971						175.0	175.0 a	122.6	122.6 a							297.6	297.6
1972						159.0	159.0 a	265.7	265.7 a		16.0 e					424.7	440.7
1973						98.0	98.0 a	272.5	272.5 a		168.0 e					370.5	538.5
1974						37.0	37.0 a	213.3	213.3 a		66.0 e					250.3	316.3
1975						79.0	79.0 a	118.1	118.1 a		66.0 e					197.1	263.1
1976						1.0	1.0 a	175.6	175.6 a		49.0 e					176.6	225.6
1977						85.0	85.0 a	197.7	197.7 a	19.7	19.7 a					302.4	302.4
1978						440.3	440.3 a	498.4	498.4 a	103.7	103.7 a					1042.4	1042.4
1979						568.2	568.2 a	413.8	413.8 a	117.0	117.0 a					1099.0	1099.0
1980						427.7	427.7 a	399.2	399.2 a	27.8	27.8 a					854.7	854.7
1981						851.7	943.9 b	286.4	261.6 b	60.3	60.3 a					1198.4	1265.8
1982	181.9				38.7	1051.3	1260.5 b	217.0	228.2 b	13.1	13.1 a		13.8 d			1281.4	1515.6
1983	0.1					1035.8	964.8 b	91.7	51.7 b	45.8	45.8 a		15.8 d			1173.3	1078.1
1984						1275.7	1305.9 b	58.0	45.6 b	87.7	87.7 a					1421.4	1439.2
1985	3.8	0.2			0.1	720.3	736.8 b	80.7	15.7 b	48.1	48.1 a		3.6 d	137.2	140.3	986.3	944.6
1986	9.1				0.5	414.1	414.7 b	245.4	197.8 b	82.7	82.7 a		1.2 d	78.9	79.0	821.0	775.4
1987	12.5				0.4	664.0	481.3 b	342.9	214.3 b	136.4	136.4 a		0.0 d	126.5	91.7	1269.8	923.7
1988	6.4				0.1	695.3	668.0 b	115.8	115.8 b	85.4	85.4 a		1.3 d	132.4	127.2	1028.9	997.7
1989	6.9	1.1			0.1	877.6	862.4 b	217.0	217.0 b	44.1	44.1 a			167.2	164.3	1305.9	1287.8
1990	34.8	2.1	0.4		0.1	778.2	779.9 b	135.4	135.4 b	58.8	58.8 a	1.8	1.8 d	148.2	148.6	1122.5	1124.5
1991	138.5	0.1	0.1		0.4	873.4	878.7 b	123.0	123.0 b	124.8	124.8 a	6.0	6.0 d	166.4	167.4	1293.6	1299.9
1992	203.6	0.6			0.6	2070.8	2071.9 b	181.2	181.2 b	19.0	19.0 a	15.0	15.0 d	394.4	394.6	2680.4	2681.7
1993	177.3				8.9	984.2	998.8 b	88.7	88.7 b	66.8	66.8 a	17.5	17.5 d	187.5	190.2	1344.7	1362.0
1994	143.0	2.5			3.8	1189.8	1237.5 b	41.3	45.4 b	58.0	58.0 a	51.2	51.2 d	226.6	235.7	1567.0	1627.9
1995	84.5	1.4	0.1	0.5	13.6	997.8	1467.5 b	29.9	70.8 b	2.0	2.0 a	76.7	76.7 d	190.1	279.5	1296.5	1896.5
1996	203.6			0.4	82.5	1295.4	1410.8 b	98.7	351.1 b	0.0	0.0 a	115.8	115.8 d	246.7	268.7	1756.6	2146.4
1997	164.6			0.2	98.4	368.7	530.2 b	21.7	45.2 b	2.1	2.1 c'	14.3	14.3 d	70.2	101.0	477.0	692.8
1998	213.3	0.2		2.2	58.4	523.9	714.0 b	53.9	148.0 b	0.0	0.0 c'	16.1	16.1 d	99.8	136.0	693.7	1014.1
1999	89.8				3.3	446.1	598.1 b	18.7	38.5 b	0.0	0.0 c	29.9	29.9 d	85.0	113.9	579.7	780.4
2000	6.0				2.1		365.5 b		28.6 b		0.0 c		15.6 d		69.6		479.3
2001	4.2				4.3		222.8 b		34.6 b		0.0 c		9.8 d		42.4		309.7
2002	2.8				4.0		145.9 b		5.3 b		4.0 c		1.5 d		27.8		184.5

Data retrieved from PacFIN database using ann_arid_woc_grg.sql.
a: Yellowtail Stock Assessment 2000, Jack Tagart et al.
b: Retrived from PacFIN on Mar. 15, 2003.
c: Provided by Becky Renko, based on NORPAC database
c': Provided by Martin Loefflad, based on NORPAC database
d: Estimated from fish tickets for whiting catch equal or greater than 5000 lbs.
e: Foreign Catches: Jean Roger (2003)
f:Assume 16% discard
h: Exclude Hook&line, Misc.,Net, and Trolls

Table 5. Estimated yellowtail rockfish biomass (t) and its coefficient of variation (CV) for NMFS triennial trawl surveys, 1977-2001.

	INPFC Area [a]															
Year	Monterey	CV	Eureka	CV	S. Col	CV	N. Col	CV	Columbia	CV	US Van	CV	CAN Van	CV	Total Van	CV
1977	683	0.58	661	0.66	1,467	0.59	10,218	0.47	11,800	0.42	11,451	0.58	No survey			
1980	205	0.62	522	0.57	4,842	0.35	411	0.68	5,284	0.56	4,979	0.68	8,625	0.80	13,604	0.56
1983	1,586	0.80	673	0.54	3,349	0.39	3,366	0.40	6,718	0.28	4,666	0.90	20,823	0.57	25,489	0.49
1986	2,222	0.56	1,086	0.50	2,841	0.54	2,642	0.31	5,415	0.32	2,592	0.36	No survey			
1989	880	0.67	387	0.70	5,172	0.63	1,824	0.80	7,031	0.51	9,443	0.80	3,574	0.57	13,017	0.65
1992	652	0.70	74	0.56	1,142	0.77	4,399	0.44	5,398	0.39	5,174	0.47	7,627	0.45	12,801	0.35
1995	408	0.67	31	0.55	870	0.89	497	0.33	1,384	0.57	1,519	0.63	627	0.53	2,146	0.51
1998	3,858	0.67	385	0.84	2,096	0.35	3,922	0.24	6,017	0.21	16,212	0.34	14,659	0.33	31,526	0.27
2001	75	0.78	24	0.71	925	0.66	182	0.35	1,107	0.42	5,830	0.38	12,084	0.58	17,914	0.49
Mean	1,174	0.67	427	0.63	2,523	0.57	3,051	0.45	5,573	0.41	6,874	0.57	9,717	0.55	16,642	0.48

	STOCK [b]							
Year	EUR/ S.COL	CV	N.COL	CV	S.VAN	CV	TOTAL US [c]	CV
1977	2,128	0.46	10,218	0.47	11,451	0.58	23,912	0.35
1980	5,364	0.32	411	0.68	4,979	0.68	10,785	0.42
1983	4,022	0.34	3,366	0.40	4,666	0.90	12,057	0.38
1986	3,927	0.41	2,642	0.31	2,592	0.36	9,093	0.22
1989	5,559	0.59	1,824	0.80	9,443	0.80	16,861	0.50
1992	1,216	0.72	4,399	0.44	5,174	0.47	10,646	0.30
1995	901	0.86	497	0.33	1,519	0.63	2,934	0.42
1998	2,481	0.32	3,922	0.24	16,212	0.34	22,614	0.25
2001	949	0.65	182	0.35	5,830	0.38	6,961	0.32
Mean	2,950	0.52	3,410	0.46	7,004	0.60	13,613	0.36
Geometric mean	2,394	0.49	1,680	0.42	5,530	0.54	10,993	0.34

a. INPFC area : Eureka, Columbia, Vancouver; S.Col and N.Col are requested division of the Columbia area at Cape Falcon, US Vanand CN Van are the United States and Canadian portions of the Vancouver area. The Columbia area was divided by special request the estimated Columbia area biomass is not necessarily equal to the sum of the S.Col and N.Col.

b. Stock units: Eureka/S.Col is Cape Mendocino to Cape Falcon; N.Col is Cape Falcon to Cape Elizabeth; S. Van is Cape Elizabeth to 49°N

c. Total US biomass is the sum of the Area biomass for Eureka, Columbia and US Van.

Table 6. By-catch indices for yellowtail rockfish from the Pacific whiting at-sea fishery, 1978-1999.

YEAR	2000 INDEX	1997 INDE
1978	0.587	2039.8
1979	0.554	1705.4
1980	1.301	4096.7
1981	1.012	4088.7
1982	0.759	2465.4
1983	1.156	4160.3
1984	1.349	4328.9
1985	1.443	4341.3
1986	1.870	9070.5
1987	1.292	4088.9
1988	1.447	5802.0
1989	0.666	2040.6
1990	1.024	3180.5
1991	0.925	5993.0
1992	1.953	5678.9
1993	1.187	2197.6
1994	0.340	1700.5
1995	0.313	3573.5
1996	0.709	
1997	0.501	
1998	0.760	
1999	0.851	

Table 7. US domestic trawl CPUE for yellowtail rockfish, based on 1988-1999 returned logbooks.

	S. Vancouver		N. Columbia		Eureka/S. Columbia		Coastwide	
YEAR	Mean	Std. Error	Mean	Std. Error	Mean	Std. Error	Mean	Std. Error
1988			979.89	318.58	1997.34	363.79	977.89	187.05
1989	599.90	363.45	895.36	317.21	1871.47	346.50	820.44	181.29
1990	700.45	361.12	1142.77	317.80	1103.89	341.35	914.71	178.40
1991	748.13	344.13	1139.54	316.33	959.40	322.00	911.46	175.81
1992	827.33	335.14	1033.10	314.02	937.77	291.08	935.25	171.46
1993	291.84	338.39	873.38	315.04	483.21	293.11	586.73	171.08
1994	707.30	345.79	831.98	313.63	236.11	285.24	503.73	169.32
1995	1147.04	345.81	905.38	315.78	607.60	298.52	726.25	172.84
1996	986.05	353.84	1020.83	314.83	648.62	283.32	778.14	169.25
1997	519.19	364.47	786.41	319.44	51.25	300.44	280.61	176.38
1998	496.37	347.46	928.90	319.66	155.05	292.04	462.92	172.84
1999	313.04	371.71	1118.50	316.57	272.22	328.10	823.44	182.31

Table 8. Coastwide sample sizes and number of otoliths for yellowtail rockfish.

Coast-wide

	Domestic Trawl		Shrimp		Whiting		Total	
Year	Samples	Fish	Samples	Fish	Samples	Fish	Samples	Fish
1974	1	122	0	0	0	0	1	122
1975	3	305	0	0	0	0	3	305
1976	13	1252	0	0	0	0	13	1252
1977	8	753	0	0	0	0	8	753
1978	5	497	0	0	0	0	5	497
1979	15	1464	0	0	1	98	16	1562
1980	60	1782	0	0	8	866	68	2648
1981	40	1301	0	0	0	0	40	1301
1982	124	4020	0	0	1	196	125	4216
1983	122	3107	0	0	0	0	122	3107
1984	136	5723	0	0	0	0	136	5723
1985	100	6305	0	0	0	0	100	6305
1986	80	4454	0	0	1	298	81	4752
1987	108	4126	0	0	0	0	108	4126
1988	79	3388	0	0	0	0	79	3388
1989	109	4154	0	0	72	473	181	4627
1990	104	3962	0	0	0	0	104	3962
1991	96	3501	0	0	4	168	100	3669
1992	123	4469	0	0	12	568	135	5037
1993	88	3784	0	0	6	266	94	4050
1994	112	4605	0	0	18	795	130	5400
1995	87	3797	0	0	26	928	113	4725
1996	81	3603	0	0	30	1221	111	4824
1997	79	3235	25	860	38	1190	142	5285
1998	70	3097	20	794	33	1188	123	5079
1999	71	3129	18	671	58	1914	147	5714
2000	71	2964	21	817	43	1427	135	5208
2001	34	1481	12	444	5	250	51	2175
2002	19	937	4	193	6	268	29	1398

Table 9. Sample sizes and number of otoliths for yellowtail rockfish from S. Vancouver.

S.Vancouver

	Domestic Trawl		Shrimp		Whiting		Total	
Year	Samples	Fish	Samples	Fish	Samples	Fish	Samples	Fish
1974	1	122	0	0	0	0	1	122
1975	2	205	0	0	0	0	2	205
1976	5	497	0	0	0	0	5	497
1977	1	97	0	0	0	0	1	97
1978	2	200	0	0	0	0	2	200
1979	6	582	0	0	1	98	7	680
1980	6	584	0	0	8	866	14	1450
1981	3	298	0	0	0	0	3	298
1982	17	1641	0	0	1	196	18	1837
1983	14	1290	0	0	0	0	14	1290
1984	18	1694	0	0	0	0	18	1694
1985	16	1598	0	0	0	0	16	1598
1986	16	1597	0	0	1	298	17	1895
1987	23	1199	0	0	0	0	23	1199
1988	21	1050	0	0	0	0	21	1050
1989	18	897	0	0	11	58	29	955
1990	24	1194	0	0	0	0	24	1194
1991	20	961	0	0	4	168	24	1129
1992	24	1135	0	0	12	568	36	1703
1993	22	1097	0	0	4	204	26	1301
1994	20	1032	0	0	16	738	36	1770
1995	27	1304	0	0	7	372	34	1676
1996	17	849	0	0	13	714	30	1563
1997	25	1119	2	70	5	243	32	1432
1998	23	1150	0	0	8	400	31	1550
1999	21	1012	0	0	10	379	31	1391
2000	23	1132	5	220	18	617	46	1969
2001	15	750	1	50	4	200	20	1000
2002	12	591	2	100	4	168	18	859

Table 10. Sample sizes and number of otoliths for yellowtail rockfish from N. Columbia.

N. Columbia

	Domestic Trawl		Shrimp		Whiting		Total	
Year	Samples	Fish	Samples	Fish	Samples	Fish	Samples	Fish
1974	0	0	0	0	0	0	0	0
1975	1	100	0	0	0	0	1	100
1976	8	755	0	0	0	0	8	755
1977	5	486	0	0	0	0	5	486
1978	3	297	0	0	0	0	3	297
1979	8	783	0	0	0	0	8	783
1980	10	966	0	0	0	0	10	966
1981	7	686	0	0	0	0	7	686
1982	19	1880	0	0	0	0	19	1880
1983	14	1354	0	0	0	0	14	1354
1984	22	2195	0	0	0	0	22	2195
1985	30	2992	0	0	0	0	30	2992
1986	22	2184	0	0	0	0	22	2184
1987	40	2084	0	0	0	0	40	2084
1988	33	1634	0	0	0	0	33	1634
1989	36	1752	0	0	24	156	60	1908
1990	34	1701	0	0	0	0	34	1701
1991	31	1355	0	0	0	0	31	1355
1992	35	1469	0	0	0	0	35	1469
1993	36	1585	0	0	2	62	38	1647
1994	50	2085	0	0	2	57	52	2142
1995	44	1947	0	0	12	349	56	2296
1996	39	1750	0	0	13	387	52	2137
1997	25	999	16	518	21	594	62	2111
1998	27	1191	15	607	15	492	57	2290
1999	23	1067	14	671	29	970	66	2708
2000	28	1145	14	597	11	387	53	2129
2001	10	481	9	394	1	50	20	925
2002	7	346	2	93	2	100	11	539

Table 11. Sample sizes and number of otoliths for yellowtail rockfish from Eureka/S. Columbia.

Eureka/S.Columbia

	Domestic Trawl		Shrimp		Whiting		Total	
Year	Samples	Fish	Samples	Fish	Samples	Fish	Samples	Fish
1974	0	0	0	0	0	0	0	0
1975	0	0	0	0	0	0	0	0
1976	0	0	0	0	0	0	0	0
1977	2	170	0	0	0	0	2	170
1978	0	0	0	0	0	0	0	0
1979	1	99	0	0	0	0	1	99
1980	44	232	0	0	0	0	44	232
1981	30	317	0	0	0	0	30	317
1982	88	499	0	0	0	0	88	499
1983	94	463	0	0	0	0	94	463
1984	96	1834	0	0	0	0	96	1834
1985	54	1715	0	0	0	0	54	1715
1986	42	673	0	0	0	0	42	673
1987	45	843	0	0	0	0	45	843
1988	25	704	0	0	0	0	25	704
1989	55	1505	0	0	37	259	92	1764
1990	46	1067	0	0	0	0	46	1067
1991	45	1185	0	0	0	0	45	1185
1992	64	1865	0	0	0	0	64	1865
1993	30	1102	0	0	0	0	30	1102
1994	42	1488	0	0	0	0	42	1488
1995	16	546	0	0	7	207	23	753
1996	25	1004	0	0	4	120	29	1124
1997	29	1117	7	272	12	353	48	1742
1998	20	756	5	187	10	296	35	1239
1999	27	1050	4	0	19	565	50	1615
2000	20	687	2	0	14	423	36	1110
2001	9	250	2	0	0	0	11	250
2002	0	0	0	0	0	0	0	0

Table 12. Number of tows and otolith samples in NMFS triennial trawl surveys, 1977-2001.

	ALL TOWS		TOWS WITH AGED FISH	
YEAR	TOTAL	CATCH>0	SAMPLED TOWS	FISH
S. VANCOUVER				
1977	81	31	6	437
1980	97	37	6	315
1983	137	33	6	460
1986	248	54	9	135
1989	131	35	5	123
1992	130	45	7	334
1995	121	29	25	184
1998	88	61	30	600
2001	85	30	27	603
N. COLUMBIA				
1977	84	39	10	626
1980	180	56	4	295
1983	127	65	7	639
1986	105	57	10	23
1989	81	16	4	121
1992	80	29	7	159
1995	57	19	15	88
1998	56	30	25	469
2001	57	6	6	34
EUREKA/S. COLUMBIA				
1977	200	27	3	257
1980	229	61	9	529
1983	254	87	9	652
1986	143	37	9	174
1989	177	19	2	110
1992	181	16	1	17
1995	198	15	7	23
1998	196	34	34	351
2001	205	21	22	143
COASTWIDE				
1977	365	97	19	1320
1980	506	154	19	1139
1983	518	185	22	1751
1986	496	148	28	332
1989	389	70	11	354
1992	391	90	15	510
1995	376	63	47	295
1998	340	125	89	1420
2001	347	57	55	780

Table 13. Coast-wide estimated yellowtail rockfish catch-at-age (numbers of fish).

Age	4	5	6	7	8	9	10	11	12	13	14	15
Year						MALES						
1977	0	0	0	77864	125557	186459	98136	90336	94328	79635	173623	197421
1978	0	30816	152297	175029	196156	243687	261021	159537	134349	116666	101634	154171
1979	0	21424	52272	202067	239478	308599	430728	303468	297646	143246	169141	157538
1980	0	21717	38136	237924	244141	229200	365177	389972	313151	224768	201350	186453
1981	0	12326	185038	266763	432456	282432	176758	151600	165161	308585	202629	108251
1982	11184	35772	133036	372758	642495	509074	255699	164445	258752	252672	199214	164399
1983	0	30196	235864	477958	802599	774521	443196	154480	149359	110155	152151	133310
1984	731	28073	84024	258640	289536	386093	378519	179006	120209	84726	52078	60747
1985	1265	23112	78666	224136	297422	267815	267524	212997	122457	60254	28004	28596
1986	0	19240	126597	126508	257837	298374	298196	230750	296158	185287	85126	56246
1987	10761	30445	122751	143411	173346	281797	377109	254324	275911	214773	152996	66551
1988	7933	63861	79807	212009	216728	248753	372535	388133	283691	228210	173241	111325
1989	32530	62052	135389	132727	235301	311990	188436	332221	295028	250657	204385	161909
1990	0	32469	159486	173997	142812	262878	224963	179281	202462	210218	163768	124604
1991	2623	8692	32321	235909	181439	135475	247597	182204	138377	184040	133498	95430
1992	3069	10318	51404	199032	459773	393669	269390	286634	215927	131742	156641	159661
1993	1288	10735	90168	185405	441614	430907	412285	309115	298689	203007	124481	115343
1994	0	9687	70369	253740	368265	487550	483336	318812	260755	185693	103118	94417
1995	1908	17582	91611	196608	409896	415611	402367	337748	222531	151048	119207	88658
1996	4052	61349	146712	261661	314706	567725	479027	466728	347106	190319	145636	78555
1997	1454	10018	48380	95907	125353	113099	149194	144262	112438	98683	60311	32062
1998	920	7743	29717	114488	182970	229813	159962	198377	163430	139939	105571	76414
1999	2106	6922	23501	86249	200897	385775	383838	193079	185238	139180	104141	76567
2000	0	19737	59372	109164	220451	396340	324202	433590	152266	139962	96416	70907
2001	0	0	11896	25883	25221	66044	89073	270151	209010	124211	79000	54114
2002	0	0	2853	20955	32663	43534	53730	85479	116633	125128	80829	68114
						FEMALES						
1977	0	0	12051	31316	86531	146377	104778	108512	44181	70229	87208	147567
1978	15094	64078	183417	88027	264408	301345	500979	155756	128925	92139	164947	162171
1979	0	20436	84920	84557	197862	364608	391636	358641	283326	186059	125989	125208
1980	0	235	100433	184605	241931	139967	254162	421927	301281	213595	130968	89011
1981	603	33501	98012	329133	462364	281201	142310	175927	216829	306845	225669	143301
1982	10976	14542	171068	230037	533367	398312	266124	170524	259001	180006	176393	67256
1983	0	65286	215132	413215	652642	829679	449507	200843	98040	121871	105141	78359
1984	5108	30704	107507	222240	247886	317145	359104	132326	123012	58884	50762	50928
1985	50386	34980	74583	205732	251305	243808	248408	221397	125642	34994	26750	21524
1986	0	24601	73149	129523	169068	311734	288010	298408	399425	191556	74088	55815
1987	8184	45948	136278	187511	206768	256323	348684	267709	244085	188893	105894	47946
1988	21121	67536	48697	217249	256885	249156	383410	409356	348152	262583	139521	86180
1989	38841	84071	98063	150786	223189	173211	132891	188221	316735	225034	135783	130429
1990	2286	16626	114930	151809	111786	204515	165989	135925	244266	192931	148465	104198
1991	0	6749	25581	199609	190242	182023	324333	219887	123135	143175	130411	94139
1992	0	18611	55755	194898	535619	386912	309820	322908	218037	163963	190319	150206
1993	476	7863	81766	152588	322484	497408	359456	304729	310754	197394	82197	81586
1994	2787	10715	65381	237711	335071	496599	471585	294133	248412	232054	136971	83207
1995	855	13411	101092	194616	406077	413239	365958	330404	238894	167910	136531	80553
1996	4325	46665	146712	211735	314967	577490	502930	468511	388164	206020	177412	120409
1997	2386	7853	32208	82081	109281	96521	153883	135564	121318	109147	68129	44372
1998	0	4362	17719	137494	200285	235889	170325	235090	197983	141070	116988	90344
1999	0	9713	25434	84414	178548	327790	328317	191978	215215	138668	93921	79039
2000	4340	10716	47273	63650	183768	269873	294787	400738	164396	123547	93517	74809
2001	173	519	4652	14934	25266	65821	83086	243891	266957	169372	93355	83008
2002	0	449	1895	13477	22985	20729	37802	79866	87940	91098	72494	45128

2002 age compsition includes only S. Vancouver and N. Columbia stocks.

Table 13. Coast-wide catch-at-age (numbers of fish).

Age	16	17	18	19	20	21	22	23	24	25
Year						MALES				
1977	195611	96503	71328	36172	35307	36831	20356	23897	53584	411249
1978	215075	245910	97028	58841	56307	122083	72627	31218	50271	454706
1979	182876	184474	224355	202198	53295	81883	48482	33291	28882	380460
1980	83229	104012	141515	123409	82966	63018	35666	45385	63229	332795
1981	98626	73067	101734	67678	115324	117612	46801	33428	42266	599400
1982	75171	75870	65153	112150	166989	147351	76466	66941	41494	336250
1983	77037	73657	33246	35666	75043	59334	59586	62225	47501	338036
1984	85939	39124	30420	33682	31544	40537	56641	33621	36807	237535
1985	29534	24736	22663	19672	11963	30384	17957	24616	27438	84175
1986	64928	73467	42446	30110	21002	20930	17255	24624	21451	152757
1987	78300	47740	39826	44390	24504	10169	22083	21526	15017	190451
1988	61282	35286	23069	45557	29209	14161	13384	7842	9668	88034
1989	108514	41201	10859	40946	30360	31111	34871	4907	15814	87278
1990	108585	55518	25565	17450	17112	19307	18097	10624	8693	78071
1991	73925	58604	19552	19204	12315	16848	7551	9584	7939	66117
1992	128136	78392	79725	44262	23416	16235	11603	16681	13105	137191
1993	124051	81140	65648	62089	39015	29481	6156	16078	18044	105849
1994	74078	91964	62240	47208	40226	27283	13660	9210	8137	75035
1995	53249	66918	62262	36283	28029	25763	11622	13858	8720	40902
1996	77316	57926	55699	44537	41603	41412	18338	14273	18605	43893
1997	25350	18164	16817	12618	15814	11318	8207	7362	5429	20952
1998	44306	33565	17411	15562	7085	11417	7759	8302	8640	19871
1999	48789	28703	24799	16784	12234	9160	12909	13180	14722	33598
2000	55324	37247	25135	17465	18422	18003	8948	8439	7554	39227
2001	29679	33081	25440	10817	10961	9497	10713	5935	4723	25091
2002	62499	39955	28387	10996	15465	22062	14473	10439	8209	33331
						FEMALES				
1977	95073	37477	14660	31435	19492	4935	11636	5542	2751	42072
1978	161821	77172	105278	54774	44716	20299	14744	0	0	13518
1979	123142	99258	81572	38320	15275	21927	15525	11839	10912	31989
1980	81435	76289	82930	29003	44433	15663	2390	141	0	17848
1981	57872	74796	38465	20262	46791	21887	15643	448	15867	42117
1982	68945	41920	39419	25982	47875	54576	14002	12194	6042	40065
1983	66034	40795	46018	26208	17329	12924	32871	37751	9901	22816
1984	40101	25230	15451	9008	3406	7580	20180	6049	5786	20177
1985	24770	22038	12966	10788	4574	3088	2857	3395	5657	8810
1986	39115	31023	25847	13912	11046	21740	3503	7849	5594	16360
1987	38189	19305	25452	24962	17141	3314	14244	3937	3874	45952
1988	40526	31192	46406	6009	9920	5040	7806	4870	2446	16309
1989	46385	22751	11249	28861	15033	10538	2966	1826	1477	18795
1990	74905	35674	14908	9419	4688	5705	4610	403	782	23572
1991	77177	40652	49917	8451	8568	3465	8542	8983	0	11562
1992	125470	75309	66406	39927	16701	8715	11257	8946	5439	36582
1993	72712	48269	58805	31316	23651	10243	2380	3973	4571	8199
1994	85446	60783	44845	33653	25135	17421	10316	6059	2590	10476
1995	54106	50189	57135	34122	23774	11907	17224	5479	2861	11068
1996	78676	42143	27763	27059	15793	13360	13580	4780	4624	9215
1997	34289	22391	18982	14561	12330	11436	9769	5903	3257	4453
1998	35741	28041	21195	9207	7977	5553	4121	3899	2559	7050
1999	50506	28289	22109	10907	14233	7153	3443	5981	3125	6300
2000	42400	23066	22975	9061	17936	10203	10125	3957	2978	12143
2001	44931	25075	20691	21235	7185	9221	9299	4557	1550	11241
2002	32905	25844	9039	15456	14105	5766	3594	5261	0	19865

2002 age compsition includes only S. Vancouver and N. Columbia stocks.

Table 14. South Vancouver area estimated yellowtail rockfish catch-at-age (numbers of fish).

Age	4	5	6	7	8	9	10	11	12	13	14	15
Year						MALES						
1974	0	9798	14687	19639	58821	39229	9790	24555	39248	9832	4885	0
1975	1603	13779	23929	32699	11003	7001	1606	2590	3447	2594	8645	2588
1976	0	0	1437	11600	21547	20423	21445	15844	20278	30224	40942	39101
1977	0	0	0	32393	32428	86292	21555	32413	32309	32369	75547	64725
1978	0	13460	33835	27085	40528	33789	48162	6712	44698	25480	10232	31994
1979	0	15453	11518	80701	56296	131435	116805	100060	77295	43237	40938	21144
1980	0	223	3523	35523	45888	52554	130437	129619	86243	78121	42106	68282
1981	0	0	91241	132717	130111	66325	60141	32844	47472	99380	74933	47193
1982	0	13588	25064	151448	260824	207531	140396	103691	180313	153413	93182	69041
1983	0	14443	122757	163951	285035	285978	173756	59173	47020	57298	75092	45107
1984	0	2514	15896	36352	50605	75350	87250	38661	21938	23808	19472	17695
1985	0	2642	22507	71254	152618	110171	105845	94949	55414	20805	8361	9491
1986	0	5591	29727	49650	80193	107563	135728	92631	151978	93055	34449	37147
1987	9285	10855	24798	16793	45075	94866	109956	64072	108476	89436	54542	28655
1988	0	8466	17760	73796	60958	88632	155140	137985	113661	115735	78445	59069
1989	0	1950	41518	64134	104920	166339	92241	186290	160260	149407	114974	80944
1990	0	0	15048	39868	57193	125556	90454	101645	102157	113780	98303	59751
1991	0	0	13822	46020	64741	56072	119400	93809	67140	76351	49468	31834
1992	0	2645	15202	57315	98730	102727	100597	109045	85865	39847	52721	51563
1993	0	2405	34197	57126	181399	160042	177107	169410	182074	126211	59728	65476
1994	0	5229	22482	101949	134244	173797	200781	137967	129623	88883	58562	45520
1995	0	4000	16553	30614	127198	127876	170285	129172	100310	58420	56389	48287
1996	0	6316	23975	66019	109475	305524	235482	257966	183646	111028	77390	36008
1997	0	638	4244	21024	39001	35675	78680	71659	60690	45608	27485	15080
1998	0	1137	5620	19360	60811	94503	70303	99621	93814	69282	62261	39559
1999	0	1444	786	27738	60973	191775	171885	85662	98410	70868	57895	35298
2000	0	11947	33386	47214	92586	183900	161899	216056	75843	78244	54623	43364
2001	0	0	9851	8841	11746	28121	41257	138603	124268	68475	42259	26072
2002	0	0	1937	20043	28187	39915	46546	76443	108945	113176	70282	66431
						FEMALES						
1974	0	9862	14687	44149	39229	14736	9805	24513	19619	9811	4895	0
1975	0	20746	24161	27132	4781	3811	866	1734	1726	2369	3321	3461
1976	0	0	1292	7335	16200	14819	14062	2870	17072	22572	37135	20907
1977	0	0	0	0	21533	53974	10762	10838	10759	21582	21589	53973
1978	0	13557	40658	6688	106270	52005	69251	6824	21997	20338	17017	22089
1979	0	3121	31445	31860	43151	75553	76976	83455	44257	18737	22923	21947
1980	0	235	1007	23958	51567	42355	76104	160298	90279	43540	41121	23739
1981	0	16574	50047	81022	155845	74621	33035	32995	54199	86903	58103	28139
1982	0	4344	15292	91964	200778	132915	113605	86120	131327	89325	78916	33741
1983	0	2979	87185	133316	239949	284842	156264	62119	27266	85289	63403	35709
1984	468	2018	11815	36643	55107	75463	92741	37375	25806	16148	18759	17117
1985	0	3504	15632	52460	103070	79518	88183	86542	46397	13054	10166	8273
1986	0	7253	26782	57951	55818	109152	110390	130169	186291	94308	33422	23166
1987	4036	23916	25509	41015	35280	73919	122453	65150	94395	73381	43250	18723
1988	0	9866	12396	51331	63183	69447	129154	134452	99012	93646	63252	40581
1989	0	1782	27187	48143	119916	61527	52449	57041	139155	106917	43489	58325
1990	0	0	7197	28727	39861	71583	74714	74013	127885	98756	75200	54329
1991	0	0	10626	48591	78281	53496	143108	90812	53115	65409	39128	27488
1992	0	3711	18254	79695	122235	100294	103392	140352	88166	66461	68061	58017
1993	0	0	36372	44862	126059	174211	131959	176286	185459	121807	45504	39984
1994	1509	5212	32014	107437	142608	199525	148194	118197	122031	123620	59869	46089
1995	0	2523	27655	50470	108982	147700	139351	119695	68989	57609	51481	26767
1996	0	3654	7999	55861	108252	282637	255334	219537	183568	69774	91223	70794
1997	0	0	3583	15750	32951	32702	68864	63873	68563	53751	37071	26492
1998	0	0	4332	18333	66321	95196	83519	114482	102595	70480	64975	56843
1999	0	2915	6628	27469	56665	144456	147317	92914	102779	66909	48455	45053
2000	3605	5940	19722	13452	71725	112107	122761	217805	73737	58339	47262	42152
2001	0	0	885	7714	10062	33520	32990	153446	162431	105353	65423	54248
2002	0	0	1446	11208	18273	19612	32799	72635	74269	80168	64523	41246

Table 14. S.Vancouver area catch-at-age (numbers of fish). (Continued)

Age	16	17	18	19	20	21	22	23	24	25
Year						MALES				
1974	0	0	14725	0	4896	4902	9822	9825	0	107975
1975	5180	1735	1728	863	3451	1724	0	1736	3455	25759
1976	21276	14450	12659	18586	11390	9907	15865	10126	10035	171783
1977	75547	21583	32342	21602	0	10767	0	10768	21612	172712
1978	62583	47563	32212	27135	10245	32221	11907	17149	20422	147952
1979	43703	28555	58245	15439	20604	2218	9286	12485	7674	65304
1980	29687	39931	47799	39073	17177	24925	13401	19497	14238	103703
1981	33110	39054	32411	26532	43069	75987	20084	6162	12326	465821
1982	40515	31733	31708	37648	55098	67590	38636	36707	26184	211444
1983	29673	20142	20951	16382	41091	22940	37612	30073	32744	156811
1984	22539	13227	9324	7297	10915	7009	12983	12291	6046	148062
1985	12578	11905	6799	7920	3572	6964	4496	4982	10375	27108
1986	34245	24274	22111	11117	9052	8148	7117	12138	10085	47574
1987	22491	26441	27814	19249	19797	3967	12966	3631	9267	104951
1988	30140	12410	6025	23933	15284	10505	3413	4941	4953	37541
1989	64550	16419	3392	13281	28624	23015	27094	1482	13020	38100
1990	54515	26772	13441	8369	11654	11274	12275	2749	4184	39204
1991	36360	30268	7909	11815	8240	3695	3036	1885	0	33894
1992	44403	24206	27266	17563	5646	5967	3582	3873	5831	51017
1993	63843	33207	21469	39177	29558	18979	3388	11560	10985	69755
1994	34767	35049	31729	18958	15480	11739	3446	4465	1774	28492
1995	27841	24640	26746	18542	12651	8734	6543	3451	2062	14964
1996	43591	32361	27596	22885	14511	11657	11281	2948	6802	26589
1997	16790	4916	7945	3834	7250	3946	1560	4317	2245	10146
1998	28303	19081	8921	5821	3100	4600	2413	5644	2493	10542
1999	23483	17016	11378	10064	5545	3752	6334	7110	6600	17447
2000	30491	18843	15599	10466	7962	9412	4988	4269	6426	20240
2001	24180	17499	13751	5227	6301	7719	6320	5677	3205	20254
2002	57375	37408	25782	8899	14798	21611	14473	9752	7950	31686
						FEMALES				
1974	0	0	4897	4897	0	0	0	0	0	14691
1975	866	860	0	0	0	0	870	0	0	0
1976	15575	5650	0	4224	4146	1360	0	1368	1396	4154
1977	21553	10759	0	10803	10802	0	0	0	0	10816
1978	10199	17049	13553	6753	0	20299	0	0	0	13518
1979	16526	15930	7369	5092	0	0	0	5624	0	9695
1980	22423	21272	26808	3640	10843	5147	2390	141	0	8191
1981	6153	6164	0	0	6143	0	0	0	6143	18296
1982	37217	11200	15026	10458	8195	10650	1466	1613	3203	9443
1983	27185	10591	22563	3580	3683	9715	13110	5492	3881	5242
1984	13385	3177	2759	2491	1859	1531	2877	1142	0	4266
1985	10978	8810	3847	2986	2193	722	0	0	1481	0
1986	19390	15583	9013	7548	2061	1059	1187	0	1121	4493
1987	19571	6407	11938	14714	7205	2426	2370	1106	1208	3467
1988	9795	19390	7954	1562	3467	1432	3318	1763	2446	5893
1989	10006	6185	5797	25756	9336	4502	0	0	0	4817
1990	41682	13362	6323	3092	2437	1363	3964	0	0	1254
1991	21965	12825	12561	2945	3900	0	3785	4976	0	1028
1992	45366	16970	23391	10136	8427	3686	2669	6893	1940	11081
1993	33315	21503	29554	18725	12066	6479	0	3166	3166	0
1994	31504	20861	10189	13278	3448	5400	3341	3107	1720	1625
1995	18134	24292	10254	13203	8305	2253	0	2932	1136	3060
1996	50218	22133	10002	8634	7018	1296	7017	1341	0	0
1997	19442	11500	7486	6268	2893	3926	4797	1986	2215	2266
1998	16584	19570	15530	6926	4959	2463	1192	3051	658	4814
1999	22805	17856	13381	5442	8658	6011	871	1718	2143	3600
2000	19282	11471	13629	6021	12512	7293	4778	3645	2797	7787
2001	27730	18479	14894	14628	726	7273	3614	4514	1459	8048
2002	26804	20985	8108	13954	12586	4867	2285	4638	0	18906

Table 15. North Columbia area estimated yellowtail rockfish catch-at-age (numbers of fish).

Age	4	5	6	7	8	9	10	11	12	13	14	15
Year						MALES						
1975	0	7435	45074	67691	60184	22589	0	15066	15051	0	15079	37585
1976	7133	8732	28919	88559	199062	74164	40389	42690	49207	30363	60613	63088
1977	0	0	0	45471	93129	96282	73993	51710	59435	45073	92015	128301
1978	0	17356	118462	147944	155628	209898	212859	152825	89651	91186	91402	122177
1979	0	5971	40754	121366	183182	164746	282809	197216	201690	93811	128203	123923
1980	0	21494	34613	190869	187687	134234	175409	228815	190603	145412	103252	93641
1981	0	7214	89160	124813	266249	207986	94016	79257	96489	151670	93165	53973
1982	11184	22184	101386	194853	346713	251668	111962	50759	56306	82410	86091	70370
1983	0	3700	107083	269221	468271	445280	245171	86344	58735	40280	64193	64758
1984	0	17636	52385	166476	161382	230569	239023	122350	76571	39227	23735	33065
1985	1265	10341	36002	105964	120711	118890	115701	80899	52327	19654	12332	12386
1986	0	6102	27627	67065	139931	164421	143539	113680	117814	77787	48021	18348
1987	1476	16109	89423	99700	105958	166912	221010	130687	129928	93129	58503	28103
1988	5268	45973	52306	120771	132350	131868	188424	221363	136535	79587	73175	37455
1989	0	13860	62045	38049	100438	77776	66063	118085	111105	65537	59667	50299
1990	0	13884	65655	80369	75188	80699	67085	54880	77259	63871	39156	35893
1991	0	1598	6710	75611	89347	62511	89205	56732	47938	76608	53424	31459
1992	3069	5385	29511	102635	169995	172430	94178	100856	90214	59653	52422	33811
1993	1288	8330	51159	102090	203889	190588	162429	96797	86766	56209	35219	22978
1994	0	3328	38800	105611	182692	202820	183575	122496	94464	60080	25000	24153
1995	0	8210	55287	132442	221618	221766	164166	131928	87619	59753	42926	23733
1996	0	15978	46645	86346	131691	184371	153770	129211	98006	48816	33245	29497
1997	0	2432	14974	44552	56065	51061	53893	58265	35892	36569	21983	11713
1998	0	0	8393	33507	72897	79535	53817	73116	47530	41536	27912	23372
1999	2106	4788	10068	41291	88309	141041	161782	79578	63513	52450	34281	25455
2000	0	2513	15689	46005	104501	181285	142303	177913	62494	52128	34160	23721
2001	0	0	1872	13528	6857	37360	30255	98087	70599	34253	25391	28042
2002	0	0	916	912	4476	3619	7184	9036	7688	11952	10547	1683
						FEMALES						
1975	7537	7456	30023	45103	75177	30059	7515	30088	15020	15020	30101	22555
1976	2448	14636	22495	54303	168606	110068	41873	37593	39134	36530	34033	29740
1977	0	0	12051	31316	64998	92403	92720	93790	31240	44339	65619	87115
1978	15094	50521	142759	81339	158138	249340	431728	148932	106928	71801	147930	140082
1979	0	17315	53475	52697	148502	270393	296014	237868	183085	129994	71958	72178
1980	0	0	83328	157453	190364	89036	176802	229079	195465	151258	71304	35224
1981	0	11722	45683	136861	280180	203692	91384	123931	146549	157596	151319	80456
1982	10976	10198	75577	125349	261428	172122	121187	69804	50791	84296	70529	26550
1983	0	13504	87786	259522	395488	487236	277989	117645	55735	28697	40245	36551
1984	2799	16515	73807	161390	128503	170158	203584	72889	68328	32540	22738	16461
1985	0	14670	41224	105275	130604	98149	101090	91138	45296	13301	10228	6986
1986	0	8171	13850	62510	109202	187863	119808	149257	162628	86975	36184	31122
1987	4148	11581	55047	73300	101057	169581	186267	145454	121926	91460	48722	23716
1988	18179	47809	31679	136991	156227	130352	210641	236151	194717	114437	63693	32902
1989	0	7298	32647	31093	74460	66797	44644	96641	121861	71656	57974	43715
1990	2286	8028	58167	93546	41639	82827	59474	43406	70021	64892	40224	30647
1991	0	3577	5069	45678	74557	86057	108250	73689	47821	48545	44661	27438
1992	0	6810	24831	80328	184049	157806	110850	85667	68306	42137	39172	38655
1993	0	7136	42650	77013	151188	211927	135798	88896	78454	50420	17814	24374
1994	1278	3353	27627	102588	152674	234565	207429	107501	93019	68525	48716	19361
1995	855	9894	70089	110989	214045	203297	171522	140584	107665	70212	59301	35490
1996	2048	17250	55717	98139	99627	179583	148057	138038	107563	62581	39983	36861
1997	461	3321	9087	39444	46383	41126	55948	43221	35255	38990	21189	11252
1998	0	678	3258	25219	71526	82578	52362	80383	69921	43480	39870	24958
1999	0	3514	6038	36432	66168	130623	131022	69991	83625	45849	33572	22682
2000	0	57	14775	34514	87318	125221	152479	154310	80388	58553	37541	28412
2001	0	0	3501	6796	13329	22824	37953	65579	84454	40423	23534	17496
2002	0	449	449	2269	4712	1117	5003	7231	13671	10930	7971	3882

Table 15. N.Columbia area catch-at-age (numbers of fish). (Continued)

Age	16	17	18	19	20	21	22	23	24	25
Year						MALES				
1975	0	0	15052	0	0	7539	7539	0	0	15060
1976	63435	20518	18463	10025	11468	23491	13555	19631	14889	143985
1977	105468	68724	30141	11083	28136	25144	19052	11825	31049	198562
1978	152492	198347	64816	31706	46062	89862	60720	14069	29849	306754
1979	120505	118596	141217	155647	32691	60982	33004	20806	21208	271734
1980	41925	50904	85904	82844	65042	36825	17011	25397	48737	227044
1981	47005	32325	61515	39442	66715	39295	22300	26384	29477	123164
1982	27951	31172	27478	33776	60288	67827	37343	29857	12476	117878
1983	45872	41160	10923	15647	21278	22773	17890	30660	6155	117170
1984	28955	18421	17051	18776	14102	9316	18553	17045	17513	44953
1985	13054	8706	13709	9342	5793	6368	6552	9972	9401	33564
1986	20318	19070	16896	18782	5479	9057	4467	11345	10888	52815
1987	20994	13321	9961	20787	3152	3969	8118	2731	4234	53264
1988	18934	19934	14573	11897	4993	1558	8475	1512	1656	32341
1989	28463	15251	2241	4400	868	6673	4488	1587	1528	28674
1990	29697	15565	5030	6901	3797	5550	5030	3814	3755	15745
1991	17651	12061	8154	3087	3386	826	4515	2132	2216	13089
1992	34957	21413	14509	9886	7346	3640	3030	8904	2504	20576
1993	36359	32089	22904	12381	2434	4390	1101	3462	3688	13482
1994	16369	23206	9593	11954	7757	6440	3443	2309	3035	9581
1995	17894	20489	20120	8243	8558	10535	4845	0	0	7111
1996	17076	14839	15563	8119	9008	6840	3662	3109	1642	10038
1997	6535	9029	5067	4784	5897	6093	3616	1868	2767	7993
1998	10133	10341	5587	6288	1313	3935	1456	1463	2642	3625
1999	14361	8612	9174	2497	5807	3639	3476	2520	1952	9583
2000	16646	13642	7584	4427	6469	7492	1936	3605	549	10069
2001	5499	12090	7963	2808	4660	1778	4393	258	1518	4640
2002	5124	2547	2605	2097	667	451	0	687	259	1645
						FEMALES				
1975	15052	15064	15058	0	22568	0	15022	7534	0	15040
1976	28875	19917	11133	17580	8263	16550	6593	1928	4658	57921
1977	59585	19342	11166	15115	4093	3639	11636	3706	0	19715
1978	151622	60123	91725	48021	44716	0	14744	0	0	0
1979	56841	64672	61781	27017	15275	15716	15525	0	4702	16056
1980	55808	20932	41784	16512	33590	10516	0	0	0	9657
1981	42434	34200	13851	17984	27391	21887	4801	0	9273	22946
1982	26566	20766	19268	14375	25821	19500	12205	10581	2839	18399
1983	29770	12337	15297	11112	5963	3209	19761	17881	6020	8210
1984	14628	7870	8000	3027	995	987	5075	3052	4061	7574
1985	7887	7113	4660	3372	1715	1936	1758	2487	2499	2282
1986	15404	11931	13298	6364	4538	5415	2316	3460	3999	5290
1987	15979	11475	3965	8756	3876	888	2602	1767	1120	10394
1988	23553	9648	4735	4447	4340	2963	4488	3107	0	7647
1989	21119	9397	1475	2248	2023	4147	896	225	204	6221
1990	15590	12760	4324	2849	1333	723	646	0	782	7813
1991	32039	11978	12785	2841	2043	700	2810	0	0	739
1992	32605	16235	8324	8039	3121	1293	0	0	0	4971
1993	14881	12685	13240	2352	3859	1108	1036	0	1405	2444
1994	25367	17413	11158	3330	4461	3584	1091	1213	0	2368
1995	14973	15247	30487	10768	6927	3624	8671	0	1405	4017
1996	16618	10395	11537	12807	6929	6447	4584	3439	2235	3011
1997	12045	8274	9852	5778	7731	4947	3721	2496	560	969
1998	15003	5741	3914	1175	2130	2417	2929	579	194	1692
1999	16193	7333	6310	3696	3516	1104	2021	3539	929	1346
2000	18364	9662	8734	3003	3313	2843	4306	206	181	4319
2001	14377	6536	4373	6583	2891	1893	2906	0	79	2965
2002	6101	4859	931	1502	1519	899	1309	623	0	959

Table 16. Eureka/S.Columbia area estimated yellowtail rockfish catch-at-age (numbers of fish).

Age	4	5	6	7	8	9	10	11	12	13	14	15
Year						MALES						
1977	0	0	0	0	0	3885	2588	6213	2584	2193	6061	4395
1978						NO DATA						
1979	0	0	0	0	0	12418	31114	6192	18661	6198	0	12471
1980	0	0	0	11532	10566	42412	59331	31538	36305	1235	55992	24530
1981	0	5112	4637	9233	36096	8121	22601	39499	21200	57535	34531	7085
1982	0	0	6586	26457	34958	49875	3341	9995	22133	16849	19941	24988
1983	0	12053	6024	44786	49293	43263	24269	8963	43604	12577	12866	23445
1984	731	7923	15743	55812	77549	80174	52246	17995	21700	21691	8871	9987
1985	0	10129	20157	46918	24093	38754	45978	37149	14716	19795	7311	6719
1986	0	7547	69243	9793	37713	26390	18929	24439	26366	14445	2656	751
1987	0	3481	8530	26918	22313	20019	46143	59565	37507	32208	39951	9793
1988	2665	9422	9741	17442	23420	28253	28971	28785	33495	32888	21621	14801
1989	32530	46242	31826	30544	29943	67875	30132	27846	23663	35713	29744	30666
1990	0	18585	78783	53760	10431	56623	67424	22756	23046	32567	26309	28960
1991	2623	7094	11789	114278	27351	16892	38992	31663	23299	31081	30606	32137
1992	0	2288	6691	39082	191048	118512	74615	76733	39848	32242	51498	74287
1993	0	0	4812	26189	56326	80277	72749	42908	29849	20587	29534	26889
1994	0	1130	9087	46180	51329	110933	98980	58349	36668	36730	19556	24744
1995	1908	5372	19771	33552	61080	65969	67916	76648	34602	32875	19892	16638
1996	4052	39055	76092	109296	73540	77830	89775	79551	65454	30475	35001	13050
1997	1454	6948	29162	30331	30287	26363	16621	14338	15856	16506	10843	5269
1998	920	6606	15704	61621	49262	55775	35842	25640	22086	29121	15398	13483
1999	0	690	12647	17220	51615	52959	50171	27839	23315	15862	11965	15814
2000	0	5277	10297	15945	23364	31155	20000	39621	13929	9590	7633	3822
2001	0	0	173	3514	6618	563	17561	33461	14143	21483	11350	0
2002						NO DATA						
						FEMALES						
1977	0	0	0	0	0	0	1296	3884	2182	4308	0	6479
1978						NO DATA						
1979	0	0	0	0	6209	18662	18646	37318	55984	37328	31108	31083
1980	0	0	16098	3194	0	8576	1256	32550	15537	18797	18543	30048
1981	603	5205	2282	111250	26339	2888	17891	19001	16081	62346	16247	34706
1982	0	0	80199	12724	71161	93275	31332	14600	76883	6385	26948	6965
1983	0	48803	40161	20377	17205	57601	15254	21079	15039	7885	1493	6099
1984	1841	12171	21885	24207	64276	71524	62779	22062	28878	10196	9265	17350
1985	50386	16806	17727	47997	17631	66141	59135	43717	33949	8639	6356	6265
1986	0	9177	32517	9062	4048	14719	57812	18982	50506	10273	4482	1527
1987	0	10451	55722	73196	70431	12823	39964	57105	27764	24052	13922	5507
1988	2942	9861	4622	28927	37475	49357	43615	38753	54423	54500	12576	12697
1989	38841	74991	38229	71550	28813	44887	35798	34539	55719	46461	34320	28389
1990	0	8598	49566	29536	30286	50105	31801	18506	46360	29283	33041	19222
1991	0	3172	9886	105340	37404	42470	72975	55386	22199	29221	46622	39213
1992	0	8090	12670	34875	229335	128812	95578	96889	61565	55365	83086	53534
1993	476	727	2744	30713	45237	111270	91699	39547	46841	25167	18879	17228
1994	0	2150	5740	27686	39789	62509	115962	68435	33362	39909	28386	17757
1995	0	994	3348	33157	83050	62242	55085	70125	62240	40089	25749	18296
1996	2277	25761	82996	57735	107088	115270	99539	110936	97033	73665	46206	12754
1997	1925	4532	19538	26887	29947	22693	29071	28470	17500	16406	9869	6628
1998	0	3684	10129	93942	62438	58115	34444	40225	25467	27110	12143	8543
1999	0	3284	12768	20513	55715	52711	49978	29073	28811	25910	11894	11304
2000	735	4719	12776	15684	24725	32545	19547	28623	10271	6655	8714	4245
2001	173	519	266	424	1875	9477	12143	24866	20072	23596	4398	11264
2002						NO DATA						

Table 16. Eureka/S.Columbia area catch-at-age (numbers of fish). (Continued)

Age	16	17	18	19	20	21	22	23	24	25
Year						MALES				
1977	14596	6196	8845	3487	7171	920	1304	1304	923	39975
1978					NO DATA					
1979	18668	37323	24893	31112	0	18683	6192	0	0	43422
1980	11617	13177	7812	1492	747	1268	5254	491	254	2048
1981	18511	1688	7808	1704	5540	2330	4417	882	463	10415
1982	6705	12965	5967	40726	51603	11934	487	377	2834	6928
1983	1492	12355	1372	3637	12674	13621	4084	1492	8602	64055
1984	34445	7476	4045	7609	6527	24212	25105	4285	13248	44520
1985	3902	4125	2155	2410	2598	17052	6909	9662	7662	23503
1986	10365	30123	3439	211	6471	3725	5671	1141	478	52368
1987	34815	7978	2051	4354	1555	2233	999	15164	1516	32236
1988	12208	2942	2471	9727	8932	2098	1496	1389	3059	18152
1989	15501	9531	5226	23265	868	1423	3289	1838	1266	20504
1990	24373	13181	7094	2180	1661	2483	792	4061	754	23122
1991	19914	16275	3489	4302	689	12327	0	5567	5723	19134
1992	48776	32773	37950	16813	10424	6628	4991	3904	4770	65598
1993	23849	15844	21275	10531	7023	6112	1667	1056	3371	22612
1994	22942	33709	20918	16296	16989	9104	6771	2436	3328	36962
1995	7514	21789	15396	9498	6820	6494	234	10407	6658	18827
1996	16649	10726	12540	13533	18084	22915	3395	8216	10161	7266
1997	2025	4219	3805	4000	2667	1279	3031	1177	417	2813
1998	5870	4143	2903	3453	2672	2882	3890	1195	3505	5704
1999	10945	3075	4247	4223	882	1769	3099	3550	6170	6568
2000	8187	4762	1952	2572	3991	1099	2024	565	579	8918
2001	0	3492	3726	2782	0	0	0	0	0	197
2002					NO DATA					
						FEMALES				
1977	13935	7376	3494	5517	4597	1296	0	1836	2751	11541
1978					NO DATA					
1979	49775	18656	12422	6211	0	6211	0	6215	6210	6238
1980	3204	34085	14338	8851	0	0	0	0	0	0
1981	9285	34432	24614	2278	13257	0	10842	448	451	875
1982	5162	9954	5125	1149	13859	24426	331	0	0	12223
1983	9079	17867	8158	11516	7683	0	0	14378	0	9364
1984	12088	14183	4692	3490	552	5062	12228	1855	1725	8337
1985	5905	6115	4459	4430	666	430	1099	908	1677	6528
1986	4321	3509	3536	0	4447	15266	0	4389	474	6577
1987	2639	1423	9549	1492	6060	0	9272	1064	1546	32091
1988	7178	2154	33717	0	2113	645	0	0	0	2769
1989	15260	7169	3977	857	3674	1889	2070	1601	1273	7757
1990	17633	9552	4261	3478	918	3619	0	403	0	14505
1991	23173	15849	24571	2665	2625	2765	1947	4007	0	9795
1992	47499	42104	34691	21752	5153	3736	8588	2053	3499	20530
1993	24516	14081	16011	10239	7726	2656	1344	807	0	5755
1994	28575	22509	23498	17045	17226	8437	5884	1739	870	6483
1995	20999	10650	16394	10151	8542	6030	8553	2547	320	3991
1996	11840	9615	6224	5618	1846	5617	1979	0	2389	6204
1997	2802	2617	1644	2515	1706	2563	1251	1421	482	1218
1998	4154	2730	1751	1106	888	673	0	269	1707	544
1999	11508	3100	2418	1769	2059	38	551	724	53	1354
2000	4754	1933	612	37	2111	67	1041	106	0	37
2001	2824	60	1424	24	3568	55	2779	43	12	228
2002					NO DATA					

Table 17. Age composition in number of yellowtail rockfish from NMFS triennial trawl surveys by stock area, 1977-2001. (sex combined, 25+: > age 25)

Year	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
S. Vancouver (INPFC Area 3E)																				
1977	0	3717	18828	132269	691174	1076260	835042	673772	523578	928435	954378	698805	461894	202639	117324	41773	13289	0	0	0
1980	0	36995	234374	448770	582712	963815	959533	1060993	848962	726672	755691	473739	260445	365259	306243	223085	253024	197886	92493	23323
1983	276786	980535	1002388	1695015	2166878	2222128	1466559	1089983	893301	613105	876745	723477	503408	532130	402058	304010	510060	417190	538201	456782
1986	1716	46953	62388	79960	138122	219833	248076	307338	174987	202506	62747	46549	16027	31343	19702	3748	13690	20055	6394	19928
1989	72017	67014	41712	156263	495242	482170	576362	545832	1043150	1016036	906485	1199757	767211	333220	194296	55190	141177	109089	43650	78701
1992	342109	164025	252712	584442	1004732	988636	779515	1111069	1211319	893880	716844	658272	418373	395710	132716	186172	145242	71810	25259	23143
1995	1113	7010	30765	55892	89326	83733	85651	60386	34584	23987	25782	10105	6129	5375	9920	8284	6858	6970	1474	0
1998	0	44951	282863	1311196	4196627	4868951	2061869	3733507	3719705	2396413	1756004	940376	814766	465290	956528	91951	175559	160340	157397	127021
2001	15530	13973	306605	709936	582498	1254415	659441	3752366	4204370	2901248	2322644	1742866	1535921	1116211	964616	612962	436083	402669	288398	206759
N. Columbia																				
1977	0	0	0	0	11319	51777	121273	157903	193287	494927	615890	445577	326094	151483	112418	38169	6441	0	0	0
1980	4985	22824	36537	27722	17732	23696	21028	20949	17116	13558	14874	8306	6081	6612	5819	3668	4271	2785	1918	385
1983	78846	317618	414128	529426	388635	255052	136644	72063	53956	31310	43726	38550	35743	33828	23786	20088	35879	37099	26465	32189
1986	4254	80786	59686	82873	128878	233268	216996	304757	169069	177601	65426	42317	16104	36224	19046	5267	17456	20016	6434	14996
1989	0	9610	15014	67598	185941	134841	152757	122220	251082	267825	166060	265372	170889	99497	44592	12436	48387	26954	16355	22389
1992	9467	5446	45911	128607	317801	267786	252839	330306	354823	232987	210069	174894	122345	94657	27750	70851	25817	16951	3674	14904
1995	959	3377	17265	17377	34307	39635	43182	31844	22753	20166	25562	12417	13456	6635	12185	8483	7126	19232	2047	0
1998	0	0	63249	261781	515799	544177	226291	389989	281965	277192	250091	185296	94061	67740	55648	31462	13670	14720	10681	2359
2001	0	0	20401	34231	20164	27417	11224	54133	41236	21686	15598	9425	7183	6330	4994	3738	2478	981	1323	1507
Eurika/S.Columbia																				
1977	0	5182	23483	51647	127728	235857	202128	140934	95938	120647	134262	88552	48653	14962	11113	3345	0	0	0	0
1980	21006	108553	188208	178952	171387	291398	293243	382898	364131	359411	379722	237803	128963	196307	164504	101700	145924	117757	51539	12818
1983	36950	145730	264801	584595	531992	406953	237048	148767	113415	66499	97063	93458	68597	55185	42554	33033	75782	49522	53740	53683
1986	17779	1696827	1139260	306919	173692	272127	205285	260430	139158	149903	29753	26145	6509	20603	10317	4831	4108	16567	4731	10906
1989	8357	78559	82575	127425	272765	193660	237347	146119	287545	348491	203271	313132	212061	134533	58456	15953	58951	38539	25190	29437
1992	972	727	9438	48111	131391	126051	112989	153067	179471	103792	81513	80456	51634	33529	15445	23246	15108	4931	3119	8871
1995	9360	245789	336915	255744	89055	43680	16443	12159	13064	7891	8929	3841	2764	1220	962	3854	2231	759	0	0
1998	0	24359	77378	364990	294959	321428	190697	110303	156012	128175	136163	164807	79594	59668	55422	6760	12715	19673	4644	23713
2001	0	0	20859	51085	47232	109522	55726	278230	272076	170370	121117	73259	63544	52722	34859	19721	18129	14790	9062	6916
Coast-wide																				
1977	0	8899	42311	183917	830221	1363894	1158443	972609	812804	1544009	1704531	1232935	836640	369084	240855	83287	19730	0	0	0
1980	25992	168371	459120	655444	771831	1278908	1273804	1464840	1230209	1099642	1150287	719849	395489	568178	476566	328453	403219	318427	145950	36526
1983	392581	1443883	1681318	2809036	3087505	2884133	1840251	1310813	1060673	710914	1017534	855485	607748	621143	468399	357131	621721	503811	618405	542654
1986	23750	1824567	1261334	469751	440692	725227	670356	872525	483214	530011	157926	115011	38640	88170	49065	13846	35254	56638	17559	45830
1989	80374	155183	139301	351286	953948	810671	966466	814172	1581777	1632351	1275816	1778261	1150161	567250	297344	83578	248515	174582	85195	130526
1992	352548	170199	308061	761160	1453924	1382473	1145343	1594442	1745613	1230659	1008425	913622	592352	523896	175910	280268	186167	93692	32052	46918
1995	11433	256176	384944	329013	212689	167048	145276	104389	70400	52045	60273	26363	22349	13229	23067	20622	16215	26961	3521	0
1998	0	69310	423489	1937967	5007385	5734557	2478857	4233799	4157682	2801779	2142258	1290480	988421	592698	1067597	130174	201944	194734	172722	153092
2001	15530	13973	347865	795252	649895	1391354	726390	4084729	4517682	3093305	2459359	1825550	1606648	1175263	1004470	636421	456690	418440	298782	215182

Table 18. The estimates of von Bertalanffy growth parameters for Yellowtail rockfish.

	Coastwide							
	Male				Female			
Year	N	Linf	K	t0	N	Linf	K	t0
PRE 198	17282	47.5654	0.1874	-1.6874	13370	53.2083	0.1705	-0.7470
1987	2216	47.3712	0.1964	-1.7142	1813	53.2287	0.1638	-1.5261
1988	1703	47.4306	0.2103	-0.9817	1648	54.3370	0.1647	-0.9609
1989	2349	47.9936	0.1553	-3.7723	2049	51.6994	0.1825	-1.2558
1990	2089	46.9167	0.2005	-1.4563	1686	54.6771	0.1379	-2.3212
1991	1653	47.1617	0.2023	-1.1368	1583	55.6351	0.1217	-3.2248
1992	2385	47.3332	0.1587	-3.3219	2450	52.0063	0.1870	-0.2305
1993	2377	47.4356	0.1769	-1.6756	2076	53.2656	0.1502	-1.4051
1994	2695	46.8561	0.1706	-2.2585	2600	52.5625	0.1538	-1.2526
1995	2183	47.3640	0.1764	-1.7810	2102	52.8760	0.1571	-1.0284
1996	1925	46.0703	0.1966	-1.3735	1968	52.6637	0.1401	-2.1387
1997	2707	46.8210	0.1981	-0.7994	2502	52.7701	0.1582	-1.0924
1998	2434	46.4740	0.1601	-2.4614	2481	52.1126	0.1412	-1.8428
1999	3471	48.8653	0.1086	-5.1483	3198	50.8536	0.1776	-0.3235
2000	3115	48.5398	0.0970	-7.9766	2926	50.1258	0.1736	-1.5009
2001	1066	47.0116	0.1388	-4.6123	1210	52.2843	0.1447	-2.2029
2002	758	48.1989	0.1362	-4.1687	638	54.2965	0.1240	-3.3755

	S. Vancouver							
	Male				Female			
Year	N	Linf	K	t0	N	Linf	K	t0
PRE 198	6965	48.1547	0.1716	-2.2017	4604	53.6603	0.1583	-1.2230
1987	677	48.6970	0.1712	-2.4991	522	55.1158	0.1411	-1.7835
1988	589	48.5984	0.1751	-1.9457	461	56.5024	0.1367	-1.3878
1989	586	48.6225	0.1669	-2.6011	369	53.2499	0.1697	-0.6465
1990	677	47.4511	0.1767	-2.2154	517	53.6374	0.1588	-0.8704
1991	542	48.7655	0.1424	-4.0618	419	56.6586	0.1166	-2.8797
1992	788	48.7211	0.1386	-4.1212	863	52.5533	0.1842	0.0820
1993	940	48.2401	0.1695	-1.5827	764	53.5064	0.1451	-1.2533
1994	922	47.5288	0.1647	-2.1581	882	53.8604	0.1450	-0.8724
1995	719	48.0801	0.1684	-2.1933	585	55.4054	0.1368	-1.3443
1996	443	47.6674	0.1812	-1.4453	436	53.6469	0.1300	-2.5486
1997	727	48.6824	0.1591	-2.1253	705	54.5531	0.1388	-1.8246
1998	679	48.2265	0.1366	-3.5098	754	53.1663	0.1365	-1.7673
1999	1175	50.1637	0.0956	-6.4364	1051	53.9922	0.1441	-0.5042
2000	1445	50.6679	0.0805	-9.6355	1289	52.2197	0.1392	-2.4950
2001	454	48.1232	0.1068	-7.5052	546	55.8225	0.1009	-4.7478
2002	503	47.6863	0.1540	-2.9764	354	53.5316	0.1543	-0.8521

	N.Columbia							
	Male				Female			
Year	N	Linf	K	t0	N	Linf	K	t0
PRE 198	8120	47.3819	0.1989	-1.2573	6558	53.0126	0.1779	-0.4407
1987	1121	47.1137	0.2191	-0.8411	963	53.4385	0.1634	-1.6147
1988	774	48.1398	0.2046	-0.8717	860	54.6578	0.1649	-0.9348
1989	1028	48.1074	0.2004	-0.7087	880	52.7113	0.1918	-0.2128
1990	911	47.7733	0.1955	-1.3672	790	56.9283	0.1203	-2.9605
1991	688	48.3811	0.1594	-3.1562	667	55.3390	0.1338	-2.5188
1992	769	45.8315	0.2093	-1.4586	700	50.7430	0.2141	0.1204
1993	884	47.0248	0.1913	-1.2265	763	53.4957	0.1653	-0.7265
1994	1074	47.3998	0.1655	-2.4605	1068	54.4084	0.1345	-2.2189
1995	1125	48.2003	0.1508	-2.7647	1171	52.6433	0.1594	-0.9789
1996	1054	46.7047	0.1758	-2.2525	1083	53.7842	0.1264	-2.9172
1997	1137	47.2876	0.1852	-1.1476	974	52.9116	0.1622	-0.6575
1998	1144	47.2293	0.1423	-3.3135	1146	52.2322	0.1335	-2.5667
1999	1397	48.0144	0.1359	-3.1690	1304	51.8022	0.1560	-1.0327
2000	1061	46.3679	0.1322	-5.6962	1067	51.7154	0.1462	-2.3757
2001	449	47.1010	0.1382	-5.3091	427	53.4324	0.1124	-5.4290
2002	255	48.3977	0.1412	-3.4738	284	52.8459	0.1580	-1.9544

	Eureka/S.Columbia							
	Male				Female			
Year	N	Linf	K	t0	N	Linf	K	t0
PRE 198	2197	46.2246	0.2058	-1.3580	2208	53.1179	0.1708	-0.8557
1987	418	45.2585	0.2165	-2.1634	328	51.0767	0.1919	-1.1438
1988	340	45.5001	0.2437	-0.9018	327	51.6137	0.2233	0.2018
1989	735	47.2928	0.1191	-8.0864	800	50.1521	0.2049	-1.2852
1990	501	45.8759	0.2060	-1.5792	379	51.7215	0.1962	-0.3827
1991	423	45.5824	0.2492	0.2013	497	55.3166	0.1169	-3.7570
1992	828	46.7730	0.1597	-3.5900	887	52.1340	0.1809	-0.4476
1993	553	46.6414	0.1696	-2.6486	549	54.8923	0.1079	-4.5197
1994	699	46.3773	0.1602	-2.7878	650	52.8679	0.1214	-3.5657
1995	339	45.4908	0.2084	-1.3543	346	51.1799	0.1608	-1.6080
1996	431	45.3580	0.1592	-3.0608	449	50.4355	0.1624	-1.2162
1997	843	44.9719	0.2353	-0.2343	823	50.8428	0.1751	-0.9949
1998	611	45.3293	0.1500	-3.5286	581	51.1669	0.1385	-2.1679
1999	894	45.7045	0.1436	-3.9658	843	47.8303	0.2300	0.2266
2000	609	43.7661	0.2512	-0.3296	570	47.3313	0.2124	-1.1132
2001	163	43.5776	0.2234	-0.9012	237	48.7583	0.1762	-1.6254
2002		No Data				No Data		

Table 19. Predicted weight (kg) at age for coastwide yellowtail rockfish. The estimates for 2002 are based on S. Vancourver and N.Columbia stocks.

Coastwide																	
	Males																
Age	're 1987	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
1	0.113	0.126	0.072	0.262	0.103	0.077	0.215	0.097	0.134	0.105	0.086	0.048	0.130	0.223	0.367	0.272	0.239
2	0.222	0.244	0.180	0.375	0.214	0.181	0.323	0.194	0.234	0.204	0.186	0.133	0.221	0.302	0.443	0.368	0.337
3	0.352	0.382	0.319	0.494	0.349	0.314	0.438	0.312	0.350	0.322	0.308	0.251	0.326	0.385	0.520	0.469	0.441
4	0.492	0.528	0.474	0.614	0.493	0.460	0.556	0.442	0.472	0.451	0.441	0.387	0.437	0.473	0.598	0.570	0.547
5	0.632	0.672	0.630	0.730	0.636	0.608	0.672	0.574	0.594	0.582	0.575	0.529	0.550	0.561	0.674	0.668	0.653
6	0.766	0.808	0.779	0.841	0.772	0.750	0.782	0.702	0.712	0.710	0.704	0.669	0.659	0.649	0.749	0.763	0.756
7	0.891	0.932	0.915	0.944	0.897	0.880	0.885	0.824	0.823	0.830	0.822	0.800	0.763	0.736	0.822	0.852	0.853
8	1.004	1.043	1.037	1.038	1.008	0.998	0.979	0.936	0.925	0.940	0.929	0.919	0.860	0.819	0.891	0.934	0.945
9	1.105	1.140	1.142	1.124	1.105	1.101	1.065	1.037	1.017	1.039	1.023	1.025	0.949	0.899	0.958	1.011	1.030
10	1.193	1.225	1.233	1.201	1.189	1.190	1.142	1.127	1.099	1.128	1.105	1.118	1.029	0.975	1.021	1.080	1.109
11	1.270	1.297	1.310	1.270	1.261	1.266	1.211	1.206	1.171	1.206	1.175	1.198	1.100	1.047	1.080	1.143	1.180
12	1.335	1.359	1.374	1.330	1.322	1.331	1.271	1.275	1.235	1.274	1.235	1.266	1.164	1.115	1.136	1.200	1.245
13	1.392	1.411	1.428	1.384	1.374	1.385	1.325	1.335	1.290	1.332	1.286	1.324	1.220	1.177	1.189	1.251	1.304
14	1.440	1.454	1.472	1.431	1.416	1.431	1.371	1.386	1.338	1.383	1.328	1.373	1.269	1.235	1.238	1.297	1.356
15	1.480	1.491	1.509	1.472	1.452	1.469	1.412	1.430	1.379	1.427	1.364	1.414	1.311	1.289	1.283	1.337	1.403
16	1.514	1.521	1.539	1.507	1.482	1.500	1.447	1.468	1.414	1.464	1.394	1.448	1.349	1.339	1.325	1.373	1.445
17	1.543	1.547	1.564	1.538	1.507	1.526	1.477	1.500	1.444	1.495	1.419	1.477	1.381	1.384	1.364	1.405	1.482
18	1.567	1.568	1.584	1.565	1.527	1.547	1.504	1.528	1.470	1.522	1.439	1.500	1.409	1.426	1.401	1.433	1.515
19	1.587	1.585	1.601	1.589	1.544	1.565	1.526	1.551	1.492	1.545	1.456	1.520	1.433	1.464	1.434	1.457	1.544
20	1.604	1.599	1.615	1.609	1.557	1.580	1.546	1.570	1.511	1.564	1.471	1.536	1.453	1.499	1.465	1.479	1.570
21	1.618	1.611	1.626	1.626	1.569	1.592	1.563	1.587	1.527	1.580	1.482	1.549	1.471	1.531	1.493	1.498	1.592
22	1.630	1.621	1.635	1.641	1.578	1.601	1.577	1.601	1.541	1.594	1.492	1.560	1.486	1.559	1.519	1.515	1.612
23	1.639	1.629	1.642	1.654	1.586	1.609	1.590	1.612	1.552	1.606	1.500	1.569	1.500	1.585	1.543	1.530	1.630
24	1.647	1.636	1.648	1.665	1.592	1.616	1.600	1.622	1.562	1.615	1.506	1.577	1.511	1.609	1.565	1.542	1.645
25	1.654	1.642	1.652	1.674	1.597	1.621	1.609	1.630	1.570	1.623	1.512	1.583	1.520	1.630	1.585	1.554	1.659
	Females																
1	0.045	0.099	0.058	0.090	0.136	0.186	0.022	0.072	0.063	0.052	0.111	0.057	0.087	0.021	0.093	0.123	0.195
2	0.132	0.211	0.154	0.206	0.244	0.295	0.095	0.162	0.148	0.135	0.207	0.143	0.173	0.086	0.198	0.224	0.303
3	0.262	0.354	0.290	0.356	0.375	0.420	0.217	0.282	0.265	0.252	0.324	0.262	0.283	0.194	0.329	0.347	0.425
4	0.419	0.516	0.454	0.525	0.521	0.557	0.375	0.423	0.403	0.393	0.455	0.406	0.409	0.332	0.476	0.482	0.557
5	0.592	0.686	0.632	0.700	0.675	0.700	0.552	0.576	0.553	0.548	0.595	0.562	0.544	0.488	0.628	0.625	0.693
6	0.770	0.857	0.815	0.872	0.831	0.845	0.735	0.733	0.708	0.709	0.737	0.723	0.683	0.650	0.778	0.768	0.831
7	0.945	1.022	0.995	1.035	0.985	0.988	0.914	0.889	0.862	0.869	0.877	0.883	0.820	0.811	0.921	0.909	0.966
8	1.112	1.177	1.166	1.186	1.133	1.128	1.082	1.039	1.010	1.023	1.012	1.036	0.954	0.963	1.054	1.043	1.097
9	1.266	1.320	1.326	1.321	1.274	1.262	1.235	1.182	1.149	1.168	1.141	1.180	1.081	1.105	1.175	1.169	1.222
10	1.406	1.451	1.473	1.442	1.405	1.390	1.373	1.314	1.278	1.302	1.260	1.312	1.199	1.233	1.284	1.286	1.340
11	1.533	1.568	1.605	1.547	1.527	1.509	1.495	1.435	1.396	1.424	1.371	1.433	1.309	1.348	1.380	1.393	1.450
12	1.645	1.672	1.723	1.639	1.638	1.620	1.601	1.545	1.503	1.535	1.472	1.542	1.410	1.449	1.464	1.491	1.552
13	1.743	1.764	1.827	1.718	1.739	1.723	1.693	1.644	1.598	1.633	1.564	1.638	1.501	1.538	1.538	1.579	1.646
14	1.829	1.845	1.919	1.786	1.831	1.818	1.772	1.732	1.683	1.721	1.646	1.724	1.584	1.615	1.602	1.657	1.732
15	1.904	1.915	1.999	1.844	1.913	1.904	1.839	1.811	1.759	1.798	1.721	1.800	1.657	1.681	1.656	1.727	1.811
16	1.969	1.976	2.069	1.893	1.987	1.983	1.896	1.880	1.825	1.866	1.787	1.866	1.723	1.738	1.703	1.789	1.882
17	2.024	2.029	2.130	1.935	2.052	2.055	1.944	1.941	1.883	1.925	1.846	1.924	1.782	1.787	1.744	1.844	1.947
18	2.072	2.075	2.182	1.970	2.111	2.120	1.985	1.995	1.934	1.976	1.898	1.974	1.834	1.828	1.778	1.893	2.005
19	2.112	2.114	2.227	2.000	2.163	2.178	2.019	2.042	1.978	2.021	1.945	2.018	1.880	1.863	1.807	1.935	2.057
20	2.147	2.147	2.265	2.025	2.208	2.231	2.047	2.083	2.017	2.060	1.985	2.055	1.921	1.893	1.832	1.973	2.104
21	2.177	2.176	2.298	2.045	2.249	2.278	2.071	2.119	2.050	2.094	2.021	2.088	1.956	1.918	1.853	2.005	2.146
22	2.202	2.201	2.326	2.063	2.284	2.320	2.091	2.150	2.079	2.122	2.053	2.116	1.988	1.939	1.871	2.034	2.184
23	2.223	2.222	2.351	2.078	2.315	2.358	2.107	2.177	2.104	2.147	2.081	2.140	2.015	1.957	1.886	2.059	2.217
24	2.241	2.240	2.371	2.090	2.343	2.392	2.121	2.200	2.125	2.169	2.105	2.161	2.039	1.972	1.898	2.081	2.247
25	2.257	2.255	2.389	2.100	2.367	2.423	2.133	2.220	2.144	2.187	2.126	2.179	2.060	1.985	1.909	2.099	2.274

Table 20. Predicted weight (kg) at age for yellowtail rockfish in S. Vancouver area.

S. Vancouver																	
Males																	
Age	Pre 1987	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
1	0.142	0.176	0.126	0.177	0.146	0.259	0.251	0.085	0.121	0.134	0.085	0.117	0.182	0.274	0.404	0.386	0.174
2	0.250	0.294	0.236	0.291	0.256	0.366	0.354	0.177	0.217	0.239	0.181	0.213	0.273	0.350	0.475	0.469	0.274
3	0.375	0.427	0.365	0.419	0.381	0.480	0.464	0.291	0.330	0.360	0.301	0.328	0.375	0.431	0.547	0.552	0.385
4	0.508	0.564	0.504	0.553	0.512	0.595	0.576	0.419	0.452	0.490	0.435	0.453	0.480	0.514	0.620	0.635	0.502
5	0.642	0.701	0.644	0.686	0.643	0.709	0.687	0.552	0.575	0.620	0.572	0.581	0.588	0.598	0.693	0.716	0.618
6	0.770	0.832	0.779	0.813	0.769	0.818	0.794	0.683	0.696	0.747	0.706	0.708	0.693	0.682	0.765	0.794	0.731
7	0.891	0.953	0.907	0.933	0.885	0.922	0.896	0.809	0.811	0.866	0.833	0.829	0.794	0.765	0.835	0.869	0.838
8	1.002	1.065	1.023	1.042	0.991	1.018	0.991	0.926	0.917	0.976	0.949	0.942	0.890	0.845	0.904	0.940	0.937
9	1.102	1.165	1.129	1.141	1.086	1.107	1.079	1.033	1.015	1.076	1.054	1.047	0.980	0.923	0.971	1.007	1.028
10	1.191	1.254	1.222	1.230	1.171	1.188	1.160	1.130	1.102	1.166	1.147	1.142	1.063	0.998	1.035	1.070	1.111
11	1.270	1.332	1.305	1.308	1.244	1.261	1.234	1.216	1.180	1.245	1.229	1.227	1.139	1.069	1.097	1.129	1.185
12	1.339	1.401	1.377	1.377	1.309	1.327	1.300	1.292	1.249	1.315	1.300	1.303	1.209	1.137	1.156	1.183	1.251
13	1.399	1.460	1.440	1.437	1.364	1.386	1.360	1.359	1.310	1.376	1.361	1.370	1.271	1.201	1.212	1.234	1.309
14	1.451	1.511	1.493	1.489	1.412	1.439	1.413	1.417	1.362	1.429	1.413	1.430	1.327	1.261	1.266	1.280	1.361
15	1.495	1.556	1.540	1.534	1.452	1.485	1.461	1.467	1.408	1.475	1.458	1.481	1.378	1.317	1.317	1.323	1.406
16	1.533	1.594	1.579	1.573	1.487	1.526	1.503	1.510	1.448	1.514	1.496	1.526	1.423	1.369	1.365	1.362	1.446
17	1.566	1.626	1.613	1.607	1.516	1.563	1.541	1.547	1.482	1.548	1.528	1.565	1.463	1.418	1.410	1.398	1.481
18	1.594	1.654	1.641	1.635	1.541	1.595	1.574	1.579	1.512	1.577	1.556	1.599	1.498	1.464	1.453	1.431	1.511
19	1.618	1.677	1.666	1.660	1.563	1.623	1.603	1.606	1.537	1.601	1.579	1.629	1.530	1.506	1.493	1.461	1.537
20	1.638	1.697	1.686	1.681	1.581	1.647	1.629	1.629	1.559	1.623	1.598	1.654	1.558	1.545	1.530	1.489	1.559
21	1.655	1.714	1.704	1.699	1.596	1.669	1.652	1.648	1.577	1.641	1.614	1.676	1.582	1.581	1.566	1.513	1.579
22	1.670	1.728	1.718	1.714	1.608	1.688	1.672	1.665	1.593	1.656	1.628	1.694	1.604	1.614	1.599	1.536	1.596
23	1.682	1.741	1.731	1.727	1.619	1.704	1.689	1.679	1.606	1.669	1.639	1.710	1.623	1.645	1.630	1.556	1.610
24	1.692	1.751	1.741	1.738	1.628	1.719	1.704	1.692	1.618	1.680	1.649	1.724	1.639	1.673	1.658	1.575	1.623
25	1.701	1.760	1.750	1.747	1.636	1.731	1.718	1.702	1.628	1.689	1.657	1.736	1.654	1.699	1.685	1.592	1.634
Females																	
1	0.069	0.097	0.067	0.038	0.045	0.147	0.010	0.057	0.037	0.060	0.131	0.094	0.080	0.021	0.137	0.245	0.041
2	0.165	0.197	0.154	0.121	0.127	0.246	0.066	0.137	0.104	0.141	0.227	0.189	0.163	0.075	0.237	0.343	0.117
3	0.294	0.325	0.273	0.245	0.247	0.363	0.174	0.247	0.206	0.253	0.343	0.310	0.271	0.164	0.356	0.451	0.229
4	0.447	0.472	0.416	0.400	0.393	0.495	0.323	0.380	0.333	0.387	0.472	0.450	0.397	0.282	0.487	0.566	0.367
5	0.613	0.630	0.575	0.571	0.556	0.636	0.498	0.526	0.478	0.537	0.608	0.601	0.533	0.421	0.623	0.686	0.522
6	0.782	0.794	0.743	0.749	0.725	0.781	0.682	0.679	0.632	0.696	0.747	0.756	0.675	0.572	0.761	0.807	0.685
7	0.949	0.956	0.913	0.924	0.894	0.928	0.866	0.833	0.789	0.857	0.885	0.912	0.817	0.728	0.896	0.928	0.849
8	1.109	1.113	1.081	1.091	1.057	1.072	1.042	0.983	0.944	1.015	1.019	1.063	0.955	0.885	1.025	1.047	1.008
9	1.258	1.263	1.243	1.247	1.210	1.212	1.205	1.126	1.093	1.169	1.148	1.207	1.088	1.037	1.147	1.163	1.159
10	1.396	1.404	1.397	1.389	1.352	1.347	1.352	1.261	1.233	1.314	1.269	1.342	1.214	1.181	1.261	1.275	1.300
11	1.521	1.534	1.541	1.518	1.481	1.475	1.484	1.386	1.364	1.451	1.382	1.468	1.331	1.317	1.365	1.382	1.429
12	1.634	1.653	1.674	1.631	1.598	1.595	1.599	1.500	1.485	1.577	1.487	1.584	1.439	1.442	1.461	1.484	1.546
13	1.734	1.761	1.796	1.732	1.702	1.708	1.700	1.603	1.594	1.693	1.583	1.689	1.538	1.557	1.547	1.580	1.651
14	1.822	1.859	1.907	1.820	1.794	1.812	1.786	1.696	1.693	1.798	1.670	1.784	1.628	1.661	1.625	1.670	1.745
15	1.900	1.947	2.008	1.896	1.876	1.908	1.860	1.780	1.782	1.893	1.750	1.870	1.709	1.754	1.695	1.755	1.828
16	1.969	2.025	2.098	1.962	1.947	1.996	1.924	1.854	1.862	1.979	1.822	1.947	1.782	1.838	1.758	1.833	1.902
17	2.028	2.094	2.180	2.019	2.009	2.077	1.977	1.920	1.932	2.056	1.886	2.015	1.847	1.913	1.814	1.907	1.966
18	2.080	2.156	2.252	2.068	2.063	2.151	2.023	1.978	1.994	2.125	1.944	2.076	1.905	1.979	1.863	1.974	2.022
19	2.125	2.211	2.316	2.110	2.110	2.218	2.061	2.030	2.049	2.186	1.996	2.130	1.957	2.037	1.906	2.037	2.072
20	2.164	2.259	2.374	2.146	2.150	2.279	2.093	2.075	2.098	2.240	2.042	2.178	2.002	2.089	1.945	2.095	2.114
21	2.197	2.301	2.424	2.176	2.185	2.334	2.120	2.114	2.140	2.288	2.084	2.220	2.043	2.134	1.979	2.148	2.151
22	2.226	2.338	2.469	2.202	2.215	2.384	2.143	2.149	2.177	2.331	2.120	2.257	2.079	2.174	2.009	2.197	2.183
23	2.251	2.371	2.509	2.224	2.241	2.429	2.162	2.179	2.210	2.368	2.153	2.290	2.110	2.209	2.035	2.241	2.211
24	2.272	2.400	2.543	2.243	2.264	2.469	2.178	2.205	2.238	2.401	2.182	2.319	2.138	2.239	2.058	2.282	2.235
25	2.290	2.425	2.574	2.259	2.283	2.505	2.191	2.228	2.263	2.430	2.207	2.344	2.163	2.266	2.078	2.320	2.256

Table 21. Predicted weight (kg) at age for yellowtail rockfish in N. Columbia area.

N.Columbia

Age	Pre 1987	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
Males																	
1	0.086	0.066	0.062	0.047	0.094	0.214	0.106	0.074	0.148	0.152	0.141	0.064	0.170	0.150	0.331	0.337	0.194
2	0.192	0.174	0.164	0.137	0.203	0.327	0.218	0.170	0.250	0.249	0.246	0.153	0.260	0.235	0.423	0.437	0.291
3	0.325	0.316	0.300	0.265	0.338	0.450	0.352	0.292	0.367	0.359	0.365	0.269	0.359	0.332	0.515	0.538	0.398
4	0.471	0.474	0.455	0.413	0.485	0.576	0.493	0.427	0.489	0.475	0.490	0.400	0.463	0.434	0.606	0.638	0.509
5	0.619	0.634	0.615	0.569	0.634	0.700	0.631	0.567	0.612	0.593	0.614	0.537	0.568	0.540	0.694	0.734	0.621
6	0.760	0.784	0.769	0.722	0.776	0.819	0.761	0.702	0.731	0.709	0.733	0.672	0.671	0.644	0.778	0.825	0.730
7	0.890	0.921	0.911	0.865	0.908	0.930	0.878	0.828	0.842	0.820	0.844	0.799	0.769	0.745	0.857	0.910	0.834
8	1.007	1.042	1.040	0.996	1.026	1.033	0.981	0.943	0.945	0.923	0.945	0.917	0.862	0.842	0.930	0.989	0.932
9	1.111	1.146	1.153	1.112	1.131	1.126	1.070	1.046	1.039	1.019	1.036	1.022	0.948	0.933	0.997	1.061	1.024
10	1.200	1.234	1.251	1.213	1.222	1.209	1.146	1.135	1.123	1.107	1.116	1.116	1.027	1.017	1.058	1.127	1.107
11	1.277	1.308	1.335	1.300	1.301	1.284	1.210	1.214	1.197	1.186	1.186	1.198	1.099	1.094	1.114	1.186	1.184
12	1.343	1.370	1.405	1.374	1.368	1.349	1.264	1.281	1.263	1.256	1.247	1.269	1.164	1.165	1.165	1.239	1.253
13	1.398	1.420	1.465	1.437	1.425	1.407	1.309	1.338	1.320	1.320	1.300	1.330	1.223	1.229	1.210	1.287	1.315
14	1.445	1.462	1.515	1.490	1.473	1.457	1.346	1.386	1.370	1.376	1.346	1.382	1.275	1.287	1.251	1.329	1.370
15	1.483	1.496	1.556	1.534	1.513	1.501	1.377	1.427	1.413	1.425	1.385	1.427	1.321	1.339	1.288	1.367	1.420
16	1.516	1.524	1.590	1.571	1.547	1.540	1.402	1.461	1.450	1.468	1.418	1.464	1.362	1.386	1.320	1.400	1.463
17	1.542	1.546	1.619	1.601	1.575	1.573	1.423	1.490	1.483	1.506	1.446	1.496	1.399	1.427	1.349	1.430	1.502
18	1.565	1.565	1.642	1.627	1.598	1.601	1.440	1.514	1.510	1.539	1.470	1.523	1.431	1.464	1.375	1.456	1.536
19	1.583	1.579	1.661	1.648	1.617	1.626	1.453	1.534	1.534	1.568	1.491	1.545	1.459	1.497	1.398	1.479	1.566
20	1.598	1.591	1.677	1.665	1.633	1.647	1.465	1.551	1.554	1.593	1.508	1.564	1.484	1.525	1.418	1.499	1.593
21	1.611	1.601	1.690	1.679	1.646	1.665	1.474	1.565	1.571	1.615	1.522	1.580	1.505	1.551	1.436	1.516	1.616
22	1.621	1.609	1.700	1.691	1.657	1.681	1.481	1.576	1.586	1.634	1.535	1.593	1.524	1.574	1.451	1.532	1.636
23	1.629	1.615	1.709	1.700	1.666	1.694	1.487	1.586	1.599	1.651	1.545	1.604	1.541	1.593	1.465	1.545	1.654
24	1.636	1.620	1.716	1.708	1.674	1.706	1.492	1.594	1.610	1.665	1.554	1.613	1.556	1.611	1.478	1.557	1.670
25	1.642	1.624	1.722	1.714	1.680	1.715	1.496	1.600	1.619	1.677	1.561	1.620	1.568	1.626	1.488	1.568	1.683
Females																	
1	0.030	0.108	0.057	0.023	0.168	0.150	0.012	0.041	0.118	0.050	0.155	0.034	0.130	0.048	0.137	0.340	0.129
2	0.110	0.224	0.154	0.103	0.276	0.261	0.081	0.123	0.217	0.132	0.255	0.108	0.225	0.125	0.242	0.450	0.245
3	0.236	0.370	0.292	0.236	0.403	0.394	0.211	0.246	0.339	0.250	0.372	0.220	0.337	0.234	0.365	0.565	0.386
4	0.396	0.535	0.458	0.406	0.544	0.540	0.383	0.398	0.476	0.391	0.500	0.361	0.461	0.366	0.500	0.684	0.541
5	0.574	0.707	0.639	0.596	0.693	0.695	0.575	0.567	0.622	0.547	0.634	0.520	0.591	0.511	0.640	0.803	0.703
6	0.757	0.878	0.826	0.791	0.846	0.852	0.768	0.742	0.772	0.708	0.770	0.685	0.723	0.661	0.780	0.920	0.863
7	0.938	1.044	1.009	0.980	0.999	1.007	0.953	0.915	0.921	0.868	0.905	0.851	0.854	0.811	0.916	1.033	1.018
8	1.109	1.200	1.184	1.157	1.149	1.156	1.121	1.082	1.066	1.022	1.037	1.011	0.980	0.955	1.045	1.142	1.164
9	1.267	1.344	1.347	1.318	1.293	1.299	1.270	1.238	1.204	1.166	1.162	1.162	1.100	1.091	1.166	1.246	1.299
10	1.411	1.475	1.496	1.461	1.431	1.432	1.400	1.381	1.334	1.299	1.281	1.301	1.212	1.217	1.278	1.343	1.422
11	1.538	1.593	1.631	1.587	1.561	1.557	1.511	1.510	1.455	1.420	1.391	1.428	1.317	1.333	1.380	1.435	1.532
12	1.651	1.697	1.752	1.695	1.682	1.671	1.604	1.626	1.566	1.529	1.494	1.542	1.413	1.437	1.472	1.520	1.631
13	1.749	1.789	1.858	1.789	1.795	1.775	1.683	1.729	1.668	1.626	1.589	1.643	1.500	1.530	1.555	1.599	1.719
14	1.835	1.870	1.952	1.869	1.898	1.870	1.748	1.819	1.761	1.712	1.675	1.733	1.580	1.613	1.629	1.671	1.796
15	1.908	1.940	2.034	1.936	1.994	1.955	1.801	1.898	1.844	1.788	1.754	1.811	1.652	1.686	1.695	1.738	1.864
16	1.971	2.002	2.105	1.993	2.081	2.032	1.845	1.966	1.919	1.854	1.825	1.880	1.717	1.750	1.753	1.799	1.923
17	2.025	2.055	2.166	2.041	2.160	2.101	1.881	2.026	1.987	1.912	1.890	1.940	1.775	1.807	1.805	1.855	1.975
18	2.070	2.100	2.219	2.081	2.232	2.162	1.911	2.077	2.047	1.962	1.948	1.991	1.827	1.856	1.850	1.906	2.020
19	2.109	2.140	2.265	2.114	2.298	2.217	1.935	2.121	2.100	2.005	2.000	2.036	1.873	1.898	1.889	1.952	2.058
20	2.142	2.173	2.304	2.142	2.356	2.266	1.954	2.159	2.148	2.043	2.046	2.075	1.914	1.935	1.924	1.994	2.092
21	2.169	2.202	2.338	2.165	2.409	2.309	1.970	2.191	2.190	2.075	2.088	2.108	1.950	1.967	1.954	2.032	2.121
22	2.193	2.227	2.367	2.185	2.457	2.347	1.983	2.219	2.227	2.103	2.125	2.136	1.982	1.995	1.981	2.066	2.145
23	2.212	2.248	2.391	2.201	2.500	2.380	1.994	2.243	2.260	2.127	2.158	2.161	2.011	2.019	2.004	2.097	2.167
24	2.229	2.266	2.412	2.214	2.538	2.410	2.002	2.263	2.289	2.147	2.188	2.181	2.036	2.040	2.024	2.125	2.185
25	2.243	2.282	2.430	2.225	2.572	2.436	2.009	2.280	2.315	2.165	2.214	2.199	2.058	2.057	2.041	2.150	2.201

Table 22. Predicted weight (kg) at age for yellowtail rockfish in Eureka/S. Columbia area.

Eureka/S.Columbia

Age	Pre 1987	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
Males																	
1	0.095	0.188	0.082	0.496	0.114	0.010	0.237	0.167	0.157	0.093	0.168	0.026	0.186	0.210	0.034	0.059	
2	0.204	0.319	0.204	0.584	0.227	0.076	0.345	0.271	0.253	0.199	0.261	0.105	0.275	0.299	0.123	0.150	
3	0.336	0.459	0.356	0.670	0.360	0.199	0.458	0.388	0.360	0.328	0.362	0.228	0.370	0.393	0.252	0.268	N
4	0.478	0.598	0.517	0.753	0.499	0.355	0.573	0.508	0.472	0.465	0.466	0.373	0.469	0.490	0.398	0.398	O
5	0.619	0.728	0.672	0.832	0.635	0.520	0.684	0.627	0.583	0.600	0.569	0.523	0.566	0.585	0.545	0.526	
6	0.751	0.845	0.813	0.907	0.763	0.680	0.789	0.741	0.691	0.728	0.668	0.666	0.659	0.676	0.680	0.647	D
7	0.872	0.947	0.935	0.977	0.879	0.824	0.886	0.847	0.792	0.844	0.761	0.796	0.747	0.762	0.799	0.755	A
8	0.980	1.036	1.040	1.042	0.981	0.949	0.975	0.943	0.885	0.946	0.847	0.909	0.829	0.843	0.901	0.850	T
9	1.073	1.111	1.127	1.102	1.069	1.054	1.056	1.030	0.971	1.035	0.924	1.006	0.903	0.917	0.985	0.931	A
10	1.154	1.174	1.198	1.157	1.145	1.142	1.128	1.108	1.047	1.111	0.994	1.087	0.971	0.984	1.055	1.000	
11	1.222	1.226	1.256	1.208	1.209	1.214	1.191	1.176	1.116	1.175	1.057	1.155	1.032	1.045	1.111	1.057	
12	1.279	1.269	1.303	1.254	1.263	1.271	1.247	1.236	1.176	1.229	1.112	1.210	1.087	1.100	1.156	1.104	
13	1.327	1.305	1.340	1.296	1.308	1.318	1.297	1.287	1.229	1.274	1.160	1.254	1.135	1.149	1.192	1.143	
14	1.368	1.334	1.370	1.334	1.346	1.354	1.340	1.332	1.276	1.312	1.203	1.290	1.178	1.193	1.220	1.174	
15	1.401	1.358	1.394	1.368	1.377	1.384	1.377	1.371	1.317	1.342	1.240	1.319	1.215	1.231	1.243	1.200	
16	1.428	1.377	1.413	1.399	1.402	1.407	1.409	1.404	1.352	1.368	1.272	1.342	1.249	1.265	1.260	1.221	
17	1.451	1.393	1.427	1.426	1.423	1.425	1.437	1.433	1.382	1.389	1.299	1.361	1.277	1.295	1.274	1.238	
18	1.469	1.406	1.439	1.451	1.441	1.439	1.462	1.457	1.409	1.406	1.323	1.376	1.303	1.322	1.285	1.251	
19	1.484	1.416	1.448	1.474	1.455	1.450	1.482	1.478	1.431	1.420	1.344	1.387	1.325	1.345	1.293	1.262	
20	1.497	1.424	1.456	1.494	1.467	1.459	1.500	1.495	1.451	1.431	1.362	1.397	1.344	1.365	1.300	1.271	
21	1.507	1.431	1.461	1.512	1.476	1.466	1.516	1.510	1.468	1.440	1.377	1.404	1.360	1.383	1.305	1.278	
22	1.515	1.436	1.466	1.528	1.484	1.471	1.529	1.523	1.482	1.448	1.391	1.410	1.375	1.398	1.309	1.284	
23	1.522	1.441	1.469	1.542	1.490	1.475	1.540	1.534	1.495	1.454	1.402	1.415	1.387	1.412	1.312	1.288	
24	1.527	1.444	1.472	1.555	1.495	1.478	1.550	1.543	1.505	1.459	1.412	1.418	1.398	1.424	1.314	1.292	
25	1.532	1.447	1.474	1.567	1.499	1.481	1.558	1.551	1.514	1.463	1.420	1.421	1.407	1.434	1.316	1.295	
Females																	
1	0.052	0.087	0.011	0.111	0.032	0.218	0.030	0.247	0.189	0.091	0.061	0.058	0.102	0.009	0.085	0.100	
2	0.145	0.206	0.085	0.245	0.121	0.326	0.110	0.349	0.288	0.190	0.145	0.150	0.188	0.070	0.200	0.203	
3	0.277	0.360	0.228	0.410	0.261	0.448	0.234	0.461	0.400	0.315	0.258	0.276	0.294	0.191	0.343	0.329	N
4	0.437	0.532	0.419	0.589	0.432	0.579	0.390	0.580	0.519	0.457	0.391	0.424	0.414	0.350	0.500	0.468	O
5	0.610	0.710	0.629	0.767	0.618	0.715	0.564	0.703	0.643	0.606	0.533	0.582	0.540	0.524	0.656	0.611	
6	0.788	0.883	0.841	0.936	0.806	0.852	0.742	0.826	0.767	0.755	0.678	0.742	0.669	0.698	0.803	0.750	D
7	0.961	1.045	1.040	1.091	0.986	0.987	0.916	0.949	0.890	0.900	0.820	0.896	0.797	0.860	0.937	0.882	A
8	1.126	1.193	1.220	1.229	1.152	1.119	1.080	1.068	1.009	1.037	0.955	1.041	0.921	1.005	1.055	1.004	T
9	1.278	1.325	1.378	1.349	1.301	1.245	1.231	1.184	1.122	1.164	1.081	1.174	1.038	1.131	1.158	1.114	A
10	1.416	1.440	1.513	1.452	1.433	1.365	1.367	1.294	1.230	1.279	1.196	1.293	1.147	1.238	1.245	1.212	
11	1.540	1.541	1.627	1.540	1.547	1.478	1.488	1.399	1.330	1.383	1.300	1.400	1.249	1.328	1.319	1.299	
12	1.650	1.627	1.723	1.615	1.646	1.584	1.594	1.497	1.424	1.476	1.392	1.493	1.342	1.402	1.381	1.374	
13	1.747	1.700	1.802	1.677	1.730	1.682	1.686	1.589	1.510	1.559	1.475	1.575	1.426	1.463	1.432	1.440	
14	1.831	1.762	1.867	1.729	1.801	1.772	1.766	1.675	1.589	1.631	1.547	1.645	1.503	1.512	1.475	1.496	
15	1.904	1.815	1.920	1.772	1.861	1.856	1.834	1.755	1.661	1.695	1.610	1.706	1.571	1.553	1.509	1.545	
16	1.967	1.859	1.963	1.807	1.911	1.932	1.892	1.828	1.727	1.750	1.665	1.759	1.633	1.585	1.538	1.586	
17	2.021	1.896	1.998	1.837	1.953	2.001	1.942	1.896	1.787	1.798	1.713	1.803	1.687	1.611	1.561	1.622	
18	2.068	1.927	2.026	1.861	1.988	2.064	1.984	1.958	1.841	1.839	1.755	1.842	1.736	1.632	1.581	1.652	
19	2.107	1.953	2.049	1.880	2.017	2.121	2.020	2.016	1.890	1.875	1.790	1.874	1.779	1.649	1.596	1.677	
20	2.141	1.974	2.067	1.897	2.041	2.173	2.049	2.068	1.934	1.906	1.821	1.901	1.817	1.662	1.609	1.699	
21	2.170	1.992	2.082	1.910	2.061	2.220	2.075	2.115	1.973	1.932	1.847	1.925	1.851	1.673	1.619	1.717	
22	2.194	2.006	2.094	1.921	2.078	2.262	2.096	2.158	2.009	1.955	1.870	1.944	1.880	1.681	1.627	1.732	
23	2.215	2.019	2.103	1.930	2.091	2.300	2.114	2.198	2.040	1.975	1.889	1.961	1.906	1.688	1.634	1.745	
24	2.233	2.029	2.111	1.937	2.102	2.334	2.129	2.233	2.069	1.992	1.906	1.975	1.929	1.694	1.640	1.756	
25	2.248	2.037	2.117	1.943	2.112	2.365	2.141	2.266	2.094	2.006	1.920	1.987	1.949	1.698	1.644	1.765	

Table 23. Fraction of maturity at age for female yellowtail rockfish (from Tagart et al. 2000).

Age	Coast-wide	S. Vancouver	N. Columbia	Eureka/S.Columbia
1	0.000	0.000	0.000	0.000
2	0.001	0.000	0.001	0.001
3	0.002	0.000	0.002	0.002
4	0.004	0.001	0.004	0.004
5	0.011	0.003	0.011	0.011
6	0.029	0.007	0.029	0.029
7	0.072	0.019	0.072	0.072
8	0.169	0.050	0.169	0.169
9	0.347	0.126	0.347	0.347
10	0.581	0.283	0.581	0.581
11	0.784	0.519	0.784	0.784
12	0.904	0.746	0.904	0.904
13	0.961	0.890	0.961	0.961
14	0.985	0.957	0.985	0.985
15	0.994	0.984	0.994	0.994
16	0.998	0.994	0.998	0.998
17	0.999	0.998	0.999	0.999
18	1.000	0.999	1.000	1.000
19	1.000	1.000	1.000	1.000
20	1.000	1.000	1.000	1.000
21	1.000	1.000	1.000	1.000
22	1.000	1.000	1.000	1.000
23	1.000	1.000	1.000	1.000
24	1.000	1.000	1.000	1.000
25	1.000	1.000	1.000	1.000
Parameters				
a	-0.96	-1.0058	-0.96	-0.96
b	9.273	10.9896	9.273	9.273

Table 24. Mean difference and standard deviation of the mean difference between replicate age assignments for yellowtail rockfish.

AGE	N	MEAN DEV	STD	PREDICTED
4	2	0.500	0.707	0.651
5	26	0.308	0.679	0.706
6	131	0.199	0.574	0.762
7	305	0.216	0.895	0.817
8	507	0.073	0.765	0.873
9	695	0.006	0.826	0.928
10	668	-0.153	0.923	0.983
11	495	-0.297	0.960	1.039
12	384	-0.372	1.105	1.094
13	266	-0.323	1.179	1.150
14	197	-0.508	1.354	1.205
15	144	-0.417	1.298	1.261
16	104	-0.433	1.519	1.316
17	88	-0.489	1.788	1.372
18	76	-0.250	1.256	1.427
19	58	-0.379	1.576	1.483
20	42	-0.429	1.434	1.538
21	35	-1.229	1.800	1.594
22	21	-0.571	1.859	1.649
23	13	-0.385	1.387	1.705
24	9	-0.556	1.424	1.760
25+	48	-0.583	1.820	1.816
TOTAL	4314			

Table 25. Summary of estimates from model fitted to the yellowtail rockfish data of coastwide, S. Vancourver, N. Columbia, and Eureka/S.Columbia areas.

	Coastwide		S. Vancouver		N. Columbia		Eureka/S.Columbia	
Output Indicator	**YT2003R**	**YT2003N**	**YT2003R**	**YT2003N**	**YT2003R**	**YT2003N**	**YT2003R**	**YT2003N**
2002 Total Biomass	62,460	63,388	31,639	31,288	22,287	21,972	8,320	9,202
CV 2002 Total Biomass	26%	26%	29%	29%	31%	31%	26%	26%
2002 Biomass / 1967 Biomass	46%	46%	65%	66%	47%	44%	50%	52%
CV Biomass ratio	28%	28%	32%	32%	36%	35%	29%	28%
5-yr Average Total Biomass (1998-2002)	66,518	67,573	34,409	33,870	22,266	22,077	9,235	10,200
2002 SPB	20,195	20,592	7,960	7,877	5,589	5,498	3,287	3,647
5-yr Average SPB (1998-2002)	20,359	20,547	7,700	7,572	5,644	5,590	2,973	3,278
Equilibrium SPB(F=0)	32,985	34,119	32,985	0	13,767	13,611	5,834	6,253
Equil SPB(40%)	13,194	13,648	13,194	13,332	5,337	5,383	5,337	5,383
2002 SPB/Equil SPB (40%)	153%	151%	60%	59%	105%	102%	62%	68%
5-yr Average SPB/Equil SPB(40%)	154%	151%	58%	57%	106%	104%	56%	61%
Average Female Spawner biomass (1967-2002)	24,304	24,466	7,438	7,282	8,552	8,571	4,363	4,655
Female M at age 25	0.25	0.25	0.28	0.28	0.24	0.24	0.18	0.18
2002 Fully Vulnerable F (Female Age 12)	0.06	0.06	0.11	0.11	0.02	0.02	0.03	0.03
2002 Fully Vulnerable F (Male Age 12)	0.06	0.06	0.10	0.11	0.02	0.02	0.03	0.03
Average Fully Vulnerable F (Female, Age 12, 1967-200	0.11	0.11	0.10	0.10	0.14	0.14	0.08	0.08
Average Fully Vulnerable F (Male, Age 12, 1967-2002)	0.10	0.10	0.10	0.10	0.14	0.14	0.08	0.07
Average Female Recruitment (1967-2002)	6,440	6,515	2,898	2,861	2,549	2,529	1,101	1,185
CV Average Female Recruitment	60%	61%	50%	51%	46%	46%	77%	79%
5-yr Average Female Recruitment (1998-2002)	2,872	2,908	1,961	1,937	1,628	1,609	401	434
Median Female Recruitment (1967-2002)	5,133	5,094	2,376	2,362	2,450	2,409	854	924
Constant Survey Catchability	0.20	0.19	0.23	0.23	0.10	0.10	0.23	0.21
Survey Abundance	4.4847	4.5940	6.4906	6.5360	19.3991	19.4586	4.3669	4.7989
Whiting bycatch	18.8214	18.9361	17.9157	17.7762	20.1273	20.4634	18.9070	19.3124
Logbook CPUE	-12.1966	-12.1931	-4.2385	-4.3094	-12.6861	-12.6425	3.9744	4.1195
Fishery Age Comp Fit	84.2555	83.8598	35.2573	35.2784	35.9342	35.8043	186.4420	185.6300
Survey Age Comp fit	35.8743	35.8204	16.6754	16.6488	27.8461	27.7602	57.5883	57.6635
Fishery Selectivity Curvature, Female	2.7995	2.7968	2.1237	2.1124	2.8456	2.8424	1.2961	1.2867
Fishery Selectivity Curvature, Male	3.7368	3.7378	2.5051	2.4898	3.4725	3.4642	1.8362	1.8377
Survey Selectivity Curvature	0.6687	0.6676	1.2897	1.2852	1.5164	1.5069	3.2016	3.1894
Fishery Selectivity Fit	0.8246	0.8220	0.2735	0.2555	0.6278	0.6156	0.2697	0.2746
Survey Selectivity Fit	0.0376	0.0370	0.0011	0.0007	0.0158	0.0188	0.1076	0.1110
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Selectivity Fit Between Female and Male	0.0001	0.0001	0.0001	0.0001	0.0002	0.0002	0.0007	0.0007
Recruitment	6.1441	6.2034	3.7391	3.8184	3.4827	3.4705	8.7182	8.6679
Catch Biomass	0.0493	0.0461	0.0187	0.0182	0.0649	0.0632	0.0540	0.0470
Penalty for Low F	2.7702	2.2891	2.2045	2.3278	5.2914	3.6443	2.8927	2.6054
Total -lnL	148.2702	147.6171	84.2561	84.2380	107.9380	106.4701	262.4070	261.3138
Effective N	579	451	346	347	408	410	146	146
$RMSE = \left(\sqrt{\frac{\sum \ln(Obs / Pred)^2}{n}} \right)$								
Triennial Survey fit	2.713	2.779	3.927	3.954	11.736	11.772	2.642	2.903
Whiting bycatch	1.510	1.519	1.437	1.426	1.615	1.642	1.517	1.550
Logbook CPUE	1.028	1.026	1.598	1.560	0.111	0.115	5.626	5.687

Table26. Yellowtail rockfish projected yield (mt), biomass (mt), and stock benchmarks for Coast-wide, S. Vancouver, N. Columbia, and Eureka/S. Columbia areas.

	Coastwide			S.Vancouver			N. Columbia			Eureka/S.Columbia		
Projections	YT2003R	YT2003N	YT2000	YT2003R	YT2003N	YT2000	YT2003R	YT2003N	YT2000	YT2003R	YT2003N	YT2000
Unfished Biomass: B(0)	114,243	115,439	114,681	50,066	49,380	48,957	48,459	48,038	54,837	17,648	18,954	20,177
Unfished Spawning Biomass: SPB(0)	32,985	33,329	32,541	13,341	13,170	12,524	13,767	13,611	15,095	5,834	6,253	6,771
SPB(50%)	16,492	16,665	16,271	6,671	6,585	6,262	6,884	6,806	7,547	2,917	3,126	3,386
SPB(40%)	13,194	13,332	13,016	5,336	5,268	5,010	5,507	5,444	6,038	2,334	2,501	2,708
SPB(25%)	8,246	8,332	8,135	3,335	3,293	3,131	3,442	3,403	3,774	1,458	1,563	1,693
Equilibrium Yield 50%	4,491	4,541	4,542	2,126	2,097	2,080	1,923	1,909	2,104	648	698	730
F(50%)	0.091	0.091	0.090	0.110	0.110	0.112	0.090	0.090	0.086	0.078	0.079	0.076
F(40%)	0.128	0.129	0.127	0.157	0.158	0.161	0.127	0.127	0.120	0.110	0.110	0.106
F(25%)	0.226	0.226	0.223	0.286	0.287	0.293	0.222	0.223	0.208	0.189	0.190	0.181
F(20%)	0.283	0.284	0.279	0.367	0.368	0.375	0.278	0.273	0.259	0.234	0.235	0.224
Projected Recriuitment 2003-2013	10,191	10,292	11,726	5,027	4,954	5,342	4,452	4,418	5,629	1,714	1,842	1,964
Yield 50%												
2004	4,241	4,320	3,950	2,288	2,262	2,004	1,596	1,575	2,021	531	593	599
2005	3,829	3,896	3,898	2,100	2,076	1,961	1,531	1,512	1,999	496	552	594
2006	3,622	3,681	3,907	1,987	1,964	1,951	1,516	1,497	1,991	479	530	595
2007	3,576	3,630	3,945	1,936	1,913	1,953	1,544	1,527	1,989	476	524	599
2008	3,607	3,656	3,985	1,927	1,903	1,956	1,588	1,572	1,989	480	526	605
2009	3,668	3,715	4,019	1,936	1,910	1,961	1,629	1,613	1,990	490	535	610
2010	3,734	3,779	4,049	1,946	1,919	1,965	1,663	1,648	1,991	502	546	615
2011	3,787	3,832		1,954	1,927		1,690	1,676		512	556	
2012	3,829	3,873		1,960	1,933		1,712	1,698		522	566	
2013	3,861	3,904		1,965	1,937		1,729	1,715		530	573	
Total Biomass 50%												
2004	63,190	64,122	64,494	30,270	29,875	28,717	25,419	25,092	33,230	8,804	9,707	10,879
2005	62,064	62,920	64,473	29,499	29,105	28,551	25,622	25,310	33,023	8,783	9,641	10,921
2006	61,714	62,514	64,627	29,086	28,691	28,487	25,958	25,659	32,892	8,850	9,675	10,983
2007	61,822	62,581	64,849	28,908	28,508	28,470	26,349	26,061	32,807	8,968	9,771	11,052
2008	62,138	62,865	65,077	28,860	28,455	28,475	26,727	26,447	32,755	9,106	9,893	11,120
2009	62,519	63,223	65,288	28,869	28,460	28,489	27,061	26,788	32,723	9,248	10,026	11,183
2010	62,890	63,577	65,472	28,899	28,486	28,507	27,345	27,078	32,703	9,380	10,150	11,239
2011	63,223	63,896		28,935	28,519		27,583	27,320		9,498	10,263	
2012	63,511	64,172		28,970	28,552		27,780	27,520		9,599	10,360	
2013	63,754	64,407		29,002	28,582		27,940	27,683		9,685	10,444	
Spawning Biomass 50%												
2004	17,310	17,612	14,416	7,593	7,499	6,238	6,188	6,086	7,798	2,624	2,926	2,729
2005	15,071	15,324	13,690	6,784	6,699	5,983	5,837	5,740	7,425	2,324	2,584	2,607
2006	13,453	13,668	13,476	6,247	6,169	5,893	5,573	5,482	7,243	2,099	2,327	2,567
2007	12,525	12,711	13,519	5,954	5,878	5,885	5,451	5,365	7,166	1,975	2,179	2,577
2008	12,210	12,377	13,652	5,851	5,774	5,908	5,480	5,398	7,140	1,947	2,137	2,605
2009	12,280	12,434	13,802	5,859	5,780	5,939	5,599	5,521	7,136	1,982	2,164	2,637
2010	12,504	12,650	13,940	5,911	5,830	5,971	5,745	5,669	7,143	2,041	2,219	2,667
2011	12,756	12,895		5,972	5,888		5,881	5,808		2,102	2,278	
2012	12,987	13,123		6,029	5,943		5,998	5,926		2,157	2,332	
2013	13,187	13,319		6,078	5,991		6,094	6,023		2,204	2,378	
3-Year average												
Mean Yield 2004-2006	3,897	3,966	3,918	2,125	2,101	2,326	1,548	1,528	2,236	502	559	647
Total Biomass 2006	61,714	62,514	3,898	29,086	28,691	29,076	25,958	25,659	33,567	8,850	9,675	10,875
Spawning Biomass 2006	13,453	13,668	13,476	6,247	6,169	6,741	5,573	5,482	8,418	2,099	2,327	2,938
SPB(2006)/SPB(40%)	102%	103%	104%	117%	117%	135%	101%	101%	139%	90%	93%	108%
10-Year average												
Mean Yield 2004-2013	3,775	3,829		2,000	1,974		1,620	1,603		502	550	
Total Biomass 2013	63,754	64,407		29,002	28,582		27,940	27,683		9,685	10,444	
Spawning Biomass 2013	13,187	13,319		6,078	5,991		6,094	6,023		2,204	2,378	
SPB(2013)/SPB(40%)	100%	100%		114%	114%		111%	111%		94%	95%	

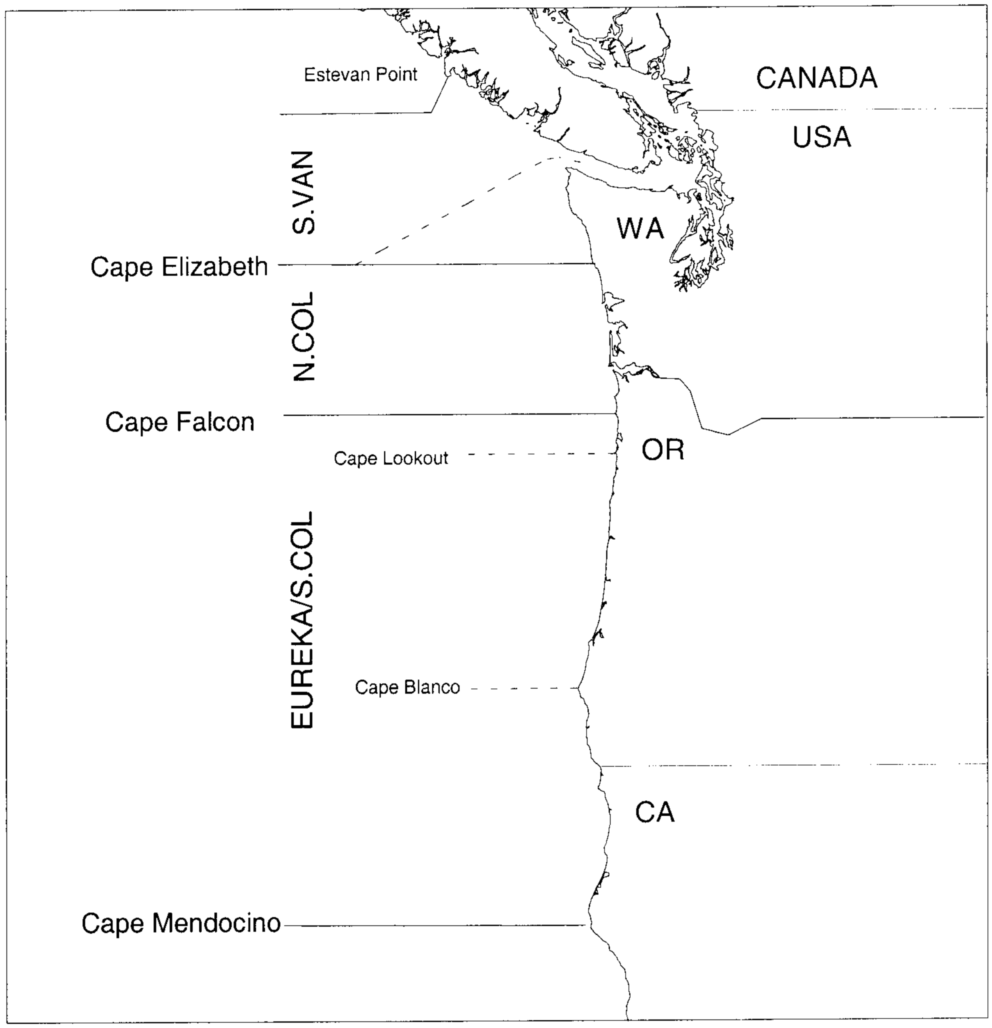


Figure 1. Yellowtail rockfish stock boundaries.

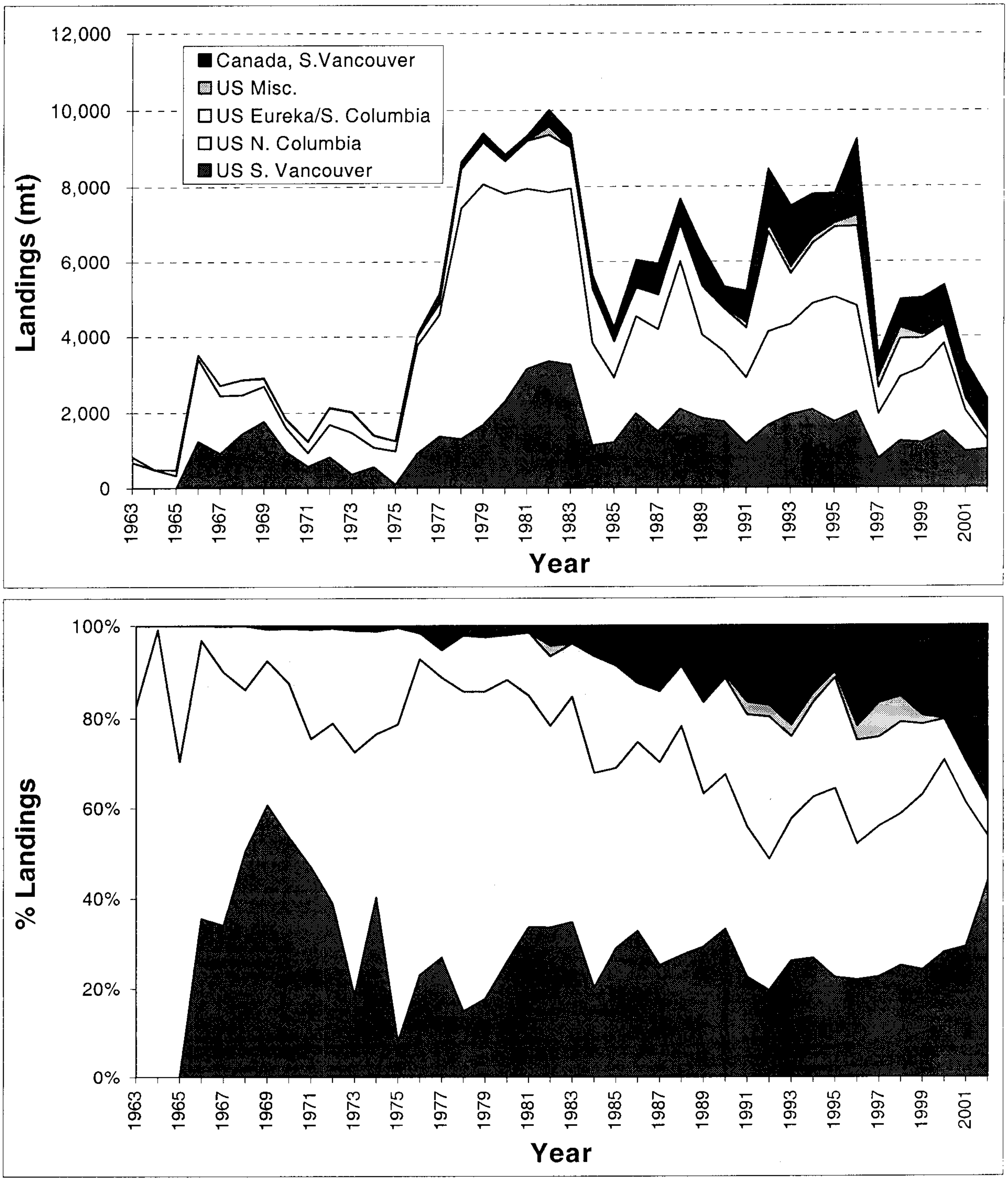


Figure 2. Distribution of annual landings for yellowtail rockfish. Misc.: Includes hook & line, net, pot, trolls, and miscellaneous gears. Based on YT2003N catch series.

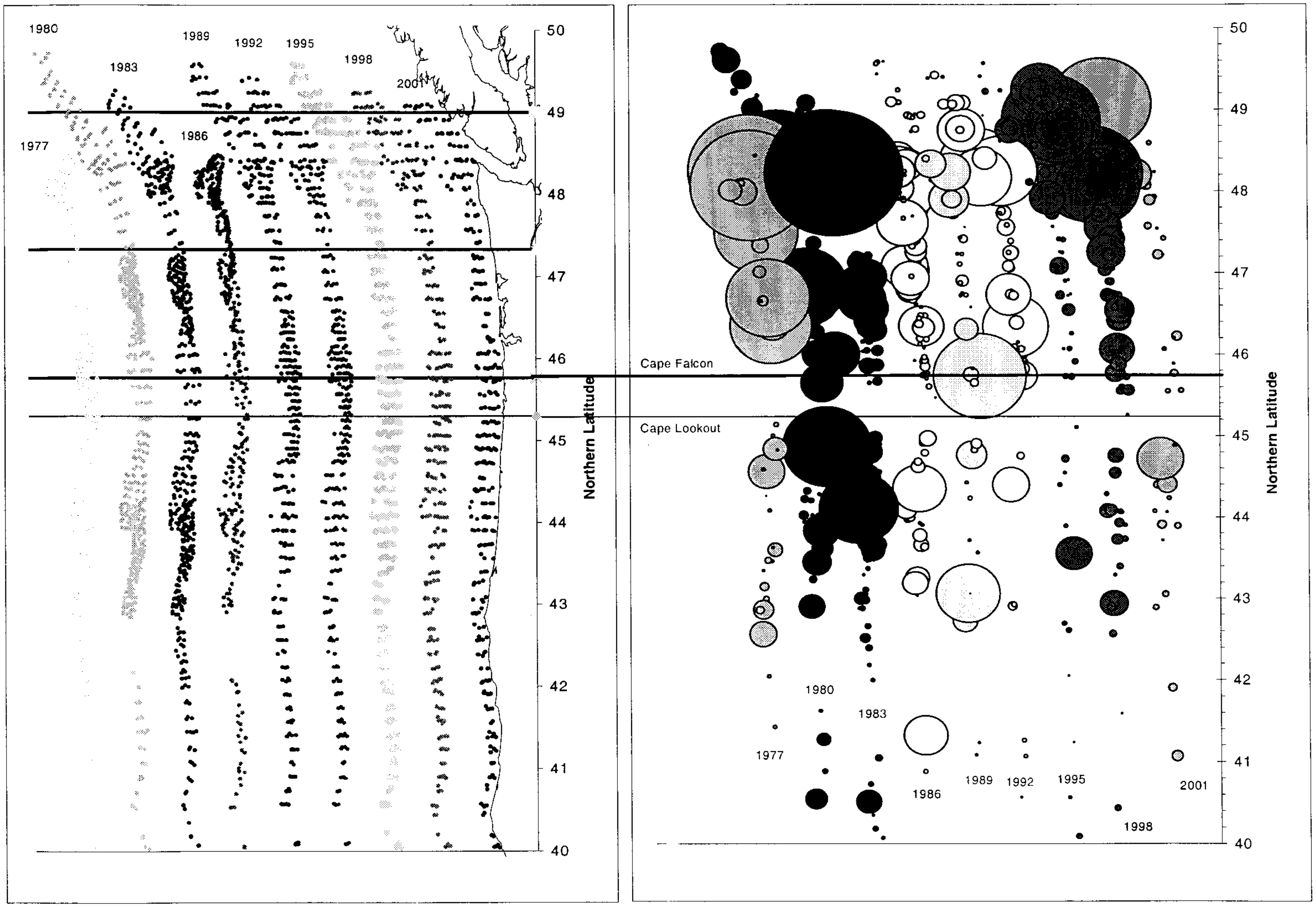


Figure 3. Tow locations and estimated catch weight (kg) per hectare of NMFS triennial surveys, 1977-2001. The circles in the right-han-side panel are the real scale of positive catch (kg) per hectare. Tows with zero yellowtail rockfish catches are not presented in the right-han-side panel.

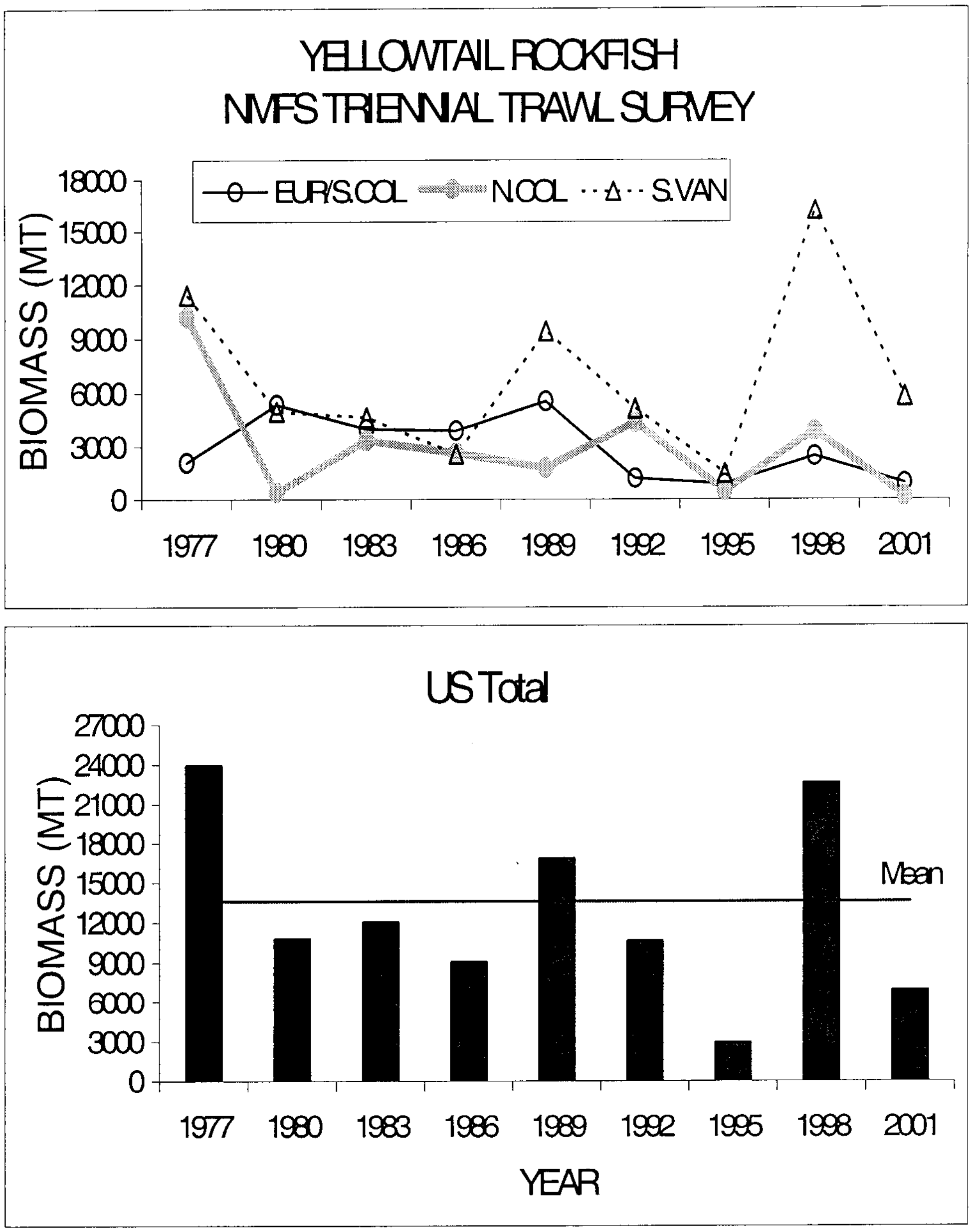


Figure 4. Estimates of NMFS triennial survey biomass for yellowtail rockfish, 1977-2001. S. VAN icludes only US portion of S. Vancouver.

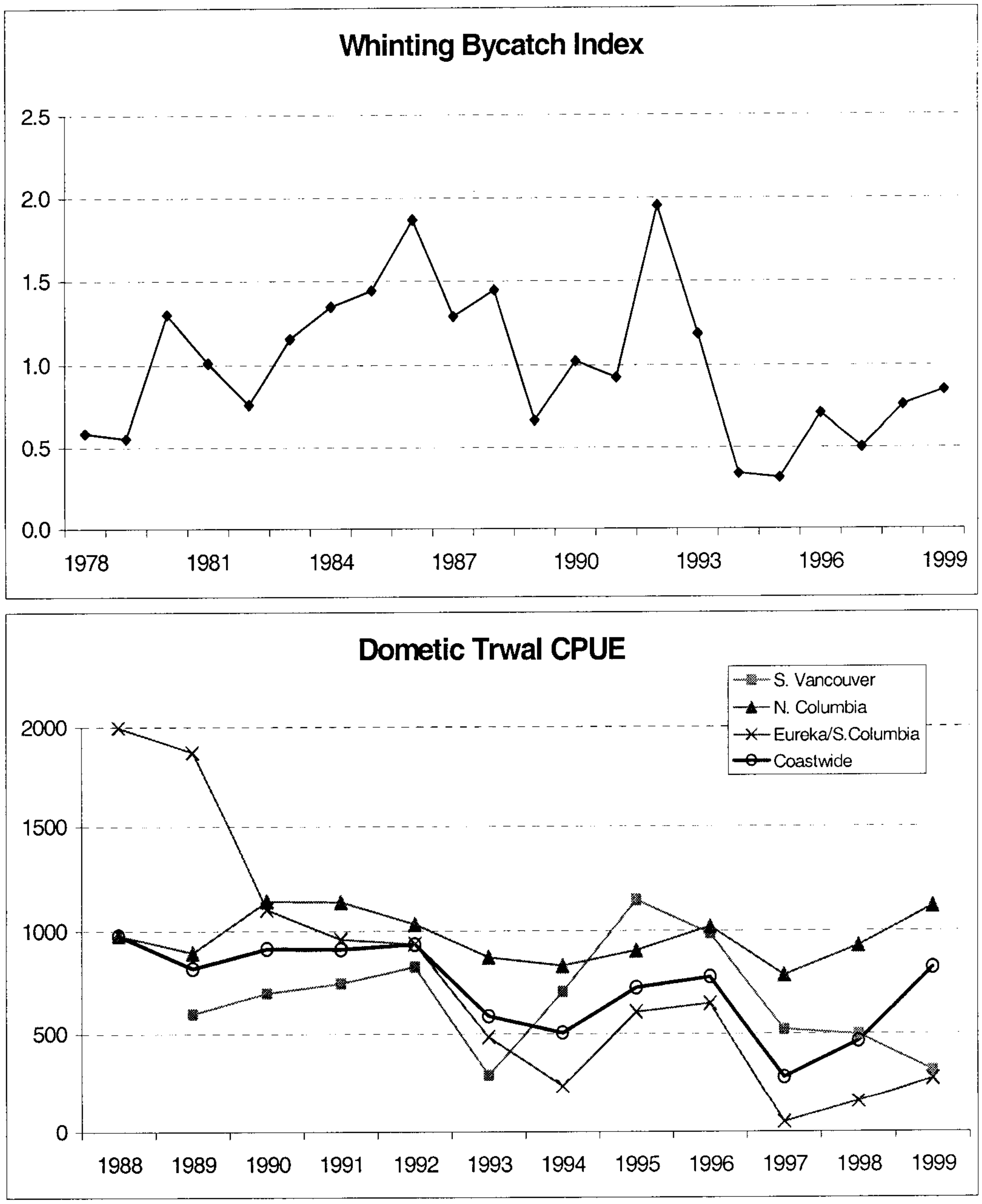
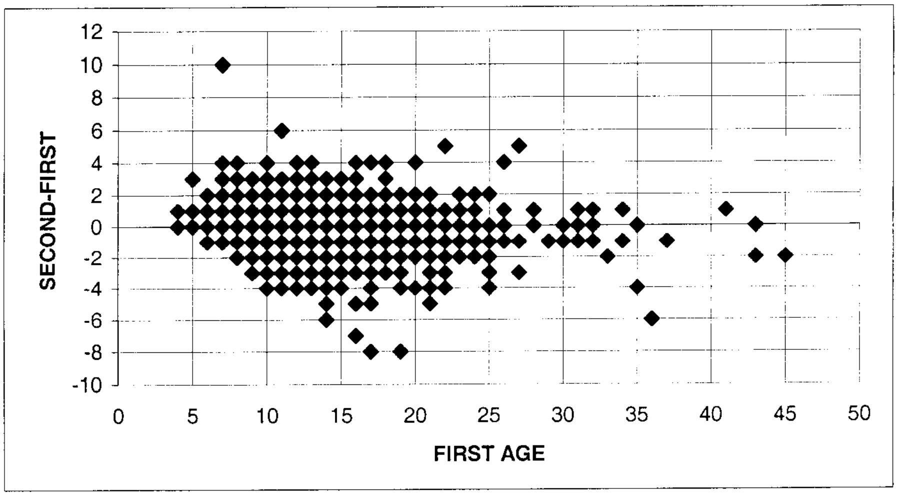


Figure 5. Whiting bycatch index and domestic trawl CPUE.



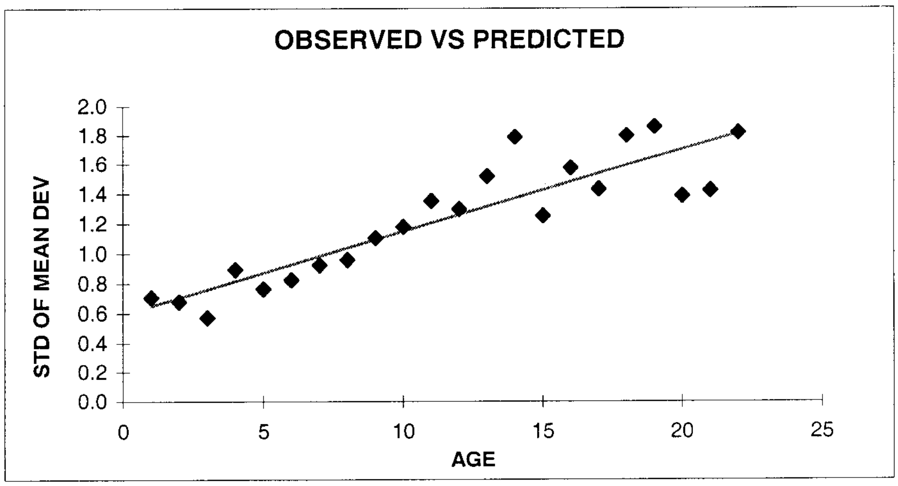


Figure 6. Variability in the replicate age assignment of Yellowtail rockfish. (Ageing error) Panel A represents the deviations between the first and second age assignment for the same age structure. Panel B shows the estimated standard deviation for the mean deviation between first and second age, and a predicted line through the standard deviations.

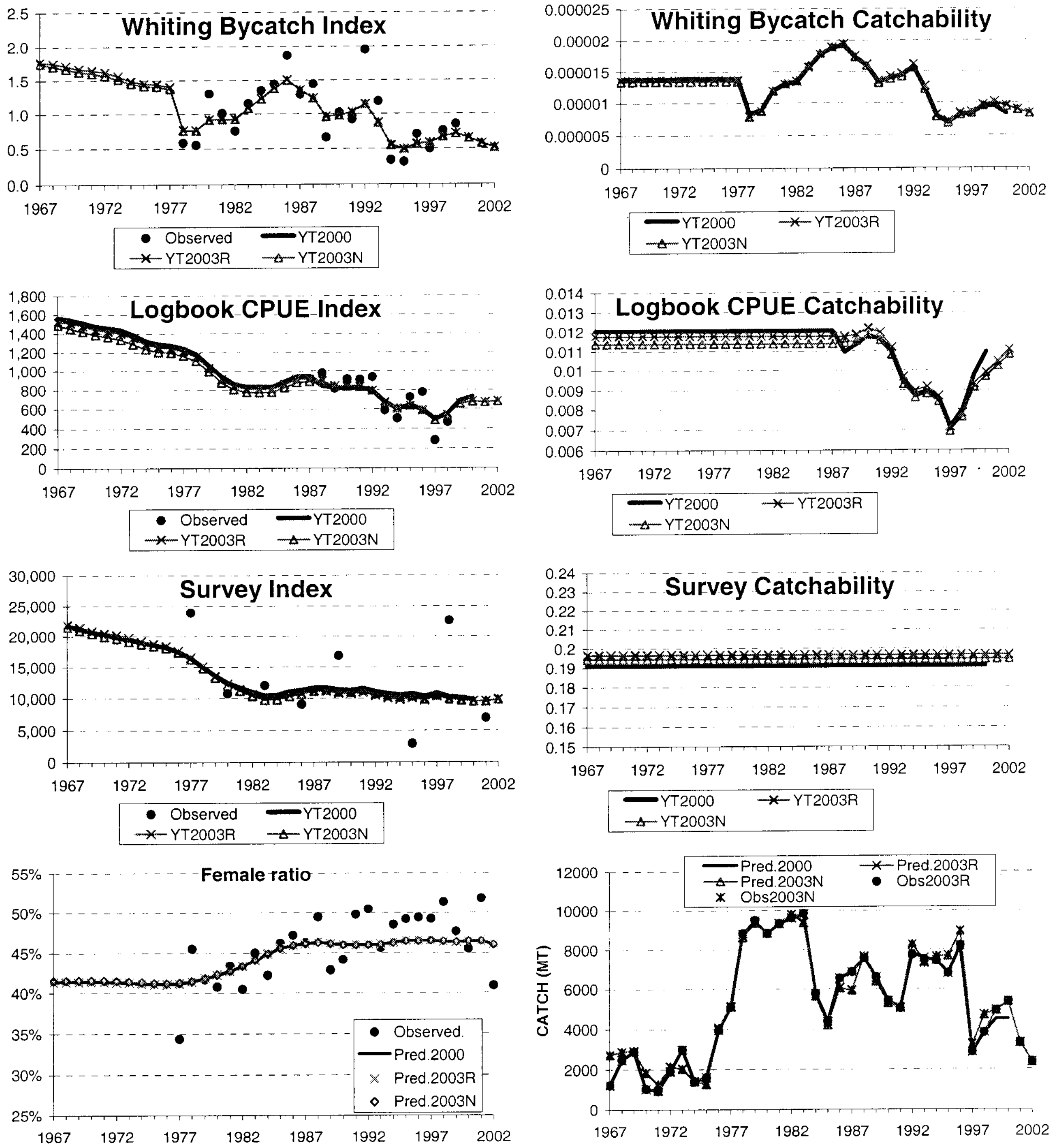


Figure 7. The model fits of three abundance indices, female ratio, and catch series. Also shown is the catchability for the three indices.

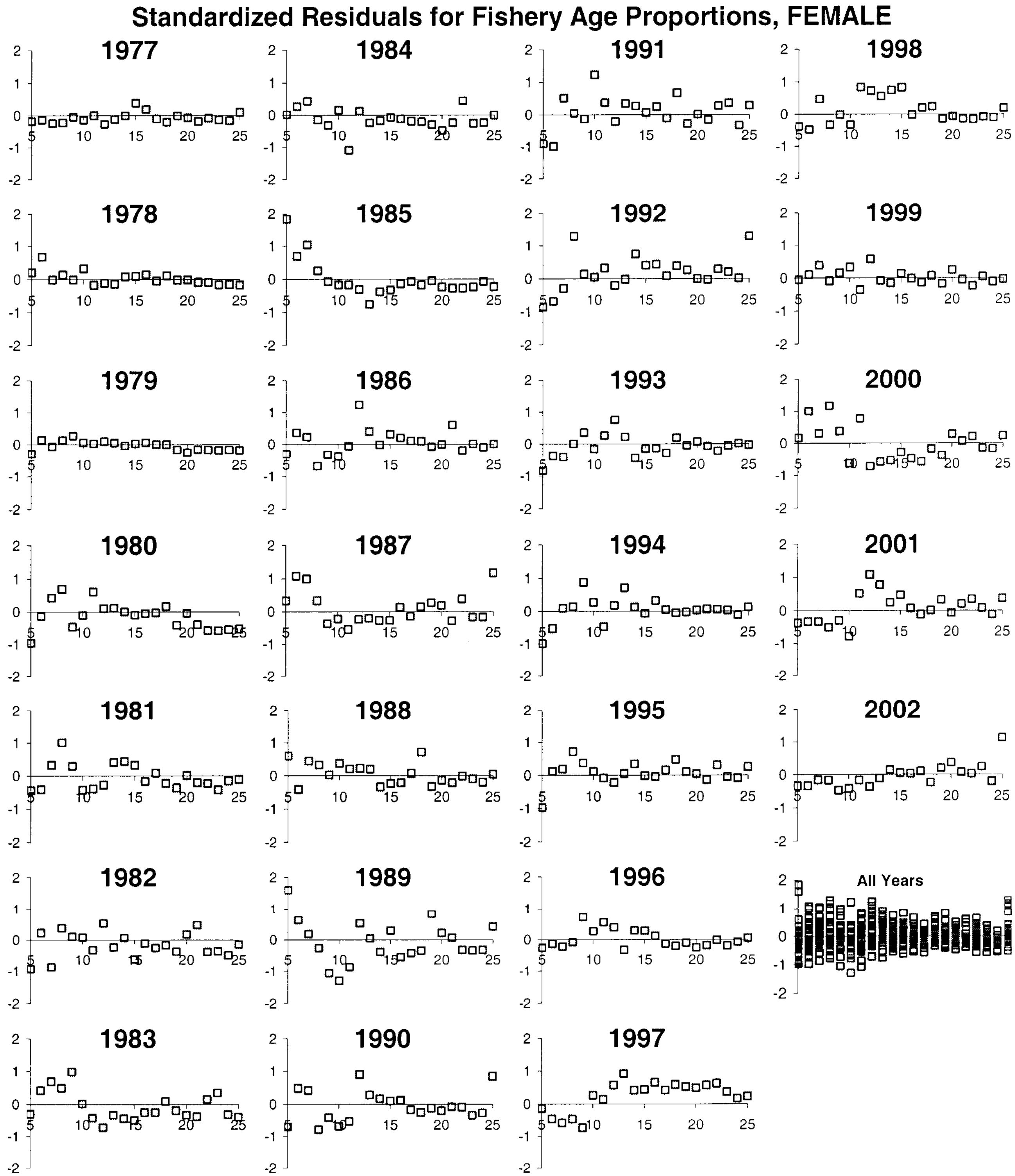


Figure 8. Residual plots for proportions of female catch at age. Only the residuals from YT2003N were shown in the figure. The residuals from YT2003R and YT2000 were too close to distiguish from YT2003N.

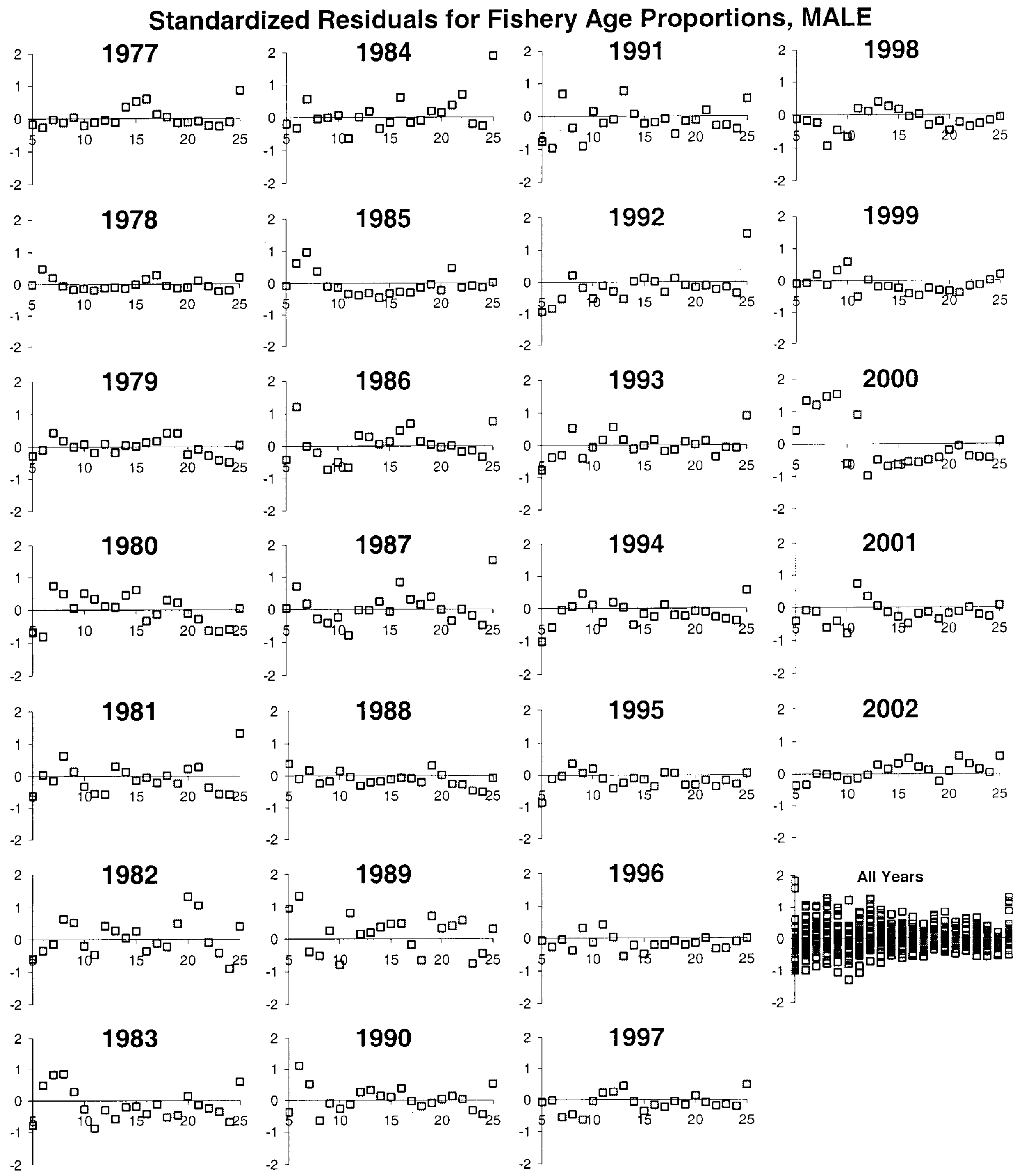


Figure 9. Residual plots for proportions of male catch at age. Only the residuals from YT2003N were shown in the figure. The residuals from YT2003R and YT2000 were too close to distiguish from YT2003N.

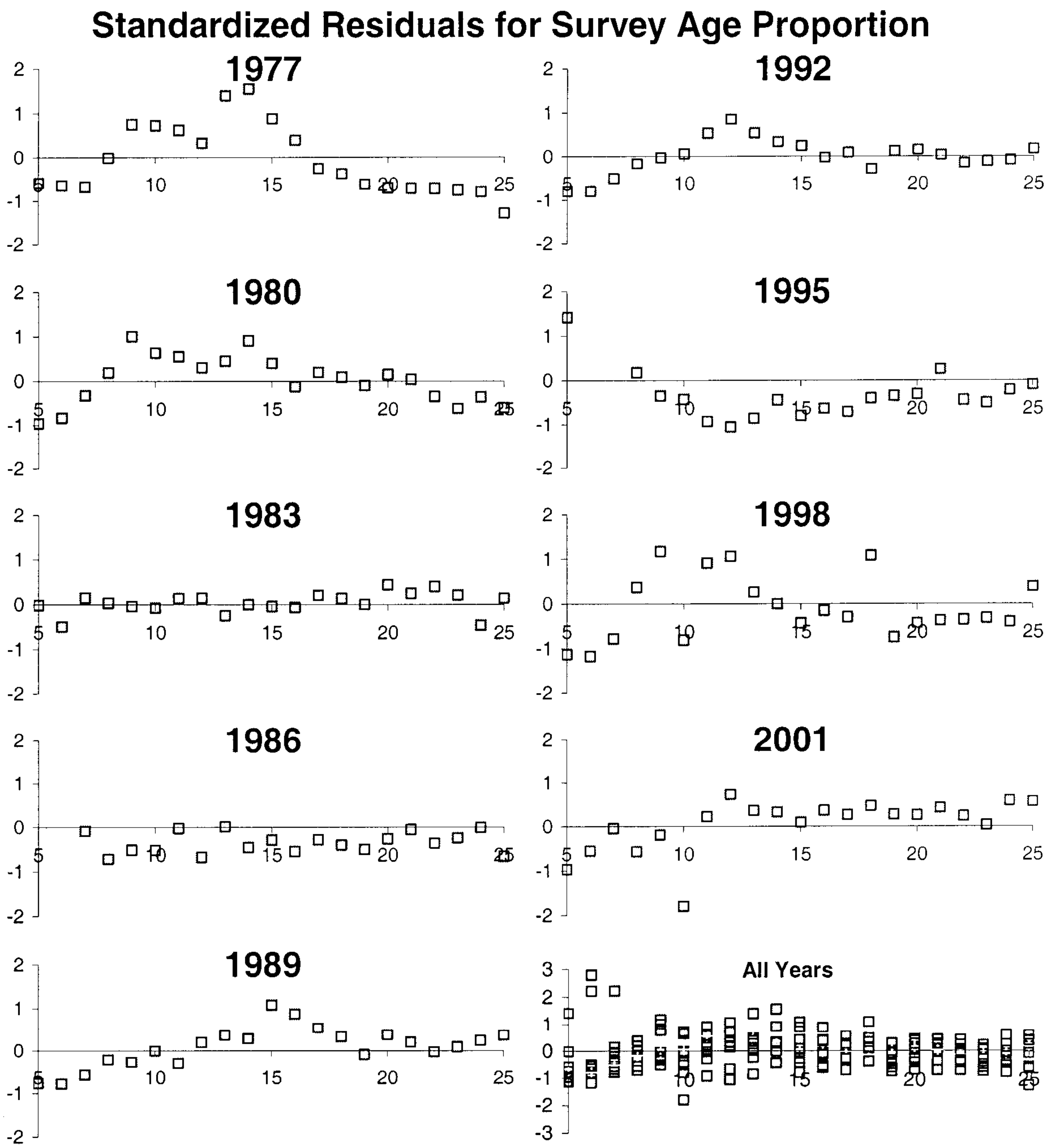


Figure 10. Residual plots for proportions of survey catch at age.

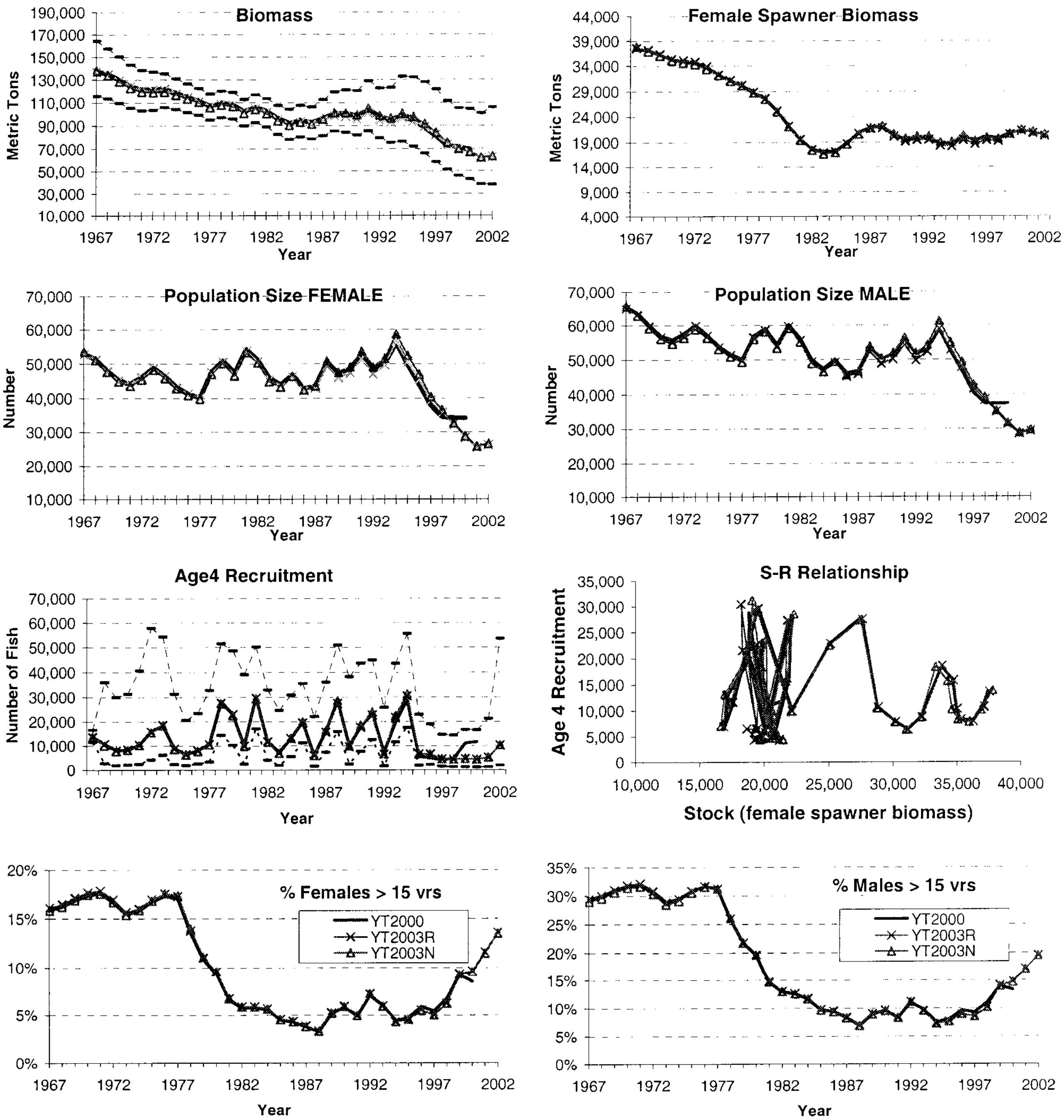


Figure 11. Estimated coastwide biomass, population sizes, recruitment, stock-recruit relationship, and fraction of female and male older than 15 yrs using catch series YT2000, YT2003R, and YT2003N (See text for the definitions of these three catch series). The 95% confidence intervals for biomass and age-4 recruitment, estimated by using YT2003N, are also provided.

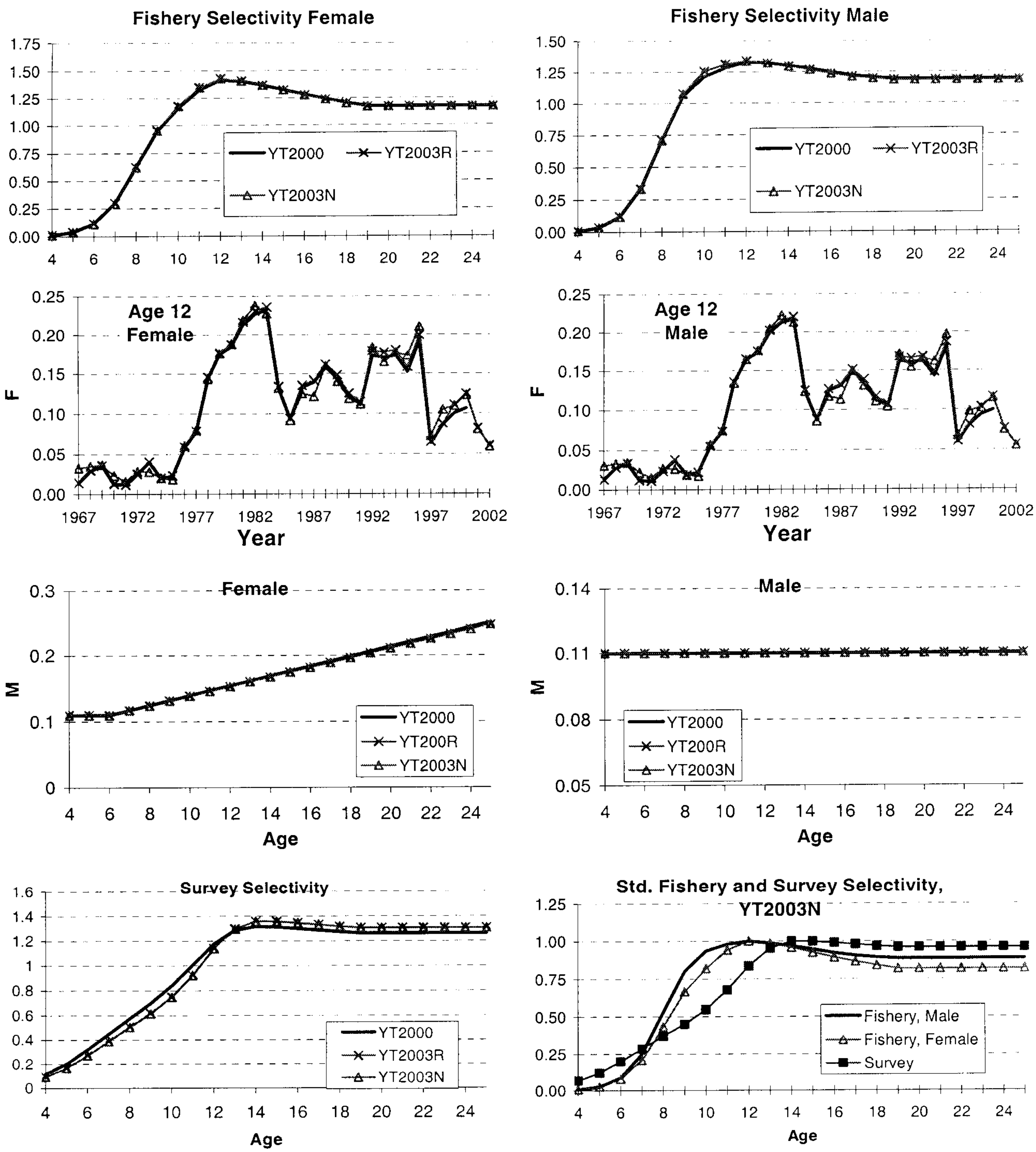


Figure 12. Estimated fishery selectivity, fishing mortality, natural mortality, survey selectivity, and the comparison of standardized (std.) fishery and survey selectivities for coastwide yellowtail rockfish using the three catch sereies YT2000, YT2003R, and YT2003N.

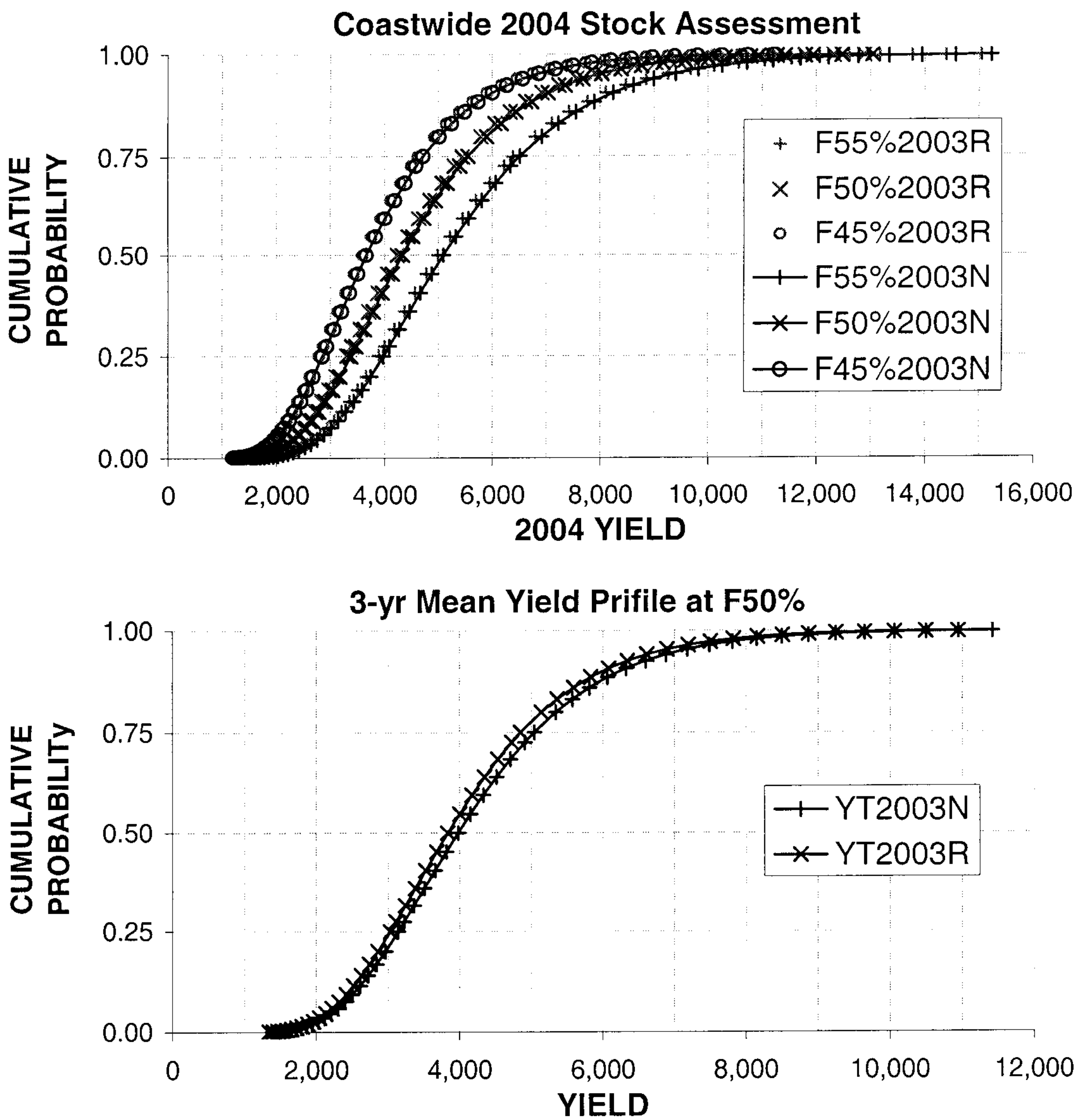


Figure 13. Cumulative probability distribution for the estimated coastwide yield in 2004 at three selected levels of fishing mortality rate and for the estimated 3-yr average yield at $F_{50\%}$. [Yield estimates based on the three catch seriesYT2003R and YT2003N. Point estimates for yield from the model are at 50-percentile.]

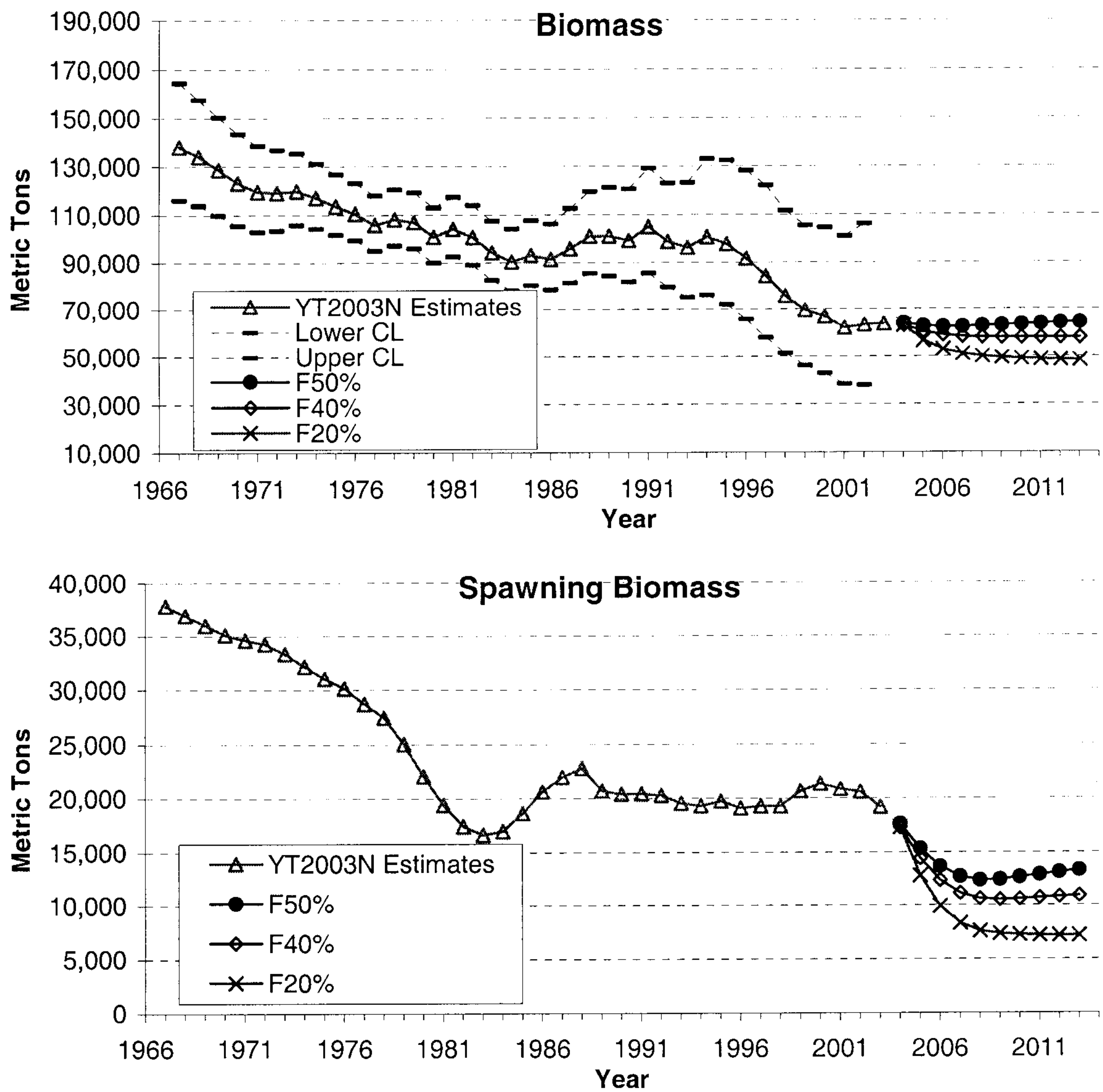


Figure 14. The estimated total biomass and spawning biomass using YT2003N. The 2003 values are estimated by assuming that 2003 landing and catch-at age is equal to 2002. Their projections from 2004-2013 are based on the arithmatic mean Age4 recruitment in 1967-2002.

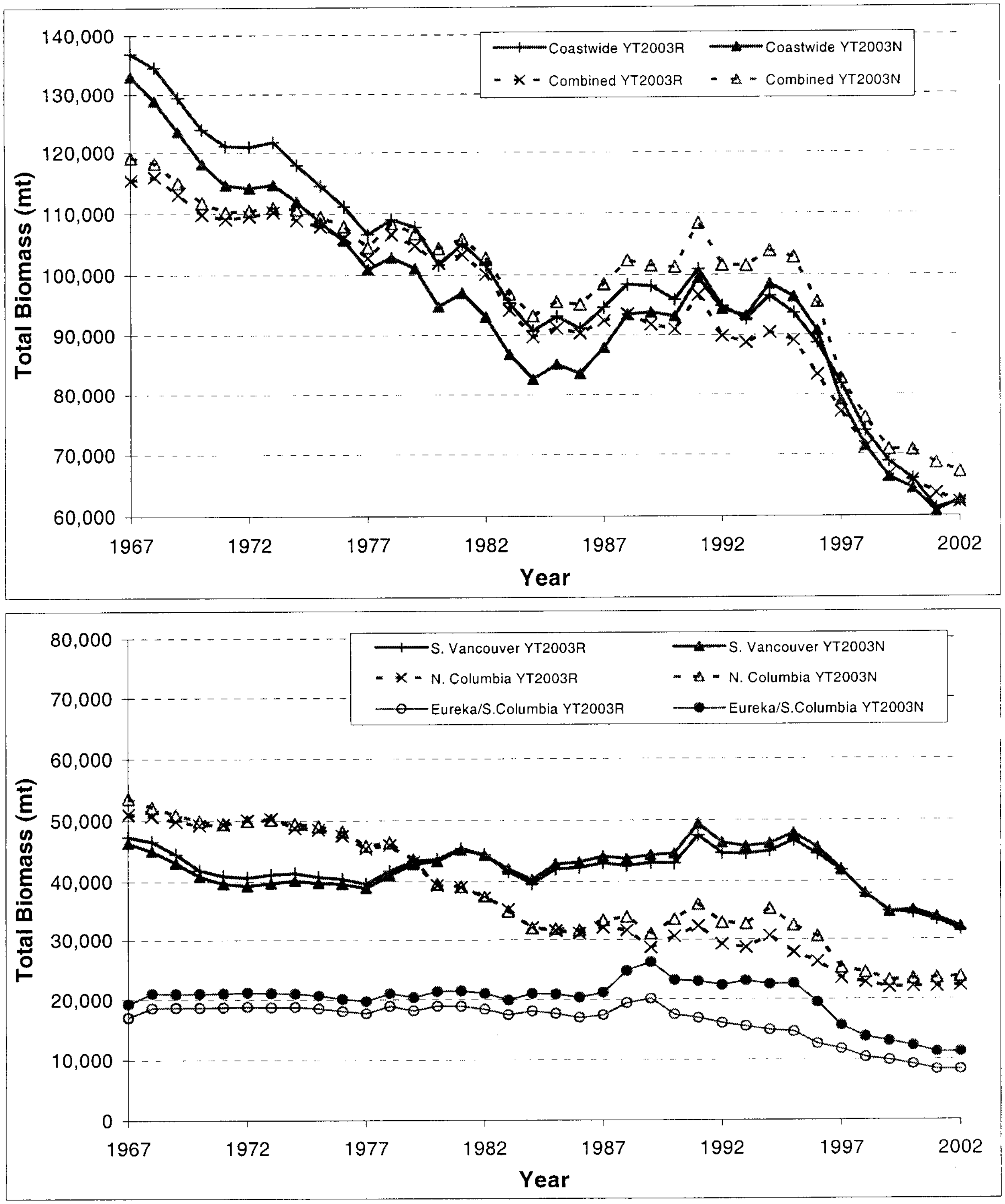


Figure 15. Comparisons of trends in estimates of coastwide and three stocks combined biomass (uper panel) and of the three individual stock areas (lower panel) with YT2003R and YT2003N catch series.

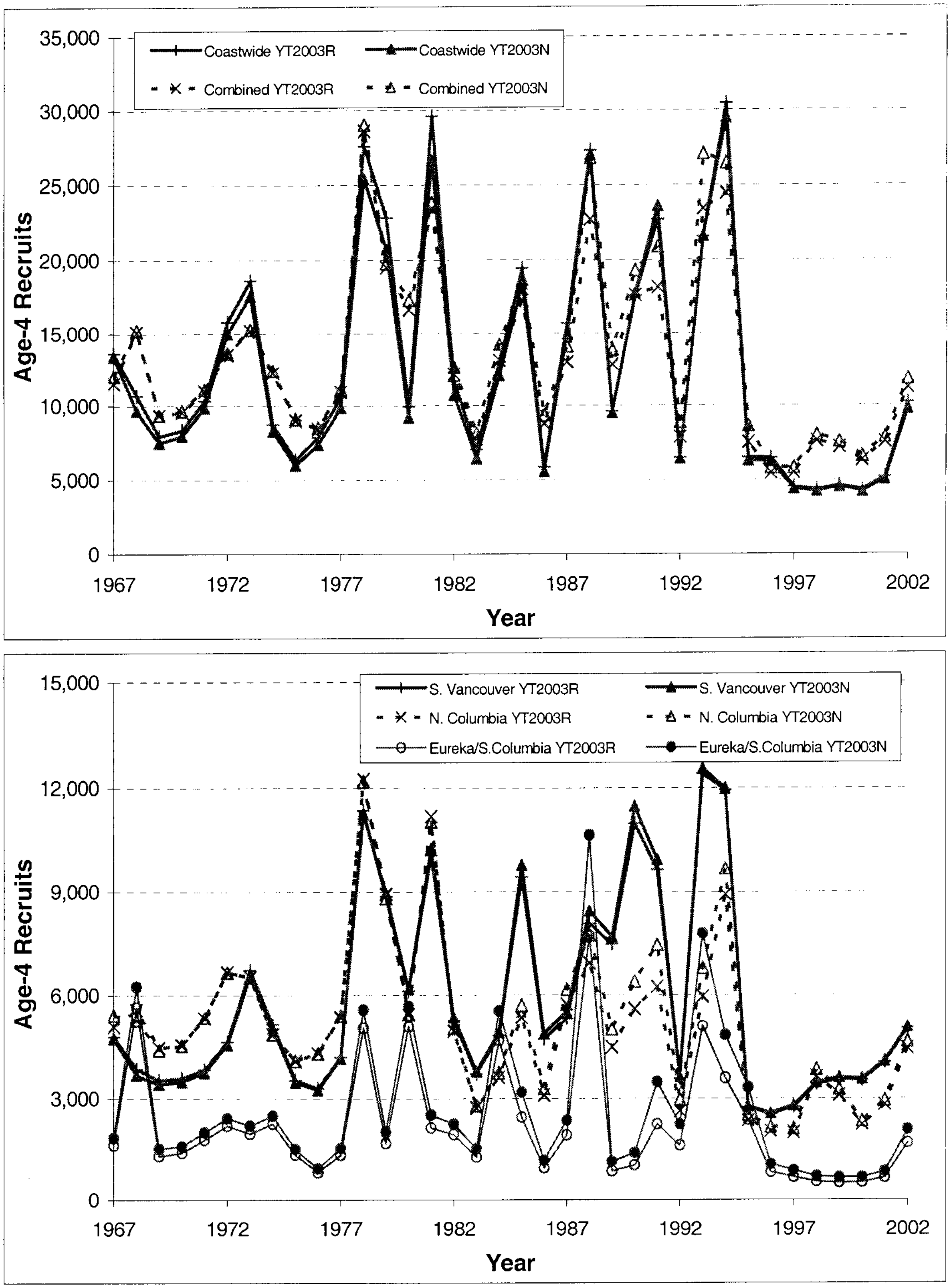


Figure 16. Comparisons of trends in estimates of coastwide and three stocks combined recruitment (uper panel) and of the three individual stock areas (lower panel) with YT2003R and YT2003N catch series.

Appendix A. Description of Model.

I. INPUT DATA

Items	Symbols/Values in Model	Variable Name in Program	Descriptions
Total Commercial Landings	$T_0 = 1967$	styr	Beginning year of catch data
	$T = 2003$	endyr	End year of catch data, assume equal catches in 2002 and 2003
	$A = 22$ (ages 4-25+)	nages	Number of age classes
	Y_i, for $i \in t^{com}=\{1967,\ldots,2002\}$	obs_catch_bio(styr,endyr)	Total commercial landings mt
NMFS Shelf Survey Indices	$\eta^{srv}=9$ survey years	nobs_srv	Number of survey years
	$T^{srv}=\{1977, 1980, 1983, 1986, 1989, 1992, 1995, 1998, 2001\}$	yrs_srv(1, nobs_srv)	Calendar years of survey
	I_i^{srv}	obs_srv(1, nobs_srv)	Survey indices
NMFS Shelf Survey Age Comp	a_i^{srv}	nsamples_srv(1, nobs_srv)	Hypothetic number of shelf survey age samples by year
	n_{ij}	obs_ac_srv(1, nobs_srv, 1,nages)	Number at age of the survey
Whiting Bycatch Indices	$\eta^{whi}=22$ years	nobs_whi	Number of years for whiting bycatch indices
	$t^{whi}=\{1978,\ldots,1999\}$	yrs_whi(1, nobs_whi)	Calendar year of whiting bycatch indices
	I_i^{whi}	obs_ac_whi(1, nobs_whi)	Whiting bycatch indices by year

Trawl Fishery CPUE	η^{log}=12 years	nobs_log	Number of years for trawl CPUE
	T^{log}={1988-1999}	yrs_log(1,nobs_log)	Calendar year of trawl CPUE
	I_i^{log}	obs_log(1,nobs_log)	Observed trawl CPUE
		obs_log_se(1,nobs_log)	Standard errors of trawl cpue
Fishery Catch at Age	T_o^{fish}=1977 (1979 for Eureka/ S.Columbia)	styr_fish	Beginning year of fishery catch at age data
	T^{fish}=2002 (2001 for Eureka/ S.Columbia)	endyr_fish	End year of fishery catch at age data
	a_i^{cat}, i ∈ t^{fish}={1977,…,2002}	nsamples_fish(1, nobs_srv)	Hypothetic number of fishery age samples by year
	C_{kij}	obs_ac_fish(1,2,styr_fish, endyr_fish,1,nages)	Sex-specific (1:F, 2:M) catch at age data by year. All fisheries
Ageing Error Matrix	$E_{jj'}$	age_err(1,nages,1,nages)	Ageing error matrix: General matrix $E_{jj'}$ if use_age_err=1; $E_{jj'}=\boldsymbol{I}$ otherwise
Weight at age	W_{kij}	wt(1,2,styr,endyr,1,nages)	Sex- and year-specific weight at age (kg.)
Female Maturity at age	φ_j	maturity(styr_fish,endyr_fish)	Female maturity at age.

II. INPUT CONTROL VARIABLES FOR MODEL

Items	Symbols/Values in Model	Variable Name in Program	Descriptions
Catchability for Indices	-5	ph_q_dev_srv	Constant survey q
	5	ph_q_dev_whi	whiting bycatch q changes are estimated
	5	ph_q_dev_log	trawl CPUE q changes are estimated
Selectivity for Fishery and Survey	4	ph_sel_coffs	Fishery selectivity changes over ages but smoothed
	-2	ph_sel_log	Fishery selectivity is not a logistic curve
	2	ph_sel_srv	survey selectivity is estimated at 2^{nd} stage of model fitting
Absolute Survey Catchability	4	ph_q	Absolute survey q means q can be > 1.
Natural Mortality for Old Ages	6	ph_M_old	M for old ages is estimated
Variance for Trawl Indices	4	ph_sigmau	Variance for trawl CPUE is estimated
Ageing Errors	1	use_age_err	use real ageing error (not **I**)
Age for Dome-shape selectivity	$a^{dec} = 5$	age_decrease	Age beyond which to panelized dome-shape selectivity
Age for Asymptotic selectivty	$a^{max} = 16$	sel_max_age	Age beyond which selectivity is constant

Adjusted Ratio of Historical F	F^{hist}=0.1	Hist_F	Ratio between pre-T_o F and F at T_o
Weighting Factors	λg; $1 \leq g \leq 20$	lambda(1,20)	See belows and likelihoods. Note: λg; $17 \leq g \leq 20$ were not used
Lambda 1 rec regularity (how much rec tends to mean (log) value)	0.5	s.d. ≈ 1.00	under normality assumptions.
Lambda 2, Fishery non-decreasing selectivity (Higher->more asymptotic)	100	s.d. ≈ 0.07	s.d. ≈ sqrt(1/2lambda)
Lambda 3 Penalty on fitting observed catch biomass	200	s.d. ≈ 0.05	
Lambda 4 Between sex difference in selectivity	0.001	s.d. ≈ 22.36	
Lambda 5 Selectivity curvature females	12.5	s.d. ≈ 0.20	
Lambda 6 Selectivity curvature males	12.5	s.d. ≈ 0.20	
Lambda 7 Survey Selectivity curvature survey combined sexes	12	s.d. ≈ 0.20	
Lambda 8 Survey non-decreasing selectivity (Higher->more asymptotic)	100	s.d. ≈ 0.07	
Lambda 9 Survey index	1.653	s.d. ≈ 0.55	
Lambda 10 Whiting Index	12.5	s.d. ≈ 0.20	
Lambda 11 Logbook CPUE (defunct, estimated internally)	1	s.d. ≈ 0.71	
Lambda 12 Penalty on Fmort deviations	0.1	s.d. ≈ 2.24	
Lambda 13 Prior variance on change in survey catchability	100	s.d. ≈ 0.16	**never used, because ph_q_dev_srv = -5.**

Lambda 14 Prior variance on change in Whiting Bycatch catchability	19.531	s.d. ≈ 0.40	
Lambda 15 Prior variance on change in Logbook CPUE catchability	19.531	s.d. ≈ 0.40	
Lambda 16 weight on Survey Age Comp (small if no survey)	1	s.d. ≈ 0.71	
Lambda 17, not used	1	s.d. ≈ 0.71	
Lambda 18, not used	1	s.d. ≈ 0.71	
Lambda 19, not used	1	s.d. ≈ 0.71	
Lambda 20, not used	1	s.d. ≈ 0.71	

III. ASSIGNED OR CALCULATED VARIABLES

Items	Symbols/Values	Variable Name in Program	Descriptions
Year Starts to Change q	$t_2^{srv} = t_1^{srv} + 1 = 1978$	styr_q	Surveys, if (ph_q_dev_srv)
	$t_2^{whi} = t_1^{whi} + 1 = 1979$	styr_q_whi	Whiting bycatch, if (ph_q_dev_whi)
	$t_2^{\log} = t_1^{\log} + 1 = 1988$	styr_q_log	Trawl CPUE, if(ph_q_dev_log)
Projection beyond endyr	$\eta^{fut} = 12$	nyrs_future	project 12 yrs beyond endyr
	$T^{fut} = T + \eta^{fut} = 2015$	endyr_fut	The last year of projection

	$t_1^{fut} = T + 1 = 2004$	styr_future	The first year of projection, assume equal catch in 2003 and 2003
	3	nFs	3 F-levels in projection (F55%, F50%, F45%)
Variance for Trawl Indices	$\sigma^2=0.27$	sigmau	0.27 is default. estimated σ^2 because ph_sigmau > 0,
Time of survey in the year	=8.5/12	yr_fraction	Fraction of date in a year when NMFS Shelf survey occurs
Annual Sex Ratios (female) of Landings	$r_i = \sum_j C_{1ij} \Big/ \sum_{k,j} C_{kij}$, for i ∈ t^{fish}	obs_sexr(styr_fish,endyr_fish)	sex: k = 1, 2 yr: i = styr_fish, ... , endyr_fish age: j = 1, nages
Proportion of Survey Age Composition	$\pi_{ij} = n_{ij} \Big/ \sum_j n_{ij}$, for i ∈ t^{srv}	obs_p_srv(1,nobs_srv,1,nages)	
Sex-specific Proportion of Catch at Age in entire (both sex) catch	$p_{kij} = C_{kij} \Big/ \sum_{k,j} C_{kij}$, for i ∈ t^{fish}	obs_p(1,2, styr_fish,endyr_fish, 1,nages)	

IV. SELECTIVITY

Items	Symbols/Values	Variable Name in Program	Descriptions
Dome-shaped Fishery Selectivity if(ph_sel_coffs)	s_{kj}	sel(1,2,1,nages)	Sex and age specific. It has mean value of 1 (NOT max.=1) because $\overline{F}_i$ is read as the year-specific average F across ages, which is NOT fully recruited F. There are 2 constraints imposed inside of LIKELIHOODs to penalize curvature and smoothness over consecutive ages.
	$\widetilde{s}_{kj}$, j=1,...,sel_max_age	sel_coffs(1,sel_max_age, ph_sel_coffs)	
	$\ln(s_{kj}) = \widetilde{s}_{kj}, \text{if } j < \text{sel\_max\_age}$ $\ln(s_{kj}) = \widetilde{s}_{k\text{sel\_max\_age}}, \text{if } j \geq \text{sel\_max\_age}$ $\ln(s_{kj}) = \ln(s_{kj}) - \ln\left(\sum_j s_{kj} \Big/ nages\right)$	log_sel(k,j)	
Logistic Fishery Selectivity if ph_sel_coffs $\leq$ 0 and ph_sel_coffs_log > 0	$s_{kj} = 1/\left(1+\exp\left(-\alpha_k(j-\beta_k)\right)\right)$	sel(1,2,1,nages)	sex-specific logistic curve α_k: slope of ascending lobe β_k: age at 50% selectivity
Dome-shaped Survey selectivity when model fistting is at the stage of ph_sel_srv	v_j	sel_srv(1,nages)	Similar to Dome-shaped Fishery Selectivity if ph_sel_coffs > 0
	$\widetilde{v}_j$, j=1,...,sel_max_age	sel_coffs_srv(1,sel_max_age, ph_sel_srv)	

	$\ln(v_j) = \tilde{v}_j$, if $j <$ sel_max_age $\ln(v_j) = \tilde{v}_{\text{sel\_max\_age}}$, if $j \geq$ sel_max_age $\ln(v_j) = \ln(v_j) - \ln\left(\sum_j v_j \middle/ nages\right)$	log_sel_srv(j)	

V. MORTALITY

Items	Symbols/Values	Variable Name in Program	Descriptions
Natural Mortality	$M_k = 0.11$ (default)	M(k)	If NOT(ph_M_old), constant M
	$\tilde{M}$	M_old(ph_M_old)	M for age 25+ female
	Male: $m_{2j} = M_2$=0.11 for all ages **Female:** if NOT(ph_M_old), $m_{1j} = M_1$ if ACTIVE(ph_M_old), $m_{1j} = M_1$, for j=ages 4, 5, 6 $m_{1j} = m_{1j-1} + (\tilde{M} - M_1)/19$, for j $\geq$ age 7	nat_mort(1,2,1,nages)	Male: age-invariant Female: If NOT(ph_M_old), constant for all ages Otherwise, constant for ages 4,5,6 and then increased by the amount of $(\tilde{M} - M_1)/19$ per age
Fully selective Fishing Mortality	$F_i = \exp(\overline{F} + dF_i)$	fmort(styr,endyr)	$\overline{F}, dF_i$ to be estimated. $\overline{F_i}$ is year-specific average F across ages (This is NOT fully [illegible]

		avg_F fmort_dev(styr,endyr)	recruited F)
Age-specific F, Z, S	$F_{kij} = s_{kj} F_i$	F(1,2, styr,endyr,1,nages)	Fishing mortality
	$Z_{kij} = F_{kij} + m_{kj}$	Z(1,2, styr,endyr,1,nages)	Total mortality
	$S_{kij} = \exp(-Z_{kij})$	S(1,2, styr,endyr,1,nages)	Survival rate

VI. CATCHABILITY

Items	Symbols/Values	Variable Name in Program	Descriptions
Mean q's for three types of indices	q^{srv}	log_q_srv	Mean survey q, To be estimated
	q^{whi}	log_q_whi	Mean whiting bycatch q, To be estimated
	$q^{\log}$	log_q_log	Mean trawl CPUE q, To be estimated
Constant q	$q_i^{srv} = \exp(q^{srv})$	catchab_srv(yrs_srv(1))	survey q in year i
	$q_i^{whi} = \exp(q^{whi})$	catchab_whi(yrs_whi(1))	Whiting bycatch q in year i
	$q_i^{\log} = \exp(q^{\log})$	catchab_log(yrs_log(1))	Trawl cpue q in year i
Year-specific q	$q_i^{srv} = q_{i-1}^{srv} * \exp(\Delta q_i^{srv})$	catchab_srv(yrs_srv(i)) q_dev_srv(i)	Δq_i^{srv} to be estimated

	$q_i^{whi} = q_{i-1}^{whi} * \exp(\Delta q_i^{whi})$	catchab_whi(yrs_whi(i)) q_dev_whi(i)	Δq_i^{whi} to be estimated
	$q_i^{\log} = q_{i-1}^{\log} * \exp(\Delta q_i^{\log})$	catchab_log(yrs_log(i)) q_dev_log(i)	$\Delta q_i^{\log}$ to be estimated

VII. RECRUITMENT

Items	Symbols/Values	Variable Name in Program	Descriptions
Mean log-scaled Recruits	$\overline{R}$	Mean_log_rec	To be estimated
Annual deviation on log-scaled Recruit, styr ≤ t ≤ endyr	ΔR_i	rec_dev(i)	To be estimated
Recruits	$N_{1,i,1} = \exp(\overline{R} + \Delta R_i)$	natage(1,i,1)	Females
	$N_{2,i,1} = N_{2,i,1}$	natage(2,i,1)	Males, assume sex ratio 1:1

VIII. POPULATION DYNAMICS

Items	Symbols/Values	Variable Name in Program	Descriptions
Initial year (styr)	$N_{k,T_0,j} = N_{k,T_0,j-1} \exp(-F_{k,T_0,j-1} F^{hist} - m_{k,j-1})$	natage(k,styr,j), j<A	Number at age Assume steady state at T_0

	$N_{k,T_0,A} = \frac{N_{k,T_0,A-1}\exp(-F_{k,T_0,j-1}F^{hist} - m_{k,A})}{1-\exp(-F_{k,T_0,j-1}F^{hist} - m_{k,A})}$	natage(k,styr,A)	Last age is plus
The following years	$N_{ktj} = N_{k,t-1,j-1}S_{k,t-1,j-1}$	natage(k,t,j), 2≤j<A	Number at age
	$N_{kiA} = N_{k,i-1,A-1}S_{k,i-1,A-1} + N_{k,i-1,A}S_{k,i-1,A}$	natage(k,i,A)	Last age is plus
Exploitable stock	$n_{k,i,j} = N_{kij}s_{kj}$	popn(k,i,j)	s_{kj} fishery selectivity
Predicted catch_at_age	$\hat{C}_{k,i,j} = \frac{N_{kij}F_{kij}(1-S_{kij})}{Z_{kij}}$	catage(k,i,j)	Baranov catch equation
Predicted annual catch in weight	$\hat{Y}_i = \sum_{k,j}\hat{C}_{kij}W_{kij}$	Pred_catch_bio(i)	
Predicted Sex-specific Proportion of Catch at Age in entire (both sex) catch	$\hat{p}_{kij} = \frac{s_{kj}N_{kij}}{n_{1ij}+n_{2ij}}E_{jj}$	pred_p(k,i,j)	
Available stock at survey time	$n_{kij}^{srv} = v_j S_{kij}^{8.5/12}N_{kij}$	eac_srv(k,i,j)	
Predicted NMFS shelf survey indices	$\hat{I}_{kij}^{srv} = q_i^{srv}\hat{n}_{kij}^{srv}W_{kij}$	pred_srv(k,i,j)	
Predicted whiting bycatch indices	$\hat{I}_{kij}^{whi} = q_i^{whi}W_{kij}s_{kj}N_{kij}$	pred_whi(k,i,j)	
Predicted NMFS shelf survey indices	$\hat{I}_{kij}^{\log} = q_i^{\log}W_{kij}s_{kj}N_{kij}$	pred_log(k,i,j)	

Predicted proportion of survey age comp	$\hat{\pi}_{ij} = \frac{n_{1ij}^{srv} + n_{2ij}^{srv}}{\sum_j (n_{1ij}^{srv} + n_{2ij}^{srv})} E_{jj}$	Pred_p_srv(i,j)	
Total biomass	$B_i = \sum_{k,j} N_{kij} W_{kij}$	totbio(i)	
Total recruitment	$R_i = \sum_k N_{ki1}$	rec(i)	
depletion	$=B_T/B_{To}$	depletion	
Stock01	$= \sum_{k,j} \left(N_{kTj} W_{kTj} S_{kTj} \right)$	stock01	

IX. PROJECTIONS for F55, F50, and F45 if ACTIVE(last_phase)

Items	Symbols/Values	Variable Name in Program	Descriptions
Levels of harvesting	f_l = F0, F55, F50, F45	ftmp, l=1: F0, l=2: F55, l=3: F50, l=4: F45	F55, F50 and F45 are to be estimated. The levels of F that will reduce equilibrium SSB/R to 55%, 50% and 45% of equilibrium $SSB_{F=0}$.
Future Mortality and Survival rate	$F_{kij}^{fut} = s_{kj} f_l$ $Z_{kij}^{fut} = F_{kij}^{fut} + m_{kj}$ $S_{kij}^{fut} = \exp(-Z_{kij}^{fut})$	F_future(k,i,j) Z_future(k,i,j) S_future(k,i,j)	endyr+1 $\leq$ i $\leq$ endyr+nyrs_future
Future Recruitment	$N_{ki1}^{fut} = \exp(\overline{R} + dR_i)$	mean_log_rec rec_dev_future(i)	geometric mean and random walk

Future N at age	$N_{kij}^{fut} = N_{k,i-1,j-1}^{fut} S_{k,i-1,j-1}^{fut}$	nage_future(k,it,j), 2≤j<A	Number at age
	$N_{kiA}^{fut} = N_{k,i-1,A-1}^{fut} S_{k,i-1,A-1}^{fut} + N_{k,i-1A}^{fut} S_{k,i-1,A}^{fut}$	nage_future(k,i,A)	Last age is plus
Future catch_at_age	$\hat{C}_{kij}^{fut} = \frac{N_{kij}^{fut} F_{kij}^{fut} (1 - S_{kij}^{fut})}{Z_{kij}^{fut}}$	catage_future(k,i,j)	
Future annual catch in weight	$\hat{Y}_{ki}^{fut} = \sum_j \hat{C}_{kij}^{fut} W_{kTj}$	catch_future(k,i)	
Future annual total biomass	$B_{ki}^{fut} = \sum_j N_{ktj}^{fut} W_{kTj}$	future_biomass(k,i)	
Future number of spawners per R	N_{l1}^{spr} =1 for j=1 $N_{lj}^{spr} = N_{l,j-1}^{spr} \exp\left(-m_{1,j-1} - s_{1,j-1} f_l\right)$ for 2≤j≤A-1 $N_{lA}^{spr} = \frac{N_{l,A-1}^{spr} \exp\left(-m_{1,A-1} - s_{1,A-1} f_l\right)}{1 - \exp\left(-m_{1,A-1} - s_{1,A-1} f_l\right)}$ for j=A	Nspr(l,j)	
Future spawner biomass per R	$SB_l = N_{lj}^{spr} \varphi_j W_{1Tj} \exp\left(-0.25(m_{1j} + s_{1j} f_l)\right)$	SB0, SBF55, SBF50, SBF45	

X. LIKELIHOODS

Items	Symbols/Values	Variable Name in Program	Descriptions
Small number	$\varepsilon = 0.001$		To prevent log(~0)
Catch biomass	$LC = \lambda_3 \sum_i (\log(Y_i) - \log(\hat{Y}_i))^2$	catch_like	Fishery landings
Indices	$L_1 = \lambda_9 \sum_{k,i,j} (\log(I_{kij}^{srv} + \varepsilon) - \log(\hat{I}_{kij}^{srv} + \varepsilon))^2$	index_like(1)	Survey
	$L_2 = \lambda_{11} \sum_{k,i,j} (\log(I_{kij}^{whi} + \varepsilon) - \log(\hat{I}_{kij}^{whi} + \varepsilon))^2$	index_like(2)	Whiting bycatch
	$L_3 = \lambda_{12} \left(\frac{\sum_{k,i,j} (\log(I_{kij}^{\log} + \varepsilon) - \log(\hat{I}_{kij}^{\log} + \varepsilon))^2}{2\sigma^2} + \eta^{\log} \log(\sigma) \right)$	index_like(3)	Trawl cpue $\eta^{\log}$ = size_count(obs_log)
Ageing	$\hat{p}_{ki2} = \hat{p}_{ki1} + \hat{p}_{ki2}$ $LA_1 = \sum_{k,i,j} \left(a_i^{cat} (p_{kij} + \varepsilon) \log(\hat{p}_{kij}^{srv} + \varepsilon) \right) - offset(1)$	age_like(1)	Catch at age Start at the 2nd age class (age 5)
	$LA_2 = \lambda_{16} \left(\sum_{k,i,j} \left(a_i^{srv} (\pi_{kij} + \varepsilon) \log(\hat{\pi}_{kij} + \varepsilon) \right) - offset(2) \right)$	age_like(2)	Survey index at age

Recruitment	$LR = \lambda_1 \sum_i (\Delta R_i)^2 + \frac{\sum_i (dR_i)^2}{2\sum_i (\Delta R_i)^2 / \eta^{rec}}$	rec_like	ΔR_i: see RECRUITMENT dR_i: rec_dev_future η^{rec} = size_count(rec_dev)
Dome-shaped Fishery Selectivity if ACTIVE (ph_sel_coffs)	$x_{k,j} = \ln(s_{k,j+1}) - \ln(s_{k,j})$ $LSEL_1 = \lambda_5 \sum_{k,j} (x_{1,j+1} - x_{1,j})^2$ $LSEL_2 = \lambda_6 \sum_{k,j} (x_{2,j+1} - x_{2,j})^2$	sel_like(k), k=1,2 for sex	Fishery selectivity is fluctuating over ages but should be as smooth as possible. This likelihood is curvature-penalty to prevent sudden change of selectivity over the adjacent ages.
	$LSEL_4 = \lambda_2 \sum_{k,j=a^{dec}} (\ln(s_{k,j-1}) - \ln(s_{k,j}))^2$	sel_like(4)	This is dome-shape penalty to ensure that fishery selectivity tends to decrease beyond a^{dec}.
	$LSEL_7 = \lambda_4 \sum_j (\ln(s_{2,j}) - \ln(s_{1,j}))^2$	sel_like(7)	To ensure that fishery selectivity are equal at the same age between male and female
Dome-shaped NMFS Shelf survey Selectivity	$x_j = \ln(v_{j+1}) - \ln(v_j)$ $LSEL_3 = \lambda_7 \sum_j (x_{j+1} - x_j)^2$	sel_like(3)	Survey selectivity is year-invariant. This is the 2nd-difference for curvature penalty
	$LSEL_5 = \lambda_8 \sum_{j=a^{dec}} (\ln(v_{j-1}) - \ln(v_j))^2$	sel_like(5)	This is dome-shape penalty to ensure that survey selectivity tends to decrease beyond a^{dec}

Scale fishery and survey selectivity to have mean 0	$\bar{s}_k = average(\ln(s_{k,j}))$ $\bar{v} = average(\ln(\bar{v}_j))$ $LSEL_6 = \sum_k (\bar{s}_k - 0)^2 + (\bar{v} - 0)^2$	sel_like(6)	
Low F penalty if current_pase < 5	$fpen = 10\left(\exp(\overline{F}) - 0.1\right)^2$	fpen	Set $\exp(\overline{F}) \geq 0.1$
Catchability	$LQ = \lambda_{13} \sum_t \left(\Delta q_t^{srv}\right)^2 + \lambda_{14} \sum_t \left(\Delta q_t^{whi}\right)^2 + \lambda_{15} \sum_t \left(\Delta q_t^{\log}\right)^2$	q_like	Normalize $\Delta q_t^{srv}, \Delta q_t^{whi}, \Delta q_t^{\log}$ to have mean 0
Spawner Biomass per R	$sprpen = 100 \left(\left(\frac{SB_2}{SB_1} - 0.55\right)^2 + \left(\frac{SB_3}{SB_1} - 0.50\right)^2 + \left(\frac{SB_4}{SB_1} - 0.45\right)^2 \right)$	sprpen	
Objective Function	Sum all of the above		

Appendix B. List of program, in AD Model Builder code, for yellowtail rockfish stock assessment modeling.

```
/////////////////////////////////////////////////////////////////////////////
// COASTWIDE YT2003
/////////////////////////////////////////////////////////////////////////////
   ////////////////////////////////////////////////////////////////////////
  //  Template File for Yellowtail rockfish
 //   James Ianelli, July 1997 (jianelli@afsc.noaa.gov)
//////////////////////////////////////////////////////////////////////////
   // Data notes: 1977 survey age comps based on surface ages and therefore
  //            not used in estimating selectivity
//////////////////////////////////////////////////////////////////////
DATA_SECTION
  init_int styr                             // Begin year of data
  init_int endyr                            // End year of data
  init_int nages                            // Number of age classes
  init_vector obs_catch_bio(styr,endyr)     // Observed catch Biomass

  init_int nobs_srv                         // Number of observations in survey
  init_ivector yrs_srv(1,nobs_srv)          // Actual years of survey occurrence
  init_vector obs_srv(1,nobs_srv)           // Biomass index values from survey

  init_vector nsamples_srv(1,nobs_srv)      // Number of age-samples assumed by yr
  init_matrix obs_ac_srv(1,nobs_srv,1,nages)// Observed numbers at age from survey

  init_int nobs_whi                         // Number of observations in Whiting Bycatch index
  init_ivector yrs_whi(1,nobs_whi)          // Actual years of whiting bycatch index
  init_vector obs_whi(1,nobs_whi)           // Biomass index values from whiting bycatch

  init_int nobs_log                         // Number of observations in logbook CPUE index
  init_ivector yrs_log(1,nobs_log)          // Actual years of logbook CPUE index
  init_vector obs_log(1,nobs_log)           // Biomass index values from logbook CPUE
  init_vector obs_log_se(1,nobs_log)        // Biomass index std errors from logbook CPUE
  !! cout << obs_log<<endl<<obs_log_se<<endl;
  init_int styr_fish                        // Year fishery age comps begin
  init_int endyr_fish                       // Year fishery age comps end
  init_vector nsamples_fish(styr_fish,endyr_fish) // Number of samples for fishery age comps
  init_3darray obs_ac_fish(1,2,styr_fish,endyr_fish,1,nages) // obs. fishery age comps
  init_matrix age_err(1,nages,1,nages)      // Transition matrix of ageing errors
  init_3darray wt(1,2,styr,endyr,1,nages)   // Wt at sex, yr, and age
  init_vector maturity(1,nages)             // Maturity at age
```

```
 vector obs_sexr(styr_fish,endyr_fish)      // sex ratio in fishery (from obs. age comp)
 int i                                      // Index for year
 int j                                      // Index for age
 int k                                      // Index for sex
 int styr_q                                 // start q-dev vector for fshry
 int styr_q_whi                             // start q-dev vector for whiting bycatch
 int styr_q_log                             // start q-dev vector for logbook cpue
LOCAL_CALCS
  ad_comm::change_datafile_name("ref.ctl");
  styr_q=yrs_srv(1)+1;
  styr_q_whi=yrs_whi(1)+1;
  styr_q_log=yrs_log(1)+1;
END_CALCS

 init_int ph_q_dev_srv   //Phase when survey catchability changes are estimated
 init_int ph_q_dev_whi   //Phase when whiting index catchability changes are estimated
 init_int ph_q_dev_log   //Phase when logbook index catchability changes are estimated
 init_int ph_sel_coffs   //Phase when smoothed selectivity parameters are estimated
 init_int ph_sel_log     //Phase when logistic sel parameters are estimated
 init_int ph_sel_srv     //Phase when survey selectivity parameters are est.
 init_int ph_q           //Phase when absolute survey catchability is estimated
 init_int ph_M_old       //Phase when M old age is estimated
 init_number ph_sigmau   //Phase to estimate sigmau (Logbook CPUE variance)
 init_number use_age_err //Flag to use (=1; or not use =0) ageing error trans. matrix
 init_int age_decrease   //Age beyond which to penalized dome-shapedness
 init_int sel_max_age    //Age behond which selectivity is held constant
 init_number Hist_F      //Historical F relative to styr F
 init_vector lambda(1,20)//Vector of wts etc (see .ctl file)

 int endyr_fut;
 int styr_fut;
 int nFs;
LOCAL_CALCS
   int nyrs_future=12;
   endyr_fut=endyr+nyrs_future;
   styr_fut=endyr+1;
   nFs=3;
END_CALCS

INITIALIZATION_SECTION
```

```
 M .11
 mean_log_rec 6.0
 avg_F -1.6
 log_q_srv -1.609437912 // Q = 0.2 as a default....
 log_q_log -2.9
 log_q_whi -11.9
 sel_coffs_srv -.01
 //sigmau .20
 F55 .1
 F50 .13
 F45 .23


PARAMETER_SECTION
  init_number mean_log_rec(1)
  //init_number prist_log_rec(1)
  init_number avg_F(1)
  init_bounded_vector rec_dev(styr,endyr,-8,8,3)
  init_bounded_dev_vector fmort_dev(styr,endyr,-6.,6.,2)
  init_bounded_dev_vector q_dev_srv(styr_q,endyr,-6.,6.,ph_q_dev_srv)
  init_bounded_dev_vector q_dev_whi(styr_q_whi,endyr,-6.,6.,ph_q_dev_whi)
  init_bounded_dev_vector q_dev_log(styr_q_log,endyr,-6.,6.,ph_q_dev_log)

  init_bounded_vector M(1,2,.1,.45,-1)
  init_bounded_number M_old(.02,.5,ph_M_old)
  init_matrix sel_coffs(1,2,1,sel_max_age,ph_sel_coffs)
  init_bounded_vector fish_sel50(1,2,1.,10.,ph_sel_log)
  init_bounded_vector fish_slope(1,2,0.001,10.,ph_sel_log)
  init_vector sel_coffs_srv(1,sel_max_age,ph_sel_srv)
  init_number log_q_srv(ph_q)
  init_number log_q_whi(1)
  init_number log_q_log(2)
  //init_bounded_number sigmau(0.05,2.,ph_sigmau)
  number sigmau
  !!sigmau=.22;

  init_bounded_number F55(0.05,1.,ph_sigmau)
  init_bounded_number F50(0.05,1.,ph_sigmau)
  init_bounded_number F45(0.05,1.,ph_sigmau)

  number sigmar
```

```
number ftmp
number SB0
number SBF55
number SBF50
number SBF45
number sprpen
matrix Nspr(1,4,1,nages)

3darray nage_future(1,2,styr_fut,endyr_fut,1,nages)
init_vector rec_dev_future(styr_fut,endyr_fut,8);
3darray F_future(1,2,styr_fut,endyr_fut,1,nages);
3darray Z_future(1,2,styr_fut,endyr_fut,1,nages);
3darray S_future(1,2,styr_fut,endyr_fut,1,nages);
3darray catage_future(1,2,styr_fut,endyr_fut,1,nages);
number avg_rec_dev_future


vector fmort(styr,endyr)
matrix log_sel(1,2,1,nages)
vector log_sel_srv(1,nages)
vector catchab_srv(styr,endyr)
vector catchab_whi(styr,endyr)
vector catchab_log(styr,endyr)
matrix nat_mort(1,2,1,nages)
matrix sel(1,2,1,nages)
vector sel_srv(1,nages)
vector avg_sel(1,2)
number avg_sel_srv
vector pred_srv(styr,endyr)
vector pred_whi(styr,endyr)
vector pred_log(styr,endyr)
matrix popn(1,2,styr,endyr)
number deltaM
number yr_fraction
3darray natage(1,2,styr,endyr,1,nages)
3darray pred_p(1,2,styr,endyr,1,nages)
3darray eac_srv(1,2,styr,endyr,1,nages)
matrix pred_p_srv(styr,endyr,1,nages)

//3darray u(1,2,styr,endyr,1,nages)
3darray Z(1,2,styr,endyr,1,nages)
```

```
  3darray F(1,2,styr,endyr,1,nages)
  3darray S(1,2,styr,endyr,1,nages)
  3darray catage(1,2,styr,endyr,1,nages)
  3darray obs_p(1,2,styr_fish,endyr_fish,1,nages)
  matrix obs_p_srv(1,nobs_srv,1,nages)
  vector pred_catch_bio(styr,endyr)
  vector pred_sexr(styr,endyr)
  number rbar
  vector offset(1,2)
  number rec_like
  number q_like
  number M_like
  number sex_like
  number catch_like
  vector sel_like(1,10)
  vector age_like(1,2)
  number fpen
  vector index_like(1,3)
  sdreport_vector totbiom(styr,endyr)
  sdreport_vector rec(styr,endyr)
  sdreport_number depletion
  sdreport_matrix catch_future(1,3,styr_fut,endyr_fut);
  sdreport_matrix future_biomass(1,3,styr_fut,endyr_fut)

  likeprof_number stock01
  objective_function_value f

RUNTIME_SECTION
  maximum_function_evaluations 4000
  convergence_criteria 1e-3 1e-4 1e-7

PRELIMINARY_CALCS_SECTION
  yr_fraction=(8.5)/12;
  for (i=styr_fish; i <= endyr_fish; i++)
    obs_sexr(i)=sum(obs_ac_fish(1,i))/(sum(obs_ac_fish(1,i))+sum(obs_ac_fish(2,i)));

  //cout<<" ObsP "<< endl<<obs_ac_srv<<endl;
  // Normalize the survey age compositions
  for (i=1;i<=nobs_srv;i++)
    obs_p_srv(i)=obs_ac_srv(i)/(sum(obs_ac_srv(i)));
```

```
 for (k=1;k<=2;k++)
   for (i=styr_fish;i<=endyr_fish;i++)
     obs_p(k,i)=obs_ac_fish(k,i)/(sum(obs_ac_fish(1,i))+sum(obs_ac_fish(2,i)));
 for (k=1; k <= 2; k++)
 {
   for (i=styr_fish; i <= endyr_fish; i++)
   {
     // this is to mimic accumulation from synthesis
     obs_p(k,i,2)+=obs_p(k,i,1);
     for (j=2; j<=nages; j++)
       offset(1)-=nsamples_fish(i)*(1e-3+obs_p(k,i,j))* log((1e-3+obs_p(k,i,j)));
    }
  }
  //Computing offset for survey (ignoring 77 data)
  for (i=2; i<=nobs_srv; i++)
    for (j=1; j<=nages; j++)
      offset(2)-=nsamples_srv(i)* (1e-3+obs_p_srv(i,j))*log((1e-3+obs_p_srv(i,j)));

  if(use_age_err==0)
    for (j=1; j<=nages; j++)
      for (int jj=1; jj<=nages; jj++)
        if(jj==j)
          age_err(j,jj)=1.;
        else
          age_err(j,jj)=0.;

 cout<<" samplesize "<<endl<<nsamples_fish<<endl<<endl;
 cout<<" Offset "<<offset<<endl<<endl;
 cout<<" HistF"<<endl<< Hist_F<<endl;
 cout<<" Lambda "<<endl<< lambda<<endl;
 //cout<<" agerr "<<endl<< age_err<<endl;
 //cout<<" ObsP "<< endl<<obs_p_srv<<endl;


PROCEDURE_SECTION
 get_selectivity();
 get_mortality();
 get_numbers_at_age();
 get_predicted_values();
 get_catch_at_age();
 evaluate_the_objective_function();
```

```
FUNCTION get_selectivity

  if (ph_sel_coffs>0)
  {
    for (k=1;k<=2;k++)
    {
      log_sel(k)(1,sel_max_age)=sel_coffs(k);
      log_sel(k)(sel_max_age+1,nages)=sel_coffs(k,sel_max_age);
      avg_sel(k)=log(mean(mfexp(log_sel(k))));
      log_sel(k)-=log(mean(exp(log_sel(k))));
      sel(k)=mfexp(log_sel(k));
    }
  }
  else
  {
    for (k=1;k<=2;k++)
      for (j=1; j<=nages; j++)
         sel(k,j)=1./(1.+mfexp(-1.*fish_slope(k)*(double(j)-fish_sel50(k))));

  }

  log_sel_srv(1,sel_max_age)=sel_coffs_srv;
  log_sel_srv(sel_max_age+1,nages)=sel_coffs_srv(sel_max_age);
  avg_sel_srv=log(mean(mfexp(log_sel_srv)));
  log_sel_srv-=log(mean(exp(log_sel_srv)));
  sel_srv=mfexp(log_sel_srv);

FUNCTION get_mortality
  fmort=mfexp(avg_F+fmort_dev);
  nat_mort(1)(1,3)=M(1);
  nat_mort(2)=M(2);
  deltaM=(M_old-M(1))/19.;
  for (j=4;j<=nages;j++)
    nat_mort(1,j)=nat_mort(1,j-1)+deltaM;

  for (k=1;k<=2;k++)
   {
    for (i=styr;i<=endyr;i++)
      {
        F(k,i) = sel(k) * fmort(i);
```

```
        Z(k,i) = F(k,i) + nat_mort(k);
      }
    }
  S=mfexp(-1.0*Z);

// Catchability in initial years
  catchab_srv(yrs_srv(1)) = exp(log_q_srv);
  catchab_whi(yrs_whi(1)) = exp(log_q_whi);
  catchab_log(yrs_log(1)) = exp(log_q_log);

  if (active(q_dev_srv))
     for (i=styr_q;i<=endyr;i++)
        catchab_srv(i) = catchab_srv(i-1)*exp(q_dev_srv(i));
  else
    catchab_srv = catchab_srv(yrs_srv(1));

  if (active(q_dev_whi))
    for (int i =styr_q_whi;i<=endyr;i++)
      catchab_whi(i) = catchab_whi(i-1)*exp(q_dev_whi(i));
  else
    catchab_whi = catchab_whi(yrs_whi(1)) ;

  if (active(q_dev_log))
    for (i=styr_q_log;i<=endyr;i++)
        catchab_log(i) = catchab_log(i-1)*exp(q_dev_log(i));
  else
    catchab_log = catchab_log(yrs_log(1)) ;


FUNCTION get_numbers_at_age
  // Initial Age composition here
  natage(1,styr,1)=mfexp(mean_log_rec+rec_dev(styr));
  natage(2,styr,1)=natage(1,styr,1);
  for (j=2;j<nages;j++)
    {
      natage(1,styr,j)=natage(1,styr,j-1)*mfexp(
                       -1.*(F(1,styr,j-1)*Hist_F+nat_mort(1,j-1)));
      natage(2,styr,j)=natage(2,styr,j-1)*mfexp(
                       -1.*(F(2,styr,j-1)*Hist_F+nat_mort(2,j-1)));
    }
  //Cumulative Plus group in initial age comp-------------------
```

```
  natage(1,styr,nages)=natage(1,styr,nages-1)*
                      mfexp(-1.*(F(1,styr,nages-1)*Hist_F+nat_mort(1,nages)))
             /(1.-exp(-1.*(F(1,styr,nages)*Hist_F+nat_mort(1,nages))));

  natage(2,styr,nages)=natage(2,styr,nages-1)*
                      mfexp(-1.*(F(2,styr,nages-1)*Hist_F+nat_mort(2,nages)))
                /(1.-exp(-1.*(F(2,styr,nages)*Hist_F+nat_mort(2,nages))));

// Now do for next several years----------------------------------
 for (i=styr+1;i<=endyr;i++)
   {
     natage(1,i,1)=mfexp(mean_log_rec+rec_dev(i));
     natage(2,i,1)=natage(1,i,1);
   }

 for (k=1;k<=2;k++)
 {
   for (i=styr;i<endyr;i++)
   {
     natage(k,i+1)(2,nages) = ++elem_prod(natage(k,i)(1,nages-1),
                                 S(k,i)(1,nages-1));
      natage(k,i+1,nages)+=natage(k,i,nages)*S(k,i,nages);
      popn(k,i)=natage(k,i)*sel(k);
   }
   popn(k,endyr)=natage(k,endyr)*sel(k);
 }
 if (last_phase())
 {
  future_biomass=0.;
  catch_future=0.;
  for (int l=1;l<=3;l++)
  {
   switch (l)
  {
   case 1:
    ftmp=F55;
    break;
   case 2:
    ftmp=F50;
    break;
   case 3:
```

```
    ftmp=F45;
    break;
  }

  for (k=1;k<=2;k++)
  {
  // Get future F's
    for (i=endyr+1;i<=endyr_fut;i++)
    {
    for (j=1;j<=nages;j++)
      {
       F_future(k,i,j)  =  sel(k,j)*ftmp;
       Z_future(k,i,j)  =  F_future(k,i,j)+nat_mort(k,j);
       S_future(k,i,j)  =  exp(-1.*Z_future(k,i,j));
      }
    }
    for (i=styr_fut;i<=endyr_fut;i++)
    {
      nage_future(k,i,1)=exp(mean_log_rec + rec_dev_future(i));
    }

    nage_future(k,styr_fut)(2,nages)=++elem_prod(natage(k,endyr)(1,nages-1),
                                               S(k,endyr)(1,nages-1));
    nage_future(k,styr_fut,nages)+=natage(k,endyr,nages)*S(k,endyr,nages);

    for (i=styr_fut;i<endyr_fut;i++)
    {
      nage_future(k,i+1)(2,nages)=++elem_prod(nage_future(k,i)(1,nages-1),
                                           S_future(k,i)(1,nages-1));
      nage_future(k,i+1,nages)+=nage_future(k,i,nages)*S_future(k,i,nages);
    }

  // Now get catch at future ages
    for (i=styr_fut; i<=endyr_fut; i++)
    {
      for (j = 1 ; j<= nages; j++)
      {
       catage_future(k,i,j) = nage_future(k,i,j) * F_future(k,i,j) *
                     (1.- S_future(k,i,j) ) / Z_future(k,i,j);
      }
   catch_future(l,i)    +=catage_future(k,i)*wt(k,endyr);
```

```
      future_biomass(1,i)   +=nage_future(k,i)*wt(k,endyr);
      }
    } // End of loop over Sex
   }   //End of loop over F's
  }   //End of Future_phase


FUNCTION get_predicted_values
 //Now get predictive parts-------------------------
  pred_srv=0.;
  pred_whi=0.;
  pred_log=0.;
  for (i=styr;i<=endyr;i++)
  {
    for (k=1;k<=2;k++)
    {
      pred_p(k,i)=(elem_prod(sel(k),natage(k,i))/ (popn(1,i)+popn(2,i)))*age_err;

      for (j = 1 ; j<= nages; j++)
      {
        eac_srv(k,i,j)=  sel_srv(j)* pow(S(k,i,j),yr_fraction)* natage(k,i,j);
        pred_srv(i)+=eac_srv(k,i,j)*wt(k,i,j);
        pred_whi(i)+=catchab_whi(i)*wt(k,i,j)*sel(k,j)*natage(k,i,j);
        pred_log(i)+=catchab_log(i)*wt(k,i,j)*sel(k,j)*natage(k,i,j);
      }
    }
    pred_p_srv(i)=(eac_srv(1,i)+eac_srv(2,i))/ sum((eac_srv(1,i)+eac_srv(2,i)))*age_err;
    pred_srv(i)*=catchab_srv(i);
  }

  if (sd_phase())
  {
    for (i=styr;i<=endyr;i++)
    {
      totbiom(i)=(natage(1,i)*wt(1,i)) + (natage(2,i)*wt(2,i));
      rec(i)=natage(1,i,1) + natage(2,i,1);
    }
    depletion=totbiom(endyr)/totbiom(styr);
  }
  stock01=elem_prod(natage(1,endyr),wt(1,endyr))*S(1,endyr) +
          elem_prod(natage(2,endyr),wt(2,endyr))*S(2,endyr);
```

```
FUNCTION get_catch_at_age
  pred_catch_bio.initialize();
  for (i=styr; i<=endyr; i++)
    for (k=1;k<=2;k++)
      for (j = 1 ; j<= nages; j++)
      {
        //--Baranov's equation here-----------------------------------
        catage(k,i,j)      = natage(k,i,j)*F(k,i,j)*(1.-S(k,i,j))/Z(k,i,j);
        pred_catch_bio(i)+=catage(k,i,j)*wt(k,i,j);
      }

FUNCTION evaluate_the_objective_function
  catch_like=lambda(3)*norm2(log(obs_catch_bio)-log(pred_catch_bio));

  index_like(1)= lambda(9)  * norm2(log(obs_srv + .001)-log(pred_srv(yrs_srv)+.001));
  index_like(2)=lambda(10)  * norm2(log(obs_whi + .001)-log(pred_whi(yrs_whi)+.001));
  //index_like(3)=0.;
  index_like(3)=lambda(11)*(norm2(log(obs_log+.001)-log(pred_log(yrs_log)+.001))/
               (2*sigmau*sigmau)+size_count(obs_log)*log(sigmau));

  //for (i=1;i<=nobs_log;i++)
  //{
    //index_like(3) += square(obs_log(i) - pred_log(yrs_log(i))) /
    //                 (2*obs_log_se(i)*obs_log_se(i));
  //}
  //index_like(3) *= lambda(11);

  //cout << index_like(3)<<" "<<lambda(11)<<endl;

  //index_like(3)=lambda(11)*norm2(log(obs_log+ .001)- log(pred_log(yrs_log)+.001));

  age_like=0.;

  for (k=1; k <= 2; k++)
    for (i=styr_fish; i <= endyr_fish; i++)
    {
     // this is to mimic accumulation from synthesis
      pred_p(k,i,2)+=pred_p(k,i,1);
      for (j=2; j<=nages; j++)
        age_like(1)-=nsamples_fish(i)*(1e-3+obs_p(k,i,j))*log(1e-3+pred_p(k,i,j));
```

```
    }

  //cout<<age_like(1)<<endl;
  // cout<<nsamples_fish <<endl;
  age_like(1)-=offset(1);
//Computing multinomial for survey age comp data (ignoring 1977 (first obs))
  for (i=2; i <= nobs_srv; i++)
    age_like(2)-=nsamples_srv(i)*(1e-3+obs_p_srv(i))*log(1e-3+pred_p_srv(yrs_srv(i)));

  //cout<<nsamples_srv <<endl;
  //cout<<age_like(1)<<endl;
  age_like(2)-=offset(2);
  age_like(2)*=lambda(16);  // This is to have the option to turn this part off

// Prior kind of stuff here---------------------------------------------------------
  rec_like=lambda(1)*norm2(rec_dev); //Regularity assumption on recruitment variability
  sigmar   =  norm2(rec_dev)/size_count(rec_dev);
  // This sets variability of future recruitment to same as in past....
  rec_like+= norm2(rec_dev_future)/(2.*sigmar+.001);

  sel_like=0.;
  if (ph_sel_coffs>0)
  {
    sel_like(1)=lambda(5)*norm2(first_difference(first_difference(log_sel(1))));
    sel_like(2)=lambda(6)*norm2(first_difference(first_difference(log_sel(2))));
    sel_like(7)=lambda(4)*norm2(log_sel(2)-log_sel(1));
    for (k=1; k <= 2; k++)
      for (j=age_decrease; j <= nages; j++)
          if (sel(k,j-1)>sel(k,j)) sel_like(4)+=lambda(2) *
                                          square(log_sel(k,j-1)-log_sel(k,j));
  }
  sel_like(3)=lambda(7)*norm2(first_difference(first_difference(log_sel_srv)));

  //For survey selectivity dome-shapedness
  for (j=age_decrease; j <= nages; j++)
    if (sel_srv(j-1)>sel_srv(j))
      sel_like(5)+=lambda(8) * square(log_sel_srv(j-1)-log_sel_srv(j));

  // Normalizing part of selectivity vector (to give it mean zero, log-scale)
  sel_like(6) = norm2(avg_sel) + square(avg_sel_srv);
```

```
// Phases less than 5, penalize low F's
if(current_phase() < 5)
  fpen=10.*square(mfexp(avg_F)-.1);

fpen=lambda(12)*norm2(fmort_dev);

q_like  = lambda(13)*norm2(q_dev_srv);
q_like += lambda(14)*norm2(q_dev_whi);
q_like += lambda(15)*norm2(q_dev_log);

if (active(F55))
{ //Compute SPR Rates and add them to the likelihood for Females
  SB0=0.;
  SBF55=0.;
  SBF50=0.;
  SBF45=0.;
  for (i=1;i<=4;i++)
    Nspr(i,1)=1.;

    for (j=2;j<nages;j++)
    {
        Nspr(1,j)=Nspr(1,j-1)*exp(-1.*nat_mort(1,j-1));
        Nspr(2,j)=Nspr(2,j-1)*exp(-1.*(nat_mort(1,j-1)+F55*sel(1,j-1)));
        Nspr(3,j)=Nspr(3,j-1)*exp(-1.*(nat_mort(1,j-1)+F50*sel(1,j-1)));
        Nspr(4,j)=Nspr(4,j-1)*exp(-1.*(nat_mort(1,j-1)+F45*sel(1,j-1)));
      }
      Nspr(1,nages)=Nspr(1,nages-1)*exp(-1.*nat_mort(1,nages-1))/
                    (1.-exp(-1.*nat_mort(1,nages)));
      Nspr(2,nages)=Nspr(2,nages-1)*
                    exp(-1.* (nat_mort(1,nages-1)+F55*sel(1,nages-1)))/
                  (1.-exp(-1.*(nat_mort(1,nages)+F55*sel(1,nages))));
      Nspr(3,nages)=Nspr(3,nages-1)*exp(-1.*
                   (nat_mort(1,nages-1)+F50*sel(1,nages-1)))/
                          (1.-exp(-1.*(nat_mort(1,nages)+F50*sel(1,nages))));
      Nspr(4,nages)=Nspr(4,nages-1)*exp(-1.*
                   (nat_mort(1,nages-1)+F45*sel(1,nages-1)))/
                          (1.-exp(-1.*(nat_mort(1,nages)+F45*sel(1,nages))));

      for (j=1;j<=nages;j++)
      {
        SB0  +=Nspr(1,j)*maturity(j)*wt(1,endyr,j)*exp(-0.25*nat_mort(1,j));
```

```
      SBF55  +=Nspr(2,j)*maturity(j)*wt(1,endyr,j)*exp(-0.25*(
               nat_mort(1,j)+F55*sel(1,j)));
      SBF50 +=Nspr(3,j)*maturity(j)*wt(1,endyr,j)*exp(-0.25*(
               nat_mort(1,j)+F50*sel(1,j)));
      SBF45  +=Nspr(4,j)*maturity(j)*wt(1,endyr,j)*exp(-0.25*(
               nat_mort(1,j)+F45*sel(1,j)));
   }
   sprpen =100.*square(SBF55/SB0-0.55);
   sprpen+=100.*square(SBF50/SB0-0.50);
   sprpen+=100.*square(SBF45/SB0-0.45);
  }


  // Sum all components---------------------------
  f+=sum(index_like);
  f+=sum(sel_like);
  f+=rec_like;
  f+=catch_like;
  f+=sum(age_like);
  f+=q_like;
  f+=fpen;
  f+=sprpen;

REPORT_SECTION
  report << "Estimated numbers of fish " << endl;
  report << natage << endl;
  report << "Estimated catch numbers " << endl;
  report << catage << endl;
  report << "Estimated F mortality " << endl;
  report << F << endl;
  report << "Observed Survey 1 " << endl;
  report << obs_srv << endl;
  report << "Predicted Survey 1 " << endl;
  report << pred_srv << endl;
  report << "Observed Prop " << endl;
  for (k=1;k<=2;k++)
  {
    for (i=1974;i<=endyr_fish;i++)
    {
      if (i<styr_fish) report <<  endl;
      if (i>=styr_fish) report << obs_p(k,i) << endl;
```

```
  }
}
report << "Predicted prop  " << endl;
report << pred_p << endl;
report << "Observed catch biomass " << endl;
report << obs_catch_bio << endl;
report << "predicted catch biomass " << endl;
report << pred_catch_bio << endl;
report << "Estimated annual fishing mortality " << endl;
report << fmort << endl;
report << "Estimated Selectivity " << endl;
report << sel << endl;
report << "Observed, Predicted Sex Ratio " << endl;
report << (obs_sexr) << endl;
for (i=styr;i<=endyr;i++)
  pred_sexr(i)=popn(1,i)/(popn(1,i)+popn(2,i));
report << (pred_sexr) << endl;
report << "totbiom" << endl;
for (i=styr;i<=endyr;i++)
  report << (natage(1,i)*wt(1,i)) + (natage(2,i)*wt(2,i)) <<" ";
report <<endl;
report << "Natural Mortality (females, males)" << endl;
report << nat_mort << endl;
report << catchab_srv << endl;
report << "Observed Whiting  " << endl;
report << yrs_whi << endl;
report << obs_whi << endl;
report << "Predicted Whiting  " << endl;
report << pred_whi << endl;
report << "Observed logbook " << endl;
report << yrs_log << endl;
report << obs_log << endl;
report << "Predicted logbook " << endl;
report << pred_log << endl;
report << "catchabilities, Survey, Whiting, Logbook" << endl;
report << catchab_srv << endl;
report << catchab_whi  << endl;
report << catchab_log  << endl;

report << "Observed Prop Survey data" << endl;
report << obs_p_srv << endl;
```

```
  report << "Predicted prop survey" << endl;
  report << pred_p_srv << endl;
  report << "Survey Selectivity " << endl;
  report << sel_srv << endl;
  report << "Likelihoods: Survey, sel, rec, catch, age, q, Fpen"<<endl;
  report << "Survey: "<< index_like <<endl;
  report << "Selectivity: "<< sel_like  <<endl;
  report << "Recruitment: "<< rec_like  <<endl;
  report << "Catch_Biom: "<< catch_like<<endl;
  report << "AgeComp: "<< age_like  <<endl;
  report << "Catchability: "<< q_like    <<endl;
  report << "Fmort: "<< fpen      <<endl;
  report << "Sigma for Logbook CPUE data"      <<endl;
  report << sigmau      <<endl;
  report << "SBF50, F55, F50, F45  ok CPUE data"      <<endl;
  report << SBF50<< " " << F55<<" "<<F50<<" "<<F45<<" "<<endl;

TOP_OF_MAIN_SECTION
  gradient_structure::set_MAX_NVAR_OFFSET(1600);
  gradient_structure::set_GRADSTACK_BUFFER_SIZE(200000);
  gradient_structure::set_CMPDIF_BUFFER_SIZE(2000000);
  arrmblsize=500000;
```

Environmental Assessment/Regulatory Impact Review/Regulatory Flexibility Analysis

For

A Program to Monitor Time-Area Closures in the Pacific Coast Groundfish Fishery

Prepared by
National Oceanic and Atmospheric Administration
NOAA Marine Fisheries Service
Northwest Region
7600 Sand Point Way, NE,
Seattle, WA 98112
Tel: (206) 526-6140
Fax: (206) 526-6736

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TABLE OF CONTENTS

1.0 INTRODUCTION

The groundfish fishery in the Exclusive Economic Zone (EEZ), 3 to 200 miles off shore, off the Washington-Oregon-California (WOC) coast is managed under the Pacific Coast Groundfish Fishery Management Plan (FMP). The Pacific Coast Groundfish FMP was prepared by the Pacific Fisheries Management Council (Council) under the authority of the Magnuson Fishery Conservation and Management Act (subsequently amended and renamed the Magnuson-Stevens Fishery Conservation and Management Act). The Pacific Coast Groundfish FMP was approved by the Assistant Administrator for Fisheries, National Oceanic and Atmospheric Administration, on January 4, 1982 and became effective on September 30, 1982.

Actions taken to amend FMPs or to implement regulations to govern the groundfish fishery must meet the requirements of several federal laws, regulations, and executive orders . In addition to the Magnuson-Stevens Fishery Conservation and Management Act (Magnuson-Stevens Act), these federal laws, regulations, and executive orders include the: National Environmental Policy Act (NEPA), Regulatory Flexibility Act (RFA), Endangered Species Act (ESA), Marine Mammal Protection Act (MMPA), Coastal Zone Management Act (CZMA), Paperwork Reduction Act (PRA), Executive Orders (E.O.) 12866,12898, 13132, and 13175, and the Migratory Bird Treaty Act.

The regulations which implement NEPA permit NEPA documents to be combined with other agency documents to reduce duplication and paperwork (40 CFR§§1506.4). NEPA, E.O. 12866 and the RFA require a description of the purpose and need for the proposed action as well as a description of alternative actions that may address the problem. The purpose and need and general background materials are included in Section 1 of this document. Section 2 describes a reasonable range of alternative management actions that may be taken under the proposed action. In accordance with NEPA requirements, Section 3 contains a description of the physical, biological and socio-economic characteristics of the affected environment. While section 4 examines the physical, biological and socio-economic impacts of the management options as required by NEPA, E.O. 12866 and the RFA. Section 5 addresses the consistency of the proposed actions with the FMP, Magnuson-Stevens Act, ESA, MPA, CZMA, PRA, E.O. 12866, E.O. 13175 and the Migratory Bird Treaty Act. The Regulatory Impact review required by E.O. 12866 to address the economic significance of the action, and the Regulatory Flexibility Analysis required by the RFA to addresses the impacts of the proposed actions on small businesses are found in Section 6. Sections 7 presents a list of individuals who assisted in preparing the EA and Section 8 is the list of references. The NEPA conclusions or the Finding of No Significant Impact will be prepared as a memorandum that accompanies this document.

1.1 Proposed Action

The proposed action is to require vessels registered to limited entry permits for the Pacific Coast groundfish fishery to carry and use mobile Vessel Monitoring System (VMS) transceiver units while fishing in the EEZ off the coasts of Washington, Oregon and California. In addition, the proposed action requires the operator of any vessel registered to a limited entry permit, and any other commercial or tribal vessel using trawl gear; including exempted gear used to take pink shrimp, spot and ridgeback prawns, California halibut and sea cucumber, to identify their intent to fish within a conservation area specific to their gear type, in a manner that is consistent with the conservation area requirements. This action will enhance monitoring of compliance with large-scale depth-based restrictions for fishing across much of the continental shelf and is intended to further the conservation goals and objectives of the Pacific Coast Groundfish Fishery Management Plan (FMP) by allowing fishing to continue in areas and with gears that can harvest healthy stocks with little incidental catch of low abundance species (overfished species).

1.2 Background

It is the responsibility of fisheries management to maintain sustainable fisheries by: researching sustainable catch levels; developing fishery specifications and management measures (regulations); monitoring and overseeing fishery harvests; enforcing fishery regulations and prosecuting those who engage in illegal activities.

Fishing fleets are routinely monitored to ensure that vessel operators comply with fisheries regulations. Traditional monitoring techniques include the monitoring of fisheries from air and surface craft, observer programs, and analysis of catch records and vessel logbooks. Because VMS can be used to deter illegal activity, target investigations, and direct patrols, the efficiency of traditional monitoring techniques can be dramatically enhanced by the addition of VMS. VMS is a tool that is commonly used to monitor vessel activity in relationship to geographical defined management areas where fishing activity is restricted. VMS transceivers installed aboard vessels automatically determine the vessel's location and transmit that position to a processing center via a communication satellite. At the processing center, the information is validated and analyzed before being disseminated for fisheries management, surveillance, and enforcement purposes. VMS transceivers document the vessel's position using Global Positioning System (GPS) satellites. Depending on the defined need, position transmissions can be made on a predetermined schedule or upon request from the processing center. VMS transceivers are designed to be tamper resistant. The vessel operator is unable to alter the signal or the time of transmission and in most cases the vessel operator is unaware of exactly when the unit is transmitting the vessel's position. Figure 1.1 illustrates the flow of information from a VMS system.

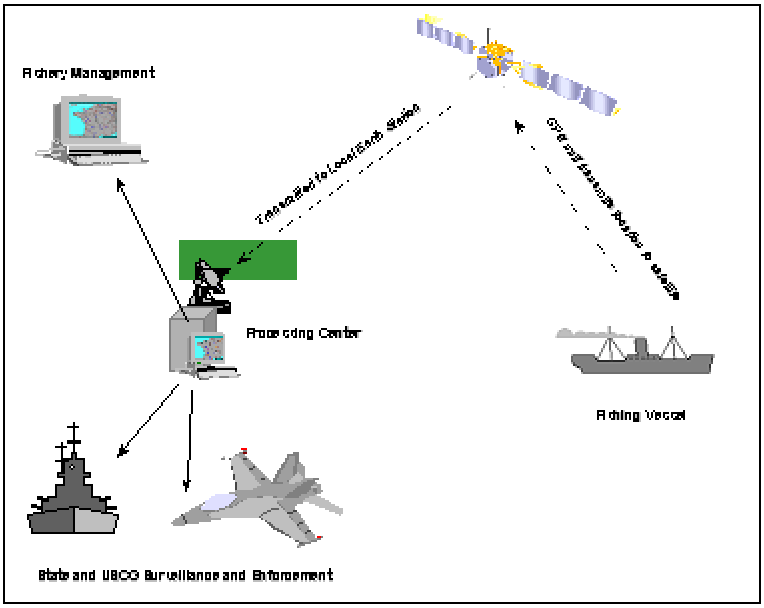


Figure 1.1 Example VMS Scenario

On September 23, 1993, NMFS published proposed VMS standards at 58 FR 49285. On March 31, 1994, NMFS published final VMS standards at 59 FR 151180. These notices stated that NMFS endorses the use of VMS and defined specific criteria for using VMS (see Appendix A) as a fishery management tool. On September 8, 1998, NOAA published a request for information (RFI) in the Commerce Business Daily in which it stated minimum VMS specifications necessary for approval by NOAA. The RFI requested that responses from interested VMS providers include supporting information which would demonstrate that the VMS could meet the minimum specifications established by the NOAA Office for Law Enforcement (OLE).

NMFS requires that VMS systems meet the defined standards to assure compatibility with the national monitoring center, while recognizing the need to promulgate regulations and approve systems on a fishery-by-fishery basis. All approved units must be consistent with the basic features identified and endorsed by NMFS, however, additional features may be added to better meet the specific needs of a particular fishery. VMS transceiver units approved by NMFS are referred to as type-approved.

The following are NMFS's minimum specifications for VMS systems used for fishery management and enforcement purposes:

- the VMS unit must be tamper proof such that it does not permit the input of false positions;

  the equipment must be fully automatic and operable at all times;

  the VMS unit must be accurate to within 400 m (1,300 feet) and capable of tracking a vessel throughout the entire geographical area where the management measures apply;

  the VMS unit must be capable of transmitting and storing information such as vessel identification, date, time, latitude, longitude, speed and bearing;

  the VMS unit must provide accurate position transmissions;

  the VMS unit must allow position transmissions to be set or changed remotely and allow NMFS to poll vessels (to freely query a vessel's transmitter for a position); and.

  under certain conditions, the VMS units may be required to provide two-way message communications between the ship and shore (one-way communication only allows the vessel to transmit positions from the ship to shore). Such communications would include, but not be limited to transmitting and receiving full or compressed data messages.

Amendment 13 to the Pacific Coast Groundfish FMP recognized the value of VMS in enforcing closed areas that are established to reduce bycatch levels. Amendment 13 also identified VMS as a technological tool that could be used to improve bycatch management by providing fishing location data that can be used in conjunction with observer data collections.

There were several mitigating factors that emerged during the development of the depth-based management regime adopted for 2003 fishery. Implementation VMS system, used to track movement of vessels through and within depth zones, was one such factor.

1.3 Purpose and need for action

Time and area closures have long been used to restrict fishing activity in the Pacific Coast groundfish fishery to keep harvests within sector allocations, at sustainable levels, or to prohibit the catch of certain species. Until September 2002, geographically defined areas tended to be nearshore or defined by a simple longitude and latitude lines. On September 13, 2002, NMFS took emergency action to define depth-based management measures (67 FR 57973). The emergency rule restricted trawling north of 40°10' N. lat., in the months of September though December 2002, to depths where darkblotched rockfish was not expected to be encountered. These measures were taken to reduce the incidental catch of darkblotched rockfish, in order to keep total catch below the 2002 Optimum Yield (OY) level. The depth-based area, referred to as the Darkblotched Rockfish Conservation Area, was based on bottom depth ranges where darkblotched rockfish commonly occur (100-250 fm) and used a series of latitudinal and longitudinal coordinates to define a large irregularly shaped geographical area that extends far offshore. This resulted in much of the fishing activity being moved far offshore and beyond the range of State enforcement capabilities.

For 2003, the Council sought a management strategy that would allow fishing to continue in areas and with gear that can harvest healthy stocks with little incidental catch of low abundance species (overfished species). Recent stock assessments for four overfished species, bocaccio, yelloweye, canary and darkblotched rockfish, indicated that little surplus production is available for harvest. Measures must be taken to protect these stocks and rebuild them to sustainable biomass levels. Therefore, the Council recommended that NMFS define additional management areas for the groundfish fishery that are based on bottom depth ranges where these low abundance species are commonly found. For 2003, large-scale depth-related areas, referred to as groundfish conservation areas, will be used to prohibit or restrict both commercial and recreational fishing across much of the continental shelf. Deep-water fisheries on the slope and nearshore fisheries will be permitted, in areas seaward or shoreward of the depth-based conservation areas.

The boundaries of the groundfish conservation areas are complex, involving hundreds of points of latitude and longitude to delineate nearshore and offshore fathom curves. The areas are vast, extending along the entire West Coast from Canada to Mexico, and the weather and sea conditions are frequently harsh. Some fishing, such as midwater trawling for pelagic species, shrimp trawling with finfish excluders and various state-managed fisheries, will be allowed to occur in the conservation areas. In addition, vessels intending to fish seaward of the westernmost boundary of a conservation area will be allowed to transit through the areas providing the gear is properly stowed.

Ensuring the integrity of conservation areas using traditional enforcement methods is especially difficult when the closed areas are large-scale and the lines defining the areas are irregular. Furthermore, when some gear types and target fishing are allowed in all or a portion of the conservation area while other fishing activities are prohibited it is difficult and costly to effectively enforce closures using traditional methods. Scarce State and Federal resources also limit the use of traditional enforcement methods. To allow for a more liberal depth-based management regime, as proposed by the Council for 2003, it is necessary to take action to establish a monitoring program to ensure the integrity of these large irregularly shaped depth-based conservation areas. This action is intended to create a program that will promote compliance with regulations that prohibit some fishing activities in conservation areas while allowing legal fishing activity that occurs within conservation areas to be effectively monitored. The purpose of this Environmental Assessment (EA) is to analyze components of a program that can used to monitor groundfish conservation areas.

1.4 Scoping Process

The purpose of the scoping process is to determine the range of issues that the NEPA document (in this case the EA) needs to address. This allows the preparation of the document to be effectively managed. Scoping is intended to ensure that problems are identified early and properly reviewed, that issues of little significance do not consume time and effort, that the draft NEPA document is thorough and balanced. The scoping process should identify the public and agency concerns; clearly define the environmental issues and alternatives to be examined in the NEPA document including the elimination of nonsignificant issues; identify related issues; and identify state and local agency requirements that must be addressed. An effective scoping process can help reduce unnecessary paperwork and time delays in preparing and processing the NEPA document.

On June 3-4, 2002 the Council's Allocation Committee met to discuss the development of management measures for the 2003 groundfish fishery. At this public meeting, representatives from NMFS OLE provided information on VMS technology and different monitoring options that could be implemented to support compliance of depth-based management measures. The cost of such systems and who would bear those costs, were key issues during the Allocation Committee's discussions. The public was invited to comments and discuss the monitoring needs of the Pacific Coast groundfish fishery in relation to management measure proposed for 2003. During the discussion, consideration was given to: the timeliness of VMS position reports, geographical areas proposed to be monitored; the size and class of vessels that may be monitored; the level of communications with the vessels needed while they are at sea; safety concerns; and ways to address transiting of closed areas. Following this discussion, the Allocation Committee recommended that the Council consider using risk-adverse measures such as VMS or observers to monitor fisheries that are most likely to encounter bocaccio, yelloweye or canary rockfish. These are the three most constraining species in 2003.

At its June 2002 meeting, the Council reviewed VMS recommendations from the Allocation Committee and Enforcement Consultants. Because of its cost effectiveness, the Enforcement Consultants recommended that VMS be considered as a monitoring tool for closed areas. The Enforcement

Consultants prepared a worksheet that identified VMS issues, system specifications, and listed VMS questions that the Council would need to consider if it chose to use VMS as a monitoring tool. These documents and committee reports were made available to the public and the public was invited to provide comment to the Council. Following Council discussion, the Council recommended forming a committee that included enforcement representatives, industry members, and biologists to review questionnaire and provide further direction to the Council on VMS development.

On July 16, 2002 , enforcement representatives met in to discuss VMS and refine a VMS proposal. VMS equipment requirements, approximate fleet sizes by fishing sectors likely to be considered for VMS units, and estimated the cost associated with purchase, installation, and operation of VMS units were identified. The Allocation Committee held a public meeting on August 28-29, 2002 in which enforcement representatives were available and VMS and observers were discussed as methods of monitoring the 2003 fishery. This was a public meeting in which public input was invited. A summary report of these meetings were presented and made available for public review at the Council's September 2002 meeting. The Council's Groundfish Advisory Sub-panel, discussed the concept of a VMS monitoring system and identified the following issues: 1) need to establish a VMS committee to help NMFS design and implement VMS program; 2) program should begin by requiring only a small portion of the fleet to carry VMS; 3) equipment manufactures need to meet with fishermen to address technical questions; 4) the need to recognize diversity within the fleet when implementing a program; and 5) the federal government should provide transceiver units. After reviewing the information provided by its advisory committees and the public, the Council recognized that a VMS program would be beneficial to the management of the groundfish fishery, specifically, in maintaining the integrity of new, depth-based management measures. The Council requested that NMFS further analyze a VMS program, develop implementing regulations, and create a VMS committee composed of enforcement and industry representatives to work with NMFS on development of a monitoring program.

On October 11,2002, the Council's VMS committee held a public meeting in Portland, Oregon and identified the goals and objectives of a monitoring program; identified desirable characteristics of a declaration reporting system; examined VMS coverage options, including priorities in coverage; and VMS unit costs and cost sharing. At the Council's November meeting, a VMS committee report was made available to the Council, its advisory bodies, and the public. At this same meeting, the Council recommended that NMFS move forward with a proposed rule to implement a VMS program for the Pacific Coast groundfish fishery in 2003 and identifeid its preferred alternatives.

On December 18, 2002, the Council's VMS committee held a public meeting in Portland Oregon. During this meeting the committee reviewed a draft rule that would implement a VMS program and declaration requirements.

2.2 DESCRIPTION OF THE ALTERNATIVE MANAGEMENT ACTIONS

Table 2.0.1 Summary of Alternative Management Actions for Monitoring Time-area Closures in the Pacific Coast Groundfish Fishery

ISSUE 1: The Monitoring System	**Alternative 1** **Status quo**	**Alternative 2** Declaration reports - from limited entry trawl and fixed gear vessels, and all other commercial and tribal trawl vessels including exempted trawl gears that intend to fish within a conservation area defined for their gear type.	**Alternative 3** Basic VMS system with one way communications; declaration reports as described under Alternative 2; VMS operated continuously in EEZ regardless of fishery. (NMFS preferred)	**Alternative 4** Upgraded VMS system with 2-way communications; declaration reports as described under Alternative 2; VMS operated continuously in EEZ regardless of fishery.	**Alternative 5** Observers with 100% coverage; and declaration reports as described under Alternative 2.
	* Limited availability of air and surface craft to monitor conservation areas. * Fish tickets and logbooks used to monitor fishing location	* Same as Alt. 1 plus: * 386 LE , 248 OA exempted trawl & 5 tribal trawl vessels would be required to provide declaration and landing reports * Declaration reports aids in identifying vessels fishing legally in conservation areas from those that are not.	* Same as Alt. 1 & 2 plus: * VMS Unit must be consistent with NMFS standards * Real-time position data would allow enforcement to respond to infractions * Distress signal	* Same as Alt. 1, 2 & 3 plus: * 2-way communications can be used to transmit reports from vessel; to receive operational messages; and to inquire about use of distress signal * Vessel may choose value added services used only by vessel	* Same as Alt. 1 & 2 plus: * Position data can be used as basis for enforcement action * Observer reports could be used to verify vessel activities * Most observer data is beyond the scope of the identified need * Catch composition data would be available to assess the impacts of fishing activities

ISSUE 2: Coverage (Issue 2 applies only when issue 1, alternatives 3, 4 or 5, VMS or observers are selected as the monitoring system)	**Alternative 1** **Status quo**	**Alternative 2A** All vessels registered to a limited entry permit	**Alternative 2B** All limited entry vessels that actually fish in EEZ	**Alternative 3** All active limited entry, and open access and recreational charter vessels that fish in conservation areas	**Alternative 4** All active limited entry vessels and all commercial fishing vessels and recreational charter vessels that fish in conservation areas.	**Alternative 5** All active limited entry, open access and recreational charter vessels regardless of where they fish
	* Coverage would be voluntary, except for mandatory observer coverage required under the federal observer program	* In 2001, this was 424 vessels including catcher/ processors (257 trawl, 140 line, 11 pot , and 16 combined gear)	* In 2001, 386 LE vessels landed groundfish (233 trawl, 129 line & 24 pot vessels)	* LE same as Alt. 2B * OA 2,881 vessels * Recreational charter: 659 vessels - If 100% of WA and 90% of CA & OR vessels identified fish in conservation area, 401 if 100% of WA and 50% of CA & OR fish in conservation area	* LE same as Alt. 2B * OA same as Alt. 3 * Recreational charter same as Alt. 3 * Other commercial fisheries: 132 hagfish (7 vessels), spiny lobster (125) rock crab, sheep crab, surfperch, shark,.....	* LE same as Alt. 2B * OA 3,840 vessels * Recreational charter of 724 vessels, with 77 from WA, 232 from OR and 415 from CA

ISSUE 3: VMS Expenditures (Issue 3 applies only when issue 1, alternatives 3 or 4, are selected for the monitoring system)	**Alternative 1** Vessel owner pays for all (NMFS preferred)	**Alternative 2** Vessel owner pays for VMS transceiver	**Alternative 3** NMFS pays for initial VMS transceiver	**Alternative 4** NMFS pays for all (Council preferred)
	* Vessel pays costs of purchasing, installing and maintaining VMS transceiver unit *Vessel pays all costs associated with the transmission of data * Does not preclude reimbursement for all or a portion of expenditures	* Vessel would be responsible for paying all costs associated with purchasing, installing and maintaining the VMS transceiver. * NMFS pays for transmission of reports and data * Federal funding not available	* NMFS pays vessel for all or a portion of VMS transceiver * Vessel pays for installation, maintenance and replacement. * Transmission costs paid by vessel * Federal funding not available	* NMFS would be responsible for paying all costs associated with purchasing, installing and maintaining the VMS transceiver unit, as well as the costs associated with the transmission of report and data rom the vessel * Federal funding not currently available

ISSUE 1: THE MONITORING SYSTEM This issue defines the types of systems and reporting requirements that could be used to monitor fishing activities to ensure the integrity of groundfish conservation areas. The alternatives below describe three different approaches to a monitoring system including: a declaration system, a VMS program, and fishery Observers.

Alternative 1: Status quo. Do not define a specific monitoring system for managing the integrity of groundfish conservation areas. Do not define reporting requirements for groundfish vessels that are conducting legal fishing activities in conservation areas**.**

Discussion: Traditional monitoring techniques, including monitoring from air and surface craft, analysis of fish tickets and vessel logbooks would continue to be used to monitor vessel activity in relationship to geographically-defined management areas where fishing activity is restricted. Enforcement resources would continue to be used to identify questionable behavior and locate vessels over a large geographical area and within fishing fleets targeting multiple species.

Alternative 2: Declaration system only. Require the operator of any vessel registered to a limited entry permit, and any other commercial or tribal vessel using trawl gear; including exempted gear used to take pink shrimp, spot and ridgeback prawns, California halibut and sea cucumber, to send a declaration report before leaving port identifying their intent to fish within a conservation area specific to their gear type.

Discussion: As with Alternative 1, traditional monitoring techniques including monitoring from air and surface craft, analysis of fish tickets, and vessel logbooks would continue to be used to monitor vessel activity in relationship to geographically- defined conservation areas where fishing activity is restricted. To assist enforcement in identifying vessels that are legally fishing in conservation areas, the operator of any vessel registered to a limited entry permit, and any other commercial or tribal vessel using trawl gear; including exempted gear used to take pink shrimp, spot and ridgeback prawns, California halibut and sea cucumber, would be required to identify their intent to fish within a conservation area specific to their gear type. A valid declaration report must be received by NMFS before the vessel leaves port. Declaration reports would be sent to NMFS and vessel operators would receive conformation that could be used to verify that the reporting requirement was met. This reporting requirement would affect approximately 386 limited entry vessels (Tables 3.3.2.1) , 248 open access vessels (Table 3.3.2.3) and 5 tribal vessels. Salmon troll and sport charter vessels are visually unique and would therefore not be required to provide declaration reports.

Alternative 3: Basic VMS system (NMFS and Council preferred alternative). Establish standards for VMS transceiver and mobile communication service providers that are consistent with the VMS standards published on March 31, 1994 at 59 FR 15180 and the specifications published by OLE in the Commerce Business Daily on September 8, 1998 (Appendix A**).** Any vessel registered to a limited entry permit, and any other commercial or tribal vessel using trawl gear; including exempted gear used to take pink shrimp, spot and ridgeback prawns, California halibut and sea cucumber, would be required to send a declaration report to identify their intent to fish within a conservation area specific to their gear type.

Discussion: This alternative provides for a basic VMS system that would transmit vessel positions, via secured satellite communications, to a central data processing center managed by the NMFS OLE. Because GPS positions provide accuracy to within 50 meters, vessel position data could be used by managers to monitor fleet behavior and by enforcement to identify questionable fishing activity and easily locate individual vessels. One-way communications allow a vessel's position to be sent to NMFS through a communication service provider. It also allows for a distress signal to be sent from the vessel. Although the interval between position fixes and receipt by NMFS is not specified in the national standards, the transceiver units currently available that meet the criteria under this alternative transmit data within approximately 5 minutes of the position fix. This alternative is intended to define minimum requirements and would not preclude a vessel owner from procuring a VMS unit approved by NMFS for the Pacific Coast groundfish fishery that provides additional services and capabilities used exclusively by the vessel owner and operator. It is NMFS intention to approve VMS transceivers and service providers and publish a list of type approved units for the Pacific Coast groundfish fishery. Transceiver manufactures or communication service providers may continue to submit products or services to NMFS for evaluation based on the published specifications. As necessary, NMFS will publish amendments to the list of approved systems in the Federal Register.

Any vessel registered to a limited entry permit, and any other commercial or tribal vessel using trawl gear; including exempted gear used to take pink shrimp, spot and ridgeback prawns, California halibut and sea cucumber, would be required to send a declaration report to identify their intent to fish within a conservation area specific to their gear. A valid declaration report must be received by NMFS before the vessel leaves port. This notice requirement would affect approximately 386 limited entry vessels (Tables 3.3.2.1) , 248 open access vessels (Table 3.3.2.3) and 5 tribal vessels.

VMS transceiver units range in price from approximately $800 (this is contingent on the low end units being approved by OLE) to $3,800 per unit, installed. The costs per day for data transmissions is $1.67-$5. The annual transmission costs may vary between vessels depending on the number of days fished and the model of transceiver the vessel has purchased (With VMS transceiver units, there is a sleep function, when the vessel is in port, position transmissions are automatically reduced). NMFS will pay for all costs associated with polling (when the processing center queries the transceiver, outside of regular transmissions, for a position report). The costs of installation are minimal because the transceivers can be installed by the vessel operator. Vessels that already have VMS transceiver units installed for other fisheries or personal purposes may use their current unit providing it is a model that has been type approved for the Pacific Coast groundfish fishery and the software has been upgraded to meet the defined requirements.

Alternative 4: Upgraded VMS system. Establish standards for VMS transceiver and mobile communication service providers that are consistent with the final VMS standards published on March 31, 1994, at 59 FR 151180 and the specifications published by OLE in the Commerce Business Daily on September 8, 1998 (Appendix A). In addition to the basic standards described under Alternative 3, the upgraded system would use two-way communications between the vessel and shore such that full or compressed data messages can be transmitted and received by the vessel. Any vessel registered to a limited entry permit, and any other commercial or tribal vessel using trawl gear; including exempted gear used to take pink shrimp, spot and ridgeback prawns, California halibut and sea cucumber, would be required send a declaration report to identify their intent to fish within a conservation area specific to their gear type.

Discussion: This alternative provides for a more advanced VMS system in that it has a message terminal or is attached to a personal commuter. Like Alternative 3, the upgraded system would transmit vessel positions, via secured satellite communications, to a central data processing center managed by the NMFS OLE. Vessel position data could be used by managers to monitor fleet behavior and by enforcement to identify questionable fishing activity and easily locate individual vessels. In addition, VMS systems with two-way satellite communications capability can be used to report suspicious activities directly to State or Federal enforcement officers and the U. S. Coast Guard. Two-way messaging capability allows the necessary position reports to be sent from the vessel, and also has the capability for the vessel to receive operational messages (changes in regulations, weather reports, safety messages, etc). These communications can be used to solve problems that might otherwise result in an enforcement action. The addition of a manual input device aboard the vessel (keyboard, hand-held terminal, or PC) adds to the catch reporting capability. Two-way communications allow for a distress signal to be sent from the vessel, and also allows for a response or inquiry to be sent back to the vessel. GPS positions provides accuracy to within 50 meters. Accuracy is particularly important given there are many areas where fishing incursions into the conservation areas could occur over very short distances and result in a heavy impact on the resources being protected by the restricted areas. Having a near real-time interval between the position fix and when NMFS receives the report, would allow enforcement to respond to an apparent infraction in near real-time, if resources were available.
These transceiver units range in price from approximately $2,700 to $5,295 per unit, installed. The costs per day for data transmissions is $1-$3.5. The annual transmission costs vary considerably between vessels depending on the number of days fished and proximity of the activities to the conservation areas.

NMFS will pay for all costs associated with polling. The costs of installation are minimal because the transceivers can be installed by the vessel operator. Like Alternative 3, vessels that already have VMS transceiver units installed for other fisheries or business purposes may use their current unit providing it is a model that has been type approved for the Pacific Coast groundfish fishery and the software has been upgraded to meet the defined requirements.

In addition to the VMS requirements, any vessel registered to a limited entry permit, and any other commercial or tribal vessel using trawl gear; including exempted gear used to take pink shrimp, spot and ridgeback prawns, California halibut and sea cucumber, would be required to send a declaration report to identify their intent to fish within a conservation area specific to their gear type. A valid declaration report must be received by NMFS before the vessel leaves port. This reporting requirement would affect approximately 386 limited entry vessels (Tables 3.3.2.1) , 248 open access vessels (Table 3.3.2.3) and 5 tribal vessels.

Alternative 5: Observers. Require vessels to carry observes to monitor vessel activity in relation to groundfish conservation areas. Require operators of any vessel registered to a limited entry permit, and any other commercial or tribal vessel using trawl gear; including exempted gear used to take pink shrimp, spot and ridgeback prawns, California halibut and sea cucumber, to send a declaration report to identify their intent to fish within a conservation area specific to their gear type.

Discussion: Observers are a uniformly trained group of scientific technicians who are stationed aboard vessels to observe fishing activities. Observers gather independent conservation and management data that is too burdensome for vessel personnel to collect and which would otherwise not be available for managing the fisheries. Although the observers do not have a direct role in fisheries compliance, data on fishing effort, which includes fishing location, could be used to in an enforcement action. In 2001, NMFS implemented a Federal observer program in the Pacific Coast groundfish fishery as a viable means to collect much-needed data on at-sea discards. In 2002, approximately 30 observers were stationed along the coast from Bellingham, WA to Morro Bay, CA. In addition, observers have been placed on a voluntary basis aboard offshore catcher/processors and processing vessels in the Pacific whiting fishery to gather total catch, bycatch, and biological data since 1991. Observers carried by vessels under this alternative would be funded by a pay-as-you-go system similar that used by the processing vessels in the whiting fishery. In a pay-as-you-go system the vessel owner is responsible for making arrangement with an observer employment firm who provides the required observer services and for paying all associated costs.

Under this alternative, observers would be available to collect information that could be used to monitor fishing activity in relationship to conservation areas. Supporting these additional observers, would most likely require a substantial expansion of the current observer program infrastructure. Because observer data is processed after a fishing trip is completed, the data would not be available in realtime. Although critical for management of the fishery, much of the observer's sampling and data are beyond the scope of the identified need and are not directly applicable to monitoring fishing activities to ensure the integrity of groundfish conservation areas.

In additon to the observer requirements, any vessel registered to a limited entry permit, and any other commercial or tribal vessel using trawl gear; including exempted gear used to take pink shrimp, spot and ridgeback prawns, California halibut and sea cucumber, would be required to send a declaration report to identify their intent to fish within a conservation area specific to their gear type. A valid declaration report must be received by NMFS before the vessel leaves port. This reporting requirement would affect approximately 386 limited entry vessels (Tables 3.3.2.1) , 248 open access vessels (Table 3.3.2.3) and 5 tribal vessels.

ISSUE 2: COVERAGE This issue identifies the sectors of the groundfish fleet that would be required to have a VMS or observer monitoring system, as identified under issue 1, Alternatives 3,4, and 5, in place in order to participate in Pacific Coast groundfish fishery.

Alternative 1: Status quo. Do not specify mandatory coverage requirements for a monitoring system.

Discussion: Under the existing regulations vessels could elect to voluntarily carry a VMS transceiver unit and provide position reports when they choose. Vessels would be expected to carry a Federal observer when randomly selected from the overall of vessels. In 2002, approximately 30 observers were stationed along the coast from Bellingham, WA to Morro Bay, CA. If coverage in 2003 were allocated in the same proportions as 2002, approximately 75% of observer time would be dedicated to cover the limited entry trawl fishery with the remaining 25% of observer time used to collect data on fixed gear and open access. Observers would continue to be placed on a voluntary basis on board offshore catcher/processors and mothership processing vessels in the Pacific whiting fishery.

Alternative 2A: All vessels registered to a limited entry permit. Beginning in 2003, require all trawl and fixed gear vessels registered to limited entry permits to have VMS or an observer as specified under issue 1, Alternatives 3,4, and 5. Vessels would be required to have VMS transceiver units or observers on board at all times regardless of the fishery.

Discussion: This alternative would affect all vessels registered to limited entry permits beginning in 2003, regardless of where they fish or if they fished in the WOC. In 2001, there were 424 vessels with Pacific Coast groundfish limited entry permits, of which 257 were trawl vessels, 140 were longline vessels and, 11 were trap vessels, and 16 were combined gear permits (Tables 3.3.2.1). Since 2001, the number of vessels registered for use with limited entry permits has decreased because of implementation of the permit stacking program for sablefish-endorsed limited entry fixed gear permits.

This alternative would allow enforcement to effectively monitor limited entry trawl vessels for unlawful incursions into conservation areas while allowing legal incursions, such as midwater trawling, for Pacific whiting, yellowtail and widow rockfish and non-groundfish target fisheries, to occur. Vessels registered to a limited entry permit would be required to have either an operable VMS unit or an observer on board. A notable number of limited entry vessels also participate in non-groundfish fisheries, such as shrimp and prawn trawl fisheries, troll albacore and troll salmon fisheries, and the pot fisheries for crab. These fisheries would continue to occur in the conservation area. Vessels would be required to have either an operable VMS unit or an observer on board whenever the vessel was used to fish in the EEZ of the states of Washington, Oregon or California.

Alternative 2B: All vessels registered to a limited entry permit and that fish for groundfish Beginning in 2003, require all trawl and fixed gear vessels registered to limited entry permits to have either VMS or an observer, as specified under issue 1, Alternatives 3,4,and 5 before the vessel can be used to fish in the Pacific Coast groundfish fishery. Vessels would be required to have a VMS transceiver or an observer on board whenever the vessel was operating in the EEZ of the states of Washington, Oregon or California.

Discussion: This alternative is the same as alternative 2A except that it would not require VMS or observers on vessels registered to limited entry permits unless they are used to harvest groundfish during the fishing year. This alternative is different form 2A in that it recognizes that not all vessels registered to a limited entry permit are used to harvest groundfish and therefore only requires vessels that fish to incur the cost of purchasing and installing a VMS unit. In 2001, there were 386 of the 424 vessels registered to limited entry permits actually fished in the Pacific Coast groundfish fishery. Of these 386 vessels, 233 were trawl vessels, 129 were longline vessels, and 24 were trap vessels (Tables 3.3.2.1). Vessels would be required to have a VMS transceiver or an observer on board whenever the vessel was operating in the EEZ of the states of Washington, Oregon or California.

NOTE TO THE READER: The Council and NMFS preferred alternative of all vessels registered to a limited entry permit and that fish in the EEZ off Washington, Oregon, and California falls between alternatives 2A and 2B. Under the preferred alternative all trawl and fixed gear vessels registered to a limited entry permits would be required to have either VMS, as specified under issue 1 Alternative 3, before they can fish in any fishery in the EEZ off Washington, Oregon, and California. Vessels would be required to have VMS transceiver unit on board at all times regardless of the fishery and regardless if they target or landed groundfish. The number of limited entry vessels affected by the alternative falls between 386 (Alternative 2B) and 424 (Alternative 2A) and is not specifically analyzed in this analysis because the exact number is unknown. For the purposes of this analysis 424 vessels, as would be affected under Alternative 2A.

Alternative 3: All vessels registered to limited entry permits regardless of where fishing occurs; and all open access and recreational charter vessels that fish in the conservation areas. Beginning in 2003, require all trawl and fixed gear vessels registered to a limited entry permit to have either VMS or an observer as specified under issue 1, Alternatives 3,4,and 5 before they can fish in the Pacific Coast groundfish fishery. By 2004, begin phasing in VMS or an observer requirement for open access vessels (including exempted gears) that fish within a conservation area. Open access fisheries would be prioritized by the estimated impacts on overfished species. By 2004, begin phasing in VMS or an observer requirement for recreational charter vessels that fish within a conservation area. Vessels would be required to have VMS transceiver unit or an observer on board at all times regardless of the fishery.

Discussion: Requirements for the limited entry fleet under this alternative are the same as alternative 2B. In addition to the requirements under 2B, this alternative would require open access gears that fished in the conservation area to have an operable VMS unit or an observer on board at all times. This is estimated to affect 386 limited entry vessels (Tables 3.3.2.1), 2,881 open access vessels (Table 3.3.2.3) and less than 659 recreational charter vessels (Tables 3.3.4.1).

Alternative 4: All vessels registered to limited entry permits regardless of where fishing occurs; all fishing vessels operating in conservation area. Beginning in 2003, require all trawl and fixed gear vessels registered to a limited entry permit to have either VMS or an observer as specified under Issue 1, Alternatives 3, 4. and 5, before they can fish in the Pacific Coast groundfish fishery. By 2004, begin phasing in VMS or observer requirements for all other fishing vessels that operate in the conservation areas. Fisheries would be prioritized by the estimated impacts on overfished species. Vessels would be required to have VMS transceiver unit or an observer on board at all times regardless of the fishery.

Discussion: Requirements for the limited entry fleet under this alternative are the same as Alternative 2B. Requirements for the open access gears and recreational charter vessels would be the same as Alternative 3. In addition, this alternative would require all other commercial fishing vessels operating in the conservation area to have an operable VMS unit or an observer on board at all times. This is estimated to affect 386 limited entry vessels (Tables 3.3.2.1), 2,881 open access vessels (Table 3.3.2.3), less than 659 recreational charter vessels (Tables 3.3.4.1), and 132 vessels from other commercial fisheries (Table 3.3.2.3).

Alternative 5: All limited entry, open access, and recreational charter vessels regardless of where fishing occurs. Beginning in 2003, require all trawl and fixed gear vessels registered to a limited entry permit to have either VMS or an observer as specified under issue 1, before they can fish in the Pacific Coast groundfish fishery. By 2004, begin phasing in VMS or observer requirements for all open access and recreational charter vessels regardless of where the vessel will be fishing. Fisheries would be prioritized by the estimated impacts on overfished species. Vessels would be required to have VMS unit or an observer on board at all times regardless of the fishery.

Discussion: Requirements for the limited entry fleet under this alternative are the same as Alternative 2B. Requirements for the open access gears and recreational charter vessels would include all vessels that can legally take groundfish, regardless of where they are fishing in relation to the conservation areas. This alternative would allow enforcement to monitor all groundfish vessels throughout the year, regardless of the fisheries in which they participate. This is estimated to affect 386 limited entry vessels (Tables 3.3.2.1), 3,840 open access vessels (Table 3.3.2.3) and 724 recreational charter vessels (Tables 3.3.4.1).

ISSUE 3: VMS RELATED EXPENDITURES -- This issue defines the responsibilities of purchasing, installation, and maintenance of VMS transceiver units, as well as the responsibilities for transmission of reports and data.

Alternative 1: Vessel pays all. Under this alternative the vessel would be responsible for paying all costs associated with purchasing, installing and maintaining the VMS transceiver unit, as well as the costs associated with the transmission of reports and data from the vessel. This alternative would not preclude reimbursement for all or a portion of expenditures at a later point in time if money were available.

Alternative 2: Vessel pays for transceiver. Under this alternative the vessel would be responsible for paying for all costs associated with purchasing, installing and maintaining the VMS transceiver unit. NMFS would pay for transmission of reports and data only.

Alternative 3: NMFS pays for initial transceiver. Under this alternative, NMFS pays or reimburses the vessel owner for all or a portion of the initial VMS transceiver unit. Associated expenses including installation, maintenance and replacement would be paid for by the vessel. Transmission costs would also be paid for by the vessel.

Alternative 4: NMFS pays all. Under this alternative NMFS would be responsible for paying all costs associated with purchasing, installing and maintaining the VMS transceiver unit, as well as the costs associated with the transmission of reports and data from the vessel.

Alternatives that were rejected

Electronic chart plotters have become an increasingly important part of the navigational equipment on many recreational and commercial vessels. Plotters vary widely, ranging from hand-held units with small screens to full color, large screen computer monitor displays and the International Maritime Organization approved Electronic Chart and Information Display Systems. The electronic charts displayed by plotters contain useful information from official charts, issued by the National Oceanographic and Atmospheric Administration (NOAA), and non-official charts such as marina data. Official marine charts issued by NOAA show boundaries of land and water, water depths and contour lines, type, identification and location of aids to navigation, position of channels, danger and prohibited areas and locations of shore-side facilities. Various information from NOAA charts may be absent on some electronic charts. In general, electronic charts are not legal replacements for paper charts.

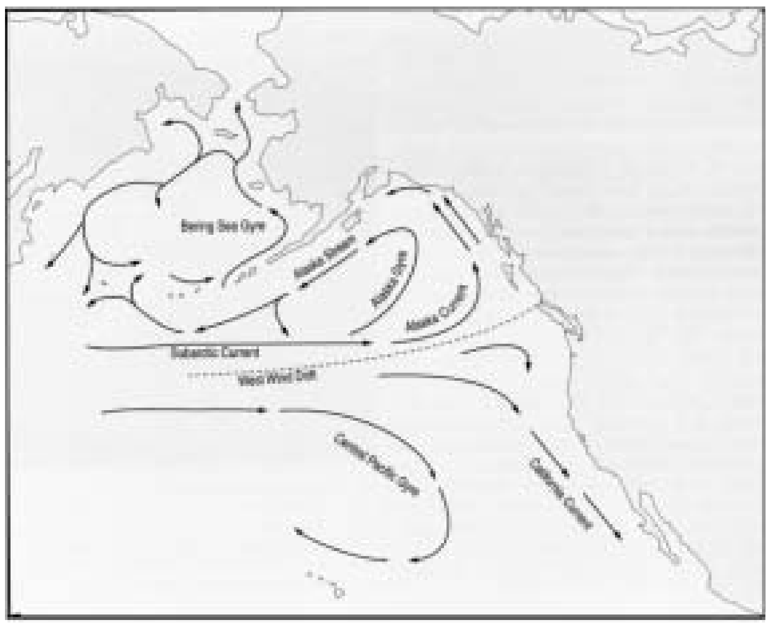
A chart plotter's greatest value is in its ability to convert the precise but abstract position information supplied by the GPS or Loran into an easily understood picture of the vessel's position in relation to its surroundings. This improves the navigator's situational awareness, his ability to correlate his vessel's position in relation to surrounding land, channel boundaries and various navigation aids and other vessels. Even low cost chart plotters that depict vessel position on a minimal content chart can greatly aid the user in "finding" his vessel's position on the chart being used for navigation. More complex plotters, full detail charts can do much more, including voyage planning, rapid input of waypoints, calculation of distances, courses and preparation of voyage time estimates.

Although plotters are a suitable tool for vessel operators to use to monitor their vessel activity in relation to depth-based management areas, it is not a suitable tool for monitoring fleetwide compliance with closed or restricted areas. The use of plotters as an viable alternative under Issue 1, monitoring systems, was rejected for several reasons including: 1) plotters are not tamper proof -- data could be deleted or false data could be loaded in the memory; 2) not all plotters are capable of storing the information necessary for the enforcement of depth-based management areas; 3) data stored on plotters would not be available until after the vessel returned to port or upon boarding; 4) the accuracy of charts and position information may vary between the different types and brands with some plotters collecting data that is not accurate enough for enforcement purposes; 5) plotters can easily be turned on and off by the vessel operator.

3.0 AFFECTED ENVIRONMENT

3.1 Physical Environment

California Current System. In the North Pacific Ocean, the large, clockwise-moving North Pacific Gyre circulates cold, sub-arctic surface water eastward splitting at the North American continent into the northward-moving Alaska Current and the southward-moving California Current (Figure 3.1.1). The California Current, a surface current, flows southward along the U.S. west coast and through the U.S. EEZ, the management area for the groundfish FMP. The California Current is known as an eastern boundary current, meaning that it draws ocean water along the eastern edge of an oceanic current gyre. Along the continental margin and beneath the California Current, waters off the U.S. West Coast are subject to major nutrient upwelling, particularly off Cape Mendocino (Bakun, 1996). Shoreline topographic features such as Cape Blanco, Point Conception and bathymetric features such as banks, canyons, and other submerged features, often create large-scale current patterns like eddies, jets, and squirts. Currents off Cape Blanco, for example, are known for a current "jet" that drives surface water offshore to be replaced by upwelling sub-surface water (Barth, et al, 2000). One of the better-known current eddies off the West Coast occurs in the Southern California Bight, between Point Conception and Baja California (Longhurst, 1998), wherein the current circles back on itself by moving in a northward and counterclockwise direction just within the Bight. The influence of these lesser current patterns and of the California Current on the physical and biological environment varies seasonally (Lynn, 1987) and through larger-scale climate variation, such as El Niño-La Niña or Pacific Decadal Oscillation (Longhurst, 1998).



Topography. Physical topography off the U.S. West Coast is characterized by a relatively narrow continental shelf. The 200 m depth contour shows a shelf break closest to the shoreline off Cape Mendocino, Point Sur, and in the Southern California Bight and widest from central Oregon north to the Canadian border as well as off Monterey Bay. Deep submarine canyons pocket the EEZ, with depths greater than 4,000 m common south of Cape Mendocino..

Essential Fish Habitat (EFH). EFH for Pacific Coast groundfish is defined as the aquatic habitat necessary to allow for groundfish production to support long-term sustainable fisheries for groundfish and for groundfish contributions to a healthy ecosystem. The groundfish species managed by the FMP occur throughout the EEZ and occupy diverse habitats at all stages in their life histories. Some species are widely dispersed during certain life stages, particularly those with pelagic eggs and larvae; the essential fish habitat (EFH) for these species/stages is correspondingly large. On the other hand, the EFH of some species/stages may be comparatively small, such as that of adults of many nearshore rockfishes which show strong affinities to a particular location or type of substrate. When these EFHs for all groundfish species are taken together, the groundfish fishery EFH includes all waters from the mean higher high water line, and the upriver extent of saltwater intrusion in river mouths seaward to the boundary of the U.S. EEZ.

The Pacific Coast groundfish FMP groups the various EFH descriptions into seven major habitat types called "composite" EFHs. This approach focuses on ecological relationships among species and between the species and their habitat, reflecting an ecosystem approach in defining EFH. The seven "composite" EFH identifications are as follows.

1. Estuarine **-** Those waters, substrates and associated biological communities within bays and estuaries of the EEZ, from mean higher high water level (MHHW, which is the high tide line) or extent of upriver saltwater intrusion to the respective outer boundaries for each bay or estuary as defined in 33 CFR 80.1 (Coast Guard lines of demarcation).

2. Rocky Shelf - Those waters, substrates, and associated biological communities living on or within 10 meters (5.5 fathoms) overlying rocky areas, including reefs, pinnacles, boulders and cobble, along the continental shelf, excluding canyons, from the high tide line MHHW to the shelf break (~200 meters or 109 fathoms).

3. Nonrocky Shelf - Those waters, substrates, and associated biological communities living on or within 10 meters (5.5 fathoms) overlying the substrates of the continental shelf, excluding the rocky shelf and canyon composites, from the high tide line MHHW to the shelf break (~200 meters or 109 fathoms).

4. Canyon - Those waters, substrates, and associated biological communities living within submarine canyons, including the walls, beds, seafloor, and any outcrops or landslide morphology, such as slump scarps and debris fields.

5. Continental Slope/Basin - Those waters, substrates, and biological communities living on or within 20 meters (11 fathoms) overlying the substrates of the continental slope and basin below the shelf break (~200 meters or 109 fathoms) and extending to the westward boundary of the EEZ.

6. Neritic Zone - Those waters and biological communities living in the water column more than 10 meters (5.5 fathoms) above the continental shelf.

7. Oceanic Zone - Those waters and biological communities living in the water column more than 20 meters (11 fathoms) above the continental slope and abyssal plain, extending to the westward boundary of the EEZ.

Life history and habitat needs for the species managed under the FMP are described in the EFH appendix to Amendment 11, which is available online at http://www.nwr.noaa.gov/1sustfsh/efhappendix/page1.html.

3.2 Biological Environment

3.2.1 Groundfish Resources

Each fishing year, the Council uses the best available stock assessment data to evaluate the biological condition of the Pacific Coast groundfish fishery and to develop estimates of ABCs for major groundfish stocks. The ABCs are biologically based estimates of the amount of fish that may be harvested from the fishery each year without jeopardizing the resource. The ABC may be modified to incorporate biological safety factors and risk assessment due to uncertainty.

The ABC for a species or species group is generally derived by multiplying the harvest rate proxy (F_{MSY} proxy) by the exploitable biomass. When setting the 2002 ABCs, the Council maintained a policy of using a default harvest rate as a proxy for the fishing mortality rate (F_{MSY} proxy) that is expected to achieve the maximum sustainable yield. Harvest rate policies must account for several complicating factors, including the age and size at which individuals in a stock reach maturity, the relative fecundity of mature individuals over time, and the optimal stock size for the highest level of productivity within that stock. Default harvest rate proxies were recommended by the Council's Scientific and Statistical Committee (SSC) in 2001 (66 FR 2338, January 11, 2001) continued to be used in 2002. These recommended harvest rate proxies are: $F_{40\%}$ for flatfish and whting, $F_{50\%}$ for rockfish (including thornyheads,) and $F_{45\%}$ for other groundfish such as sablefish and lingcod.

Harvest levels or OYs are established each year for the species or species groups that the Council proposes to manage. Groundfish species and species groups with OYs include bocaccio, canary rockfish, chilipepper rockfish, cowcod, darkblotched rockfish, Dover sole, lingcod, longspine thornyhead, the minor rockfish complexes (northern and southern for nearshore, continental shelf, and continental slope species,) Pacific cod, Pacific ocean perch, Pacific whiting, sablefish, shortbelly rockfish, shortspine thornyhead, splitnose rockfish, widow rockfish, yelloweye rockfish, and yellowtail rockfish. Numerical OYs are not set for every stock, especially where harvest has been less than ABC.

The Magnuson-Stevens Act requires an FMP to prevent overfishing. Overfishing is defined in the National Standards Guidelines (63 FR 24212, May 1, 1998) as exceeding the fishing mortality rate needed to produce maximum sustainable yield. The OY harvest levels are set at levels that are expected to prevent overfishing, equal to or less than the ABCs. The term "overfished" describes a stock whose abundance is below its overfished/rebuilding threshold. Overfished/rebuilding thresholds are generally linked to the same productivity assumptions that determine the ABC levels. The default value of this threshold is 25% of the estimated unfished biomass level or 50% of B_{MSY}, if known. Nine groundfish species are below the overfished threshold in 2002: bocaccio, canary rockfish, cowcod (south of Point Conception,) darkblotched rockfish, lingcod, Pacific whiting, Pacific ocean perch, widow rockfish, and yelloweye rockfish.

Table 3.2.1.1 , Summary of Stock Status for Pacific Coast Groundfish Species, summarizes the biological condition of the Pacific Coast groundfish stocks. More detailed information on the status of each of these species or species groups is available in the stock assessments associated with the annual SAFE report, as well as in the Environmental Assessment/Regulatory Impact Review/Initial Regulatory Flexibility Analysis for Proposed Groundfish ABC and OY specifications and management measures for the 2002 Pacific Coast Groundfish Fishery. These documents are available from the Council office.

Table 3.2.1.1. Summary of Stock Status for Pacific Coast Groundfish Species				
Species	**Year of Most Recent Stock Assessment**	**Biomass Estimate (% Unfished)**	**Did overfishing Occur in 2001? Was the fishing mortality above the MSST[1]?**	**Is the stock overfished in 2001? Was the Biomass below the MSST threshold?**
Roundfish				
Lingcod	2001 revision	15%	No	Yes
Pacific Cod			Unknown	Unknown
Pacific whiting	2002	24%	No	Yes
Sablefish	2002	31%-38%	No	No
Flatfish				
Dover sole	2001	29%	No	No
English sole	1993		Unknown	Unknown
Petrale sole	1999	42%	Unknown	Unknown
Arrowtooth	1993		No	No
Other flatfish			Unknown	Unknown
Rockfish				
POP	2000		No	Yes
Shortbelly	1989	>43%	No	No
Widow	2000	24%	No	Yes
Canary	2002	8%	No	Yes
Chilipepper	1998	46%-61%	No	No
Bocaccio	2002	3.6% Southern stock	No	Yes
Splitnose	1994		Unknown	Unknown
Yellowtail	2000	63%	No	No
Shortspine	2001	25%-50%	No	No
Longspine	1998	>40%	No	No
Darkblotched	2000	22%	No	Yes
Yelloweye	2002	24%	No	Yes
Cowcod	1999	4%-11%	No	Yes
Bank	2000	25%-31%	No	No
Black	1999 & 2001[2]	35% 2/	No	**No**
Blackgill	1998	51%	Unknown	Unknown
Redstripe			Unknown	Unknown
Sharpchin			Unknown	Unknown
Silvergrey			No	Unknown
Yellowmouth			Unknown	Unknown
Other rockfish			Unknown	**Unknown**
Other fish			Unknown	**Unknown**

1/ MSST The minimum stock size threshold (overfished/rebuilding threshold) is the default value of 25% of the estimated unfished biomass level or 50% of B_{MSY}, if known.
2/ 2001 update completed for Oregon only.

The Pacific Coast groundfish FMP manages over 80 species which are divided by type as follows: roundfish, flatfish, rockfish, sharks, skates, ratfish, morids, and grenadiers. These species, occur throughout the EEZ and occupy diverse habitats at all stages in their life history. Information on the interactions between the various groundfish species and between groundfish and non-groundfish species varies in completeness. While a few species have been intensely studied, there is relatively little information on most groundfish species

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Roundfish

Lingcod (*Ophiodon elongatus*), a top order predator of the family Hexagrammidae, ranges from Baja California to Kodiak Island in the Gulf of Alaska. Lingcod is demersal at all life stages (Allen and Smith 1988, NOAA 1990, Shaw and Hassler 1989). Adult lingcod prefer two main habitat types: slopes of submerged banks 10-70 m below the surface with seaweed, kelp and eelgrass beds and channels with swift currents that flow around rocky reefs (Emmett et al. 1991, Giorgi and Congleton 1984, NOAA 1990, Shaw and Hassler 1989). Juveniles prefer sandy substrates in estuaries and shallow subtidal zones (Emmett et al. 1991, Forrester 1969, Hart 1973, NOAA 1990, Shaw and Hassler 1989). As the juveniles grow they move to deeper waters. Adult lingcod are considered a relatively sedentary species, but there are reports of migrations of greater than 100 km by sexually immature fish (Jagielo 1990, Mathews and LaRiviere 1987, Mathews 1992, Smith et al. 1990).

Mature females live in deeper water than males and move from deep water to shallow water in the winter to spawn (Forrester 1969, Hart 1973, Jagielo 1990, LaRiviere et al. 1980, Mathews and LaRiviere 1987, Mathews 1992, Smith et al. 1990). Mature males may live their whole lives associated with a single rock reef, possibly out of fidelity to a prime spawning or feeding area (Allen and Smith 1988, 298, Shaw and Hassler 1989). Spawning generally occurs over rocky reefs in areas of swift current (Adams 1986, Adams and Hardwick 1992, Giorgi 1981, Giorgi and Congleton 1984, LaRiviere et al. 1980). After the females leave the spawning grounds, the males remain in nearshore areas to guard the nests until the eggs hatch. Hatching occurs in April off Washington but as early as January and as late as June at the geographic extremes of the lingcod range. Males begin maturing at about 2 years (50 cm), whereas females mature at 3+ years (76 cm). In the northern extent of their range, fish mature at an older age and larger size (Emmett et al. 1991, Hart 1973, Mathews and LaRiviere 1987, Miller and Geibel 1973, Shaw and Hassler 1989). The maximum age for lingcod is about 20 years (Adams and Hardwick 1992).

Lingcod are a visual predator, feeding primarily by day. Larvae are zooplanktivores (NOAA 1990). Small demersal juveniles prey upon copepods, shrimps and other small crustaceans. Larger juveniles shift to clupeids and other small fishes (Emmett et al. 1991, NOAA 1990). Adults feed primarily on demersal fishes (including smaller lingcod), squids, octopi and crabs (Hart 1973, Miller and Geibel 1973, Shaw and Hassler 1989). Lingcod eggs are eaten by gastropods, crabs, echinoderms, spiny dogfish, and cabezon. Juveniles and adults are eaten by marine mammals, sharks, and larger lingcod (Miller and Geibel 1973, NOAA 1990)

Pacific Cod (*Gadus macrocephalus*) are widely distributed in the coastal north Pacific, from the Bering Sea to southern California in the east, and to the Sea of Japan in the west. Adult Pacific cod occur as deep as 875 m (Allen and Smith 1988), but the vast majority occurs between 50 and 300 m (Allen and Smith 1988, Hart 1973, Love 1991, NOAA 1990). Along the West Coast, Pacific cod prefer shallow, soft-bottom habitats in marine and estuarine environments (Garrison and Miller 1982), although adults have been found associated with coarse sand and gravel substrates (Palsson 1990, Garrison and Miller 1982). Larvae and small juveniles are pelagic; large juveniles and adults are parademersal (Dunn and Matarese 1987, NOAA 1990). Adult Pacific cod are not considered to be a migratory species. There is however a seasonal bathymetric movement from deep spawning areas of the outer shelf and upper slope in fall and winter to shallow middle-upper shelf feeding grounds in the spring (Dunn and Matarese 1987, Hart 1973, NOAA 1990, Shimada and Kimura 1994).

Pacific cod have external fertilization (Hart 1973, NOAA 1990) and spawning from late fall to early spring. Their eggs are demersal. Larvae may be transported to nursery areas by tidal currents (Garrison and

Miller 1982). Half of females are mature by 3 years (55 cm), and half of males are mature by 2 years (45 cm) (Dunn and Matarese 1987, Hart 1973). Juveniles and adults are carnivorous, and feed at night (Allen and Smith 1988, Palsson 1990) with the main part of the adult Pacific cod diet being whatever prey species is most abundant (Kihara and Shimada 1988,Klovach et al. 1995). Larval feeding is poorly understood. Pelagic fish and sea birds eat Pacific cod larvae, while juveniles are eaten by larger demersal fishes, including Pacific cod. Adults are preyed upon by toothed whales, Pacific halibut, salmon shark, and larger Pacific cod (Hart 1973, Love 1991, NOAA 1990, Palsson 1990). The closest competitor of the Pacific cod for resources is the sablefish (Allen 1982).

Pacific Whiting (*Merluccius productus*), also known as Pacific hake, is a semi-pelagic merlucciid (a cod-like fish species) that range from Sanak Island in the western Gulf of Alaska to Magdalena Bay, Baja California Sur. They are most abundant in the California Current System (Bailey 1982, Hart 1973, Love 1991, NOAA 1990). Smaller populations of Pacific whiting occur in several of the larger semi-enclosed inlets of the northeast Pacific Ocean, including the Strait of Georgia, Puget Sound, and the Gulf of California (Bailey et al. 1982, Stauffer 1985). The highest densities of Pacific hake are usually between 50 and 500 m, but adults occur as deep as 920 m and as far offshore as 400 km (Bailey 1982, Bailey et al. 1982, Dark and Wilkins 1994, Dorn 1995, Hart 1973, NOAA 1990, Stauffer 1985). Hake school at depth during the day, then move to the surface and disband at night for feeding (McFarlane and Beamish 1986, Sumida and Moser 1984, Tanasich et al. 1991). Coastal stocks spawn off Baja California in the winter, then the mature adults begin moving northward and inshore, following food supply and Davidson currents (NOAA 1990). Hake reach as far north as southern British Columbia by fall. They then begin the southern migration to spawning grounds and further offshore (Bailey et al. 1982, Dorn 1995, Smith 1995, Stauffer 1985).

Spawning occurs from December through March, peaking in late January (Smith 1995). Pacific hake are oviparous with external fertilization. Eggs of the Pacific hake are neritic and float to neutral buoyancy (Baily 1981, Bailey et al. 1982, NOAA 1990). Hatching occurs in 5-6 days and within 3-4 months juveniles are typically 35 mm (Hollowed 1992). Juveniles move to deeper water as they get older (NOAA 1990). Females off mature at 3-4 years (34-40 cm,) and nearly all males are mature by 3 years (28 cm). Females grow more rapidly than males after four years; growth ceases for both sexes at 10-13 years (Bailey et al. 1982).

All life stages feed near the surface late at night and early in the morning (Sumida and Moser 1984). Larvae eat calanoid copepods, as well as their eggs and nauplii (McFarlane and Beamish 1986, Sumida and Moser 1984). Juveniles and small adults feed chiefly on euphausiids (NOAA 1990). Large adults also eat amphipods, squid, herring, smelt, crabs, and sometimes juvenile hake (Bailey 1982, Dark and Wilkins 1994, McFarlane and Beamish 1986, NOAA 1990). Eggs and larvae of Pacific hake are eaten by pollock, herring, invertebrates, and sometimes hake. Juveniles are eaten by lingcod, Pacific cod and rockfish species. Adults are preyed on by sablefish, albacore, pollock, Pacific cod, marine mammals, soupfin sharks and spiny dogfish (Fiscus 1979, McFarlane and Beamish 1986, NOAA 1990).

Sablefish (*Anoplopoma fimbria*) are abundant in the north Pacific, from Honshu Island, Japan, north to the Bering Sea, and southeast to Cedros Island, Baja California. There are at least three genetically distinct populations off the West Coast of North America: one south of Monterey characterized by slower growth rates and smaller average size, one that ranges from Monterey to the U.S./Canada border that is characterized by moderate growth rates and size, and one ranging off British Columbia and Alaska characterized by fast growth rates and large size. Large adults are uncommon south of Point Conception (Hart 1973, Love 1991, McFarlane and Beamish 1983a, McFarlane and Beamish 1983b, NOAA 1990). Adults are found as deep as 1,900 m, but are most abundant between 200 and 1,000 m (Beamish and McFarlane 1988, Kendall and Matarese 1987, Mason et al. 1983). Off southern California, sablefish were abundant to depths of 1500 m (MBC 1987). Adults and large juveniles commonly occur over sand and mud (McFarlane and Beamish 1983a, NOAA 1990) in deep marine waters. They were also reported on hard-packed mud and clay bottoms in the vicinity of submarine canyons (MBC 1987).

Spawning occurs annually in the late fall through winter in waters greater than 300 m (Hart 1973, NOAA 1990). Sablefish are oviparous with external fertilization (NOAA 1990). Eggs hatch in about 15 days (Mason et al. 1983, NOAA 1990) and are demersal until the yolk sac is absorbed (Mason et al. 1983). After yolk sac is absorbed, the age-0 juveniles become pelagic. Older juveniles and adults are benthopelagic. Larvae and small juveniles move inshore after spawning and may rear for up to four years (Boehlert and Yoklavich 1985, Mason et al. 1983). Older juveniles and adults inhabit progressively deeper waters. The best estimates indicate that 50% of females are mature at 5-6 years (24 inches), and 50% of males are mature at 5 years (20 inches).

Sablefish larvae prey on copepods and copepod nauplii. Pelagic juveniles feed on small fishes and cephalopods, mainly squids (Hart 1973, Mason et al. 1983). Demersal juveniles eat small demersal fishes, amphipods and krill (NOAA 1990). Adult sablefish feed on fishes like rockfishes and octopus (Hart 1973, McFarlane and Beamish 1983a). Larvae and pelagic juvenile sablefish are heavily preyed upon by sea birds and pelagic fishes. Juveniles are eaten by Pacific cod, Pacific halibut, lingcod, spiny dogfish, and marine mammals, such as Orca whales (Cailliet et al. 1988, Hart 1973, Love 1991, Mason et al. 1983, NOAA 1990). Sablefish compete with many other co-occurring species for food, mainly Pacific cod and spiny dogfish (Allen 1982).

Flatfish

Dover Sole (*Microstomus pacificus*) are distributed from the Navarin Canyon in the northwest Bering Sea and westernmost Aleutian Islands to San Cristobal Bay, Baja California (Hagerman 1952, Hart 1973, NOAA 1990). Dover sole are a dominant flatfish on the continental shelf and slope from Washington to southern California. Adults are demersal and are found from 9-1,450 m, with highest abundance below 200-300 m (Allen and Smith 1988). Adults and juveniles, show a high affinity toward soft bottoms of fine sand and mud. Juveniles are often found in deep nearshore waters. Dover sole are considered to be a migratory species. In the summer and fall, mature adults and juveniles can be found in shallow feeding grounds, as shallow as 55 m off British Columbia (Westrheim and Morgan 1963). By late fall, the Dover sole begin moving offshore into deep waters (400 m or more) to spawn. Although there is an inshore-offshore seasonal migration, little north-south coastal migration occurs (Westrheim and Morgan 1963)

Spawning occurs from November-April off Oregon and California (Hart 1973, NOAA 1990, Pearcy et al. 1977) in waters 80-550 m depth at or near the bottom (Hagerman 1952, Hart 1973, Pearcy et al. 1977). Dover sole are oviparous; fertilization is external. Larvae are planktonic, being transported offshore and to nursery areas by ocean currents and winds for up to two years. Settlement to benthic living occurs mid-autumn to early spring off Oregon, and February-July off California (Markle et al 1992). Juvenile fish move into deeper water with age, and begin seasonal spawning-feeding migrations upon reaching maturity.

Dover sole larvae eat copepods, eggs and nauplii, as well as other plankton. Juveniles and adults eat polychaetes, bivalves, brittlestars and small benthic crustaceans. Dover sole feed diurnally by sight and smell (Dark and Wilkins 1994, Gabriel and Pearcy 1981, Hart 1973, NOAA 1990). Dover sole larvae are eaten by pelagic fishes like albacore, jack mackerel and tuna, as well as sea birds. Juveniles and adults are preyed upon by sharks, demersally feeding marine mammals, and to some extent by sablefish (NOAA 1990). Dover sole compete with various eelpout species, rex sole, English sole, and other fishes of the mixed species flatfish assemblage (NOAA 1990).

English Sole (*Parophrys vetulus*) are found from Nunivak Island in the southeast Bering Sea and Agattu Island in the Aleutian Islands, to San Cristobal Bay, Baja California Sur (Allen and Smith 1988). In research survey data, nearly all occurred at depths <250 m (Allen and Smith 1988). Adults and juveniles prefer soft bottoms composed of fine sands and mud (Ketchen 1956), but also occur in eelgrass habitats (Pearson and Owen 1992). English sole uses nearshore coastal and estuarine waters as nursery areas (Krygier and Pearcy 1986, Rogers et al. 1988). Adults make limited migrations. Those off Washington show a northward post-spawning migration in the spring on their way to summer feeding grounds, and a southerly movement in the fall (Garrison and Miller 1982). Tagging studies have identified separate stocks based on this species' limited movements and meristic characteristics (Jow 1969).

Spawning occurs over soft-bottom mud substrates (Ketchen 1956) from winter to early spring depending on the stock. Eggs are neritic and buoyant, but sink just before hatching (Hart 1973), juveniles and adults are demersal (Garrison and Miller 1982). Small juveniles settle in the estuarine and shallow nearshore areas all along the coast, but are less common in southerly areas, particularly south of Point Conception. Large juveniles commonly occur up to depths of 150 m. Although many postlarvae may settle outside of estuaries, most will enter estuaries during some part of their first year of life (Gunderson et al. 1990). Some females mature as 3-year-olds (26 cm), but all females over 35 cm long are mature. Males mature at 2 years (21 cm).

Larvae are planktivorous. Juveniles and adults are carnivorous, eating copepods, amphipods, cumaceans, mysids, polychaetes, small bivalves, clam siphons, and other benthic invertebrates (Allen 1982, Becker 1984, Hogue and Carey 1982, Simenstad et al. 1079) . English sole feed primarily by day, using sight and smell, and sometimes dig for prey (Allen 1982, Hulberg and Oliver 1979). A juvenile English sole's main predators are probably piscivorous birds such as great blue heron (Ardia herodias), larger fishes and marine mammals. Adults may be eaten by marine mammals, sharks, and other large fishes.

Petrale Sole (*Eopsetta jordani*) are found form Cape St. Elias, Alaska to Coronado Island, Baja California. The range may possibly extend into the Bering Sea, but the species is rare north and west of southeast Alaska and in the inside waters of British Columbia (Garrison and Miller 1982, Hart 1973). Nine separate breeding stocks have been identified, although stocks intermingle on summer feeding grounds (Hart 1973, NOAA 1990). Of these nine, one occurs off British Columbia, two off Washington, two off Oregon and four off California (NOAA 1990). Adults are found from the surf line to 550 m, but their highest abundance is <300 m (NOAA 1990). Adults migrate seasonally between deepwater, winter spawning areas to shallower, spring feeding grounds (NOAA 1990). They show an affinity to sand, sandy mud and occasionally muddy substrates (NOAA 1990).

Spawning occurs over the continental shelf and continental slope to as deep as 550 m. Eggs are pelagic and juveniles and adults are demersal (Garrison and Miller 1982). Eggs and larvae are transported from offshore spawning areas to nearshore nursery areas by oceanic currents and wind. Larvae metamorphose into juveniles at six months (22 cm) and settle to the bottom of the inner continental shelf (Pearcy et al. 1977). Petrale sole tend to move into deeper water with increased age and size. Petrale sole begin maturing at three years. Half of males mature by seven years (29-43 cm) and half of the females are mature by eight years (>44 cm) (Pedersen 1975a, Pedersen 1975b). Near the Columbia River, petrale sole mature one to two years earlier (Pedersen 1975a, Pedersen 1975b).

Larvae are planktivorous. Small juveniles eat mysids, sculpins and other juvenile flatfishes. Large juveniles and adults eat shrimps and other decapod crustaceans, as well as euphausiids, pelagic fishes, ophiuroids and juvenile petrale sole (Garrison and Miller 1982, Hart 1973, 162, NOAA 1990, Pearcy et al. 1977, Pedersen 1975a, Pedersen 1975b). Petrale sole eggs and larvae are eaten by planktivorous invertebrates and pelagic fishes. Juveniles are preyed upon (sometimes heavily) by adult petrale sole, as well as other large flatfishes. Adults are preyed upon by sharks, demersally feeding marine mammals, and larger flatfishes and pelagic fishes (NOAA 1990). Petrale sole competes with other large flatfishes. It has the same summer feeding grounds as lingcod, English sole, rex sole and Dover sole (NOAA 1990).

Arrowtooth Flounder (*Atheresthes stomias*) range from the southern coast of Kamchatka to the northwest Bering Sea and Aleutian Islands to San Simeon, California. Arrowtooth flounder is the dominant flounder species on the outer continental shelf from the western Gulf of Alaska to Oregon. Eggs and larvae are pelagic; juveniles and adults are demersal (Garrison and Miller 1982, NOAA 1990). Juveniles and adults are most commonly found on sand or sandy gravel substrates, but occasionally occur over low-relief rock-sponge bottoms Arrowtooth flounder exhibit a strong migration from shallow water summer feeding grounds on the continental shelf to deep water spawning grounds over the continental slope (NOAA

1990). Depth distribution may vary from as little as 50 m in summer to more than 500 m in the winter (NOAA 1990, Rickey 1995).

Arrowtooth flounder are oviparous with external fertilization (Barry 1996). Spawning may occur deeper than 500 m off Washington (Rickey 1995). Larvae eat copepods, their eggs and copepod nauplii (Yang 1995, Yang and Livingston 1985). Juveniles and adults feed on crustaceans (mainly ocean pink shrimp and krill) and fish (mainly gadids, herring and pollock) (Hart 1973, NOAA 1990). Arrowtooth flounder exhibit two feeding peaks, at noon and midnight

"Other Flatfish" are those species that do not have individual ABC/OYs and include butter sole, curlfin sole, flathead sole, Pacific sand dab, rex sole, rock sole, sand sole, and starry flounder. Life history descriptions of these species may be found in the Essential Fish Habitat West Coast Groundfish which was prepared for amendment 11 to the FMP. This document may be requested from the Council office and is available http://www.nwr.noaa.gov/1sustfsh/efhappendix/page1.html

Rockfish

Pacific ocean perch (*Sebastes alutus*) are found from La Jolla (southern California) to the western boundary of the Aleutian Archipelago (Eschmeyer et al 1983, Gunderson 1971, Ito 1986, Miller and Lea 1972), but are common from Oregon northward (Eschmeyer et al 1983). Pacific ocean perch primarily inhabit waters of the upper continental slope (Dark and Wilkins 1994) and are found along the edge of the continental shelf (Archibald et al. 1983). Pacific ocean perch occur as deep as 825 m, but usually are at 100-450 m and along submarine canyons and depressions (NOAA 1990). Larvae and juveniles are pelagic; subadults and adults are benthopelagic. Adults form large schools 30 m wide, to 80 m deep, and as much as 1,300 m long (NOAA 1990). They also form spawning schools (Gunderson 1971). Juvenile Pacific ocean perch form ball-shaped schools near the surface or hide in rocks (NOAA 1990). Throughout its range, Pacific ocean perch is generally associated with gravel, rocky or boulder type substrate found in and along gullies, canyons, and submarine depressions of the upper continental slope (Ito 1986).

Pacific ocean perch winter and spawn in deeper water (>275 m), then move to feeding grounds in shallower water (180-220 m) in the summer (June-August) to allow gonads to ripen (Archibald et al. 1983, Gunderson 1971, NOAA 1990). Pacific ocean perch are slow-growing and long-lived. The maximum age has been estimated at about 90 years (ODFW, personal communication). Largest size is about 54 cm and 2 kg (Archibald et al. 1983, Beamish 1979, Eschmeyer et al. 1983, Ito 1986, Mulligan and Leaman 1992, NOAA 1990, Richards 1994). Pacific ocean perch are carnivorous. Larvae eat small zooplankton. Small juveniles eat copepods, and larger juveniles feed on euphausiids. Adults eat euphausiids, shrimps, squids, and small fishes. Immature fish feed throughout the year, but adults feed only seasonally, mostly April-August (NOAA 1990). Predators of Pacific ocean perch include sablefish and Pacific halibut.

Shortbelly rockfish (*Sebastes jordani*) are found from San Benito Islands, Baja California, Mexico to La Perouse Bank, British Columbia (Eschmeyer et al 1983, Lenarz 1980). The habitat of the shortbelly rockfish is wide ranging (Eschmeyer et al 1983). Shortbelly rockfish inhabit waters from 50-350 m in depth (Allen and Smith 1988) on the continental shelf (Chess et al. 1988) and upper-slope (Stull and Tang 1996). Adults commonly form very large schools over smooth bottom near the shelf break (Lenarz 1992). Shortbelly rockfish have also been observed along the Monterey Canyon ledge (Sullivan 1995). During the day shortbelly rockfish are found near the bottom in dense aggregations. At night they are more dispersed. (Chess et al 1988). During the summer shortbelly rockfish tend to move into deeper waters and to the north as they grow, but they do not make long return migrations to the south in the winter to spawn (Lenarz 1980).

Shortbelly rockfish are viviparous, bearing advanced yolk-sac larvae (Ralston et al 1996). Shortbelly rockfish spawn off California during January through April (Lenarz 1992). Larvae metamorphose to juveniles at 27 mm and appear to begin forming schools at the surface at that time (Laidig et al. 1991, Lenarz 1980). A few shortbelly rockfish mature at age 2, while 50% are mature at age 3 and nearly all are mature by age 4 (Lenarz 1992). They live to be about 10 years old (Lenarz 1980, MacGregor 1986) with the maximum recorded age being 22 years (Lenarz 1992).

Shortbelly rockfish feed primarily on various life stages of euphausiids and calanoid copepods both during the day and night (Chess et al. 1988, Lenarz et al. 1991). Shortbelly rockfish play a key role in the food chain, as they are preyed upon by chinook and coho salmon, lingcod, black rockfish, hake, bocaccio, chilipepper, pigeon guillemots, western gull, marine mammals, and others (Chess et al. 1988, Eschmeyer et al. 1983, Hobson and Howard 1989, Lenarz 1980).

Widow rockfish (*Sebastes entomelas*) range from Albatross Bank of Kodiak Island to Todos Santos Bay, Baja California (Eschmeyer et al. 1983, 176, Miller and Lea 1972, NOAA 1990). Widow rockfish occur over hard bottoms along the continental shelf (NOAA 1990) Widow rockfish prefer rocky banks, seamounts, ridges near canyons, headlands, and muddy bottoms near rocks. Large widow rockfish concentrations occur off headlands such as Cape Blanco, Cape Mendocino, Pt. Reyes, and Pt. Sur. Adults form dense, irregular, midwater and semi-demersal schools deeper than 100 m at night and disperse during the day (Eschmeyer et al. 1983, NOAA 1990, Wilkins 1986). All life stages are pelagic, but older juveniles and adults are often associated with the bottom (NOAA 1990). All life stages are fairly common from Washington to California (NOAA 1990). Pelagic larvae and juveniles co-occur with yellowtail rockfish, chilipepper, shortbelly rockfish, and bocaccio larvae and juveniles off central California (Reilly et al 1992).

Widow rockfish are viviparous, have internal fertilization, and brood their eggs until released as larvae (NOAA 1990, Ralston et al 1996, Reilly et al 1992). Mating occurs from late fall-early winter. Larval release occurs from December-February off California, and from February-March off Oregon. Juveniles are 21-31 mm at metamorphosis, and they grow to 25-26 cm over 3 years. Age and size at sexual maturity varies by region and sex, generally increasing northward and at older ages and larger sizes for females. Some mature in 3 years (25-26 cm), 50% are mature by 4-5 years (25-35 cm), and most are mature in 8 years (39-40 cm) (28, NOAA 1990). The maximum age of widow rockfish is 28 years, but rarely over 20 years for females and 15 years for males (NOAA 1990). The largest size is 53 cm, about 2.1 kg (Eschmeyer et al. 1983, NOAA 1990).

Widow rockfish are carnivorous. Adults feed on small pelagic crustaceans, midwater fishes (such as age-1 or younger Pacific hake), salps, caridean shrimp, and small squids (Adams 1987, NOAA 1990). During spring, the most important prey item is salps, during the fall fish are more important, and during the winter widow rockfish primarily eat sergestid shrimp (Adams 1987). Feeding is most intense in the spring after spawning (NOAA 1990). Pelagic juveniles are opportunistic feeders and their prey consists of various life stages of calanoid copepods, and euphausiids (Reilly et al. 1992).

Canary Rockfish (*Sebastes pinniger*) are found between Cape Colnett, Baja California, and southeastern Alaska (Boehlert 1980, Boehlert and Kappenman 1980, Hart 1973, Love 1991,Miller and Lea 1972, Richardson and Laroche 1979). There is a major population concentration of canary rockfish off Oregon (Richardson and Laroche 1979). Canary primarily inhabit waters 91-183 m deep (Boehlert and Kappenman 1980). In general, canary rockfish inhabit shallow water when they are young and deep water as adults (Mason 1995). Adult canary rockfish are associated with pinnacles and sharp drop-offs (Love 1991). Canary rockfish are most abundant above hard bottoms (Boehlert and Kappenman 1980). In the southern part of its range, the canary rockfish appears to be a reef-associated species (Boehlert 1980). In central California, newly settled canary rockfish are first observed at the seaward, sand-rock interface and farther seaward in deeper water (18-24 m).

Canary rockfish are ovoviviparous and have internal fertilization (Boehlert and Kappenman 1980, Richardson and Laroche 1979). Off California, canary rockfish spawn from November-March and from January-March off Oregon and, Washington, (Hart 1973, Love 1991, Richardson and Laroche 1979). The age of 50% maturity of canary rockfish is 9 years; nearly all are mature by age 13 . The maximum length canary rockfish grow to is 76 cm (Boehlert and Kappenman 1980, Hart 1973, Love 1991). Canary rockfish primarily prey on planktonic creatures, such as krill, and occasionally on fish (Love 1991). Canary rockfish feeding increases during the spring-summer upwelling period when euphausiids are the dominant prey and the frequency of empty stomachs is lower (Boehlert et al. 1989).

Chilipepper rockfish (*Sebastes goodei*) are found from Magdalena Bay, Baja California, to as far north as the northwest coast of Vancouver Island, British Columbia (Allen and Smith 1988, Hart 1973, Miller and Lea 1972). Chilipepper have been taken as deep as 425 m, but nearly all in survey catches were taken between 50 and 350 m (Allen and Smith 1988). Adults and older juveniles usually occur over the shelf and slope; larvae and small juveniles are generally found near the surface. In California, chilipepper are most commonly found associated with deep, high relief rocky areas and along cliff drop-offs (Love et al. 1990), as well as on sand and mud bottoms (MBC 1987). They are occasionally found over flat, hard substrates (Love et al. 1990). Love (Love 1981) does not consider this to be a migratory species. Chilipepper may migrate as far as 45 m off the bottom during the day to feed (Love 1981).

Chilipeppers are ovoviviparous, and eggs are fertilized internally (Reilly et al. 1992). Chilipepper school by sex just prior to spawning (MBC 1987). In California, fertilization of eggs begins in October ands spawning occurs from September to April (Oda 1992) with the peak being December to January (Love et al. 1990). Chilipepper may spawn multiple broods in a single season (Love et al. 1990). Females of the species are significantly larger, reaching lengths of up to 56 cm (Hart 1973). Males are usually smaller than 40 cm (Dark and Wilkins 1994). Males mature at 2 to 6 years of age and 50% are mature at 3 to 4 years. Females mature at 2 to 5 years with 50% mature at 3 to 4 years (MBC 1987). Females may attain an age of about 27 years whereas the maximum age for males is about 12 years (MBC 1987).

Larval and juvenile chilipepper eat all life stages of copepods and euphausiids, and are considered to be somewhat opportunistic feeders (Reilly et al. 1992). In California, adults prey on large euphausiids, squid, and small fishes such as anchovies, lanternfish and young hake (Hart 1973, Love et al. 1990). Chilipepper are found with widow rockfish, greenspotted rockfish, and swordspine rockfish (Love et al. 1990). Juvenile chilipepper compete for food with bocaccio, yellowtail rockfish, and shortbelly rockfish (Reilly et al. 1992).

Bocaccio rockfish (*Sebastes paucispinis*) are found in the Gulf of Alaska off Krozoff and Kodiak Islands, south as far as Sacramento Reef, Baja California (Hart 1973, Miller and Lea 1972). In survey catches, Allen and Smith (1988) found bocaccio to be most common at 100-150 m over the outer continental shelf. Sakuma and Ralston (1995) categorized bocaccio as both a nearshore and offshore species. Larvae and small juveniles are pelagic (Garrison and Miller 1982) and are commonly found in the upper 100 m of the water column, often far from shore (MBC 1987). Large juveniles and adults are semi-demersal and are most often found in shallow coastal waters over rocky bottoms associated with algae (Sakuma and Ralston). Adults are commonly found in eelgrass beds, or congregated around floating kelp beds (Love et al. 1990, Sakuma and Ralston). Young and adult bocaccio also occur around artificial structures, such as piers and oil platforms (MBC 1987). Although juveniles and adults are usually found around vertical relief, adult aggregations also occur over firm sand-mud bottoms (MBC 1987). Bocaccio move into shallow waters during their first year of life (Hart 1973), then move into deeper water with increased size and age (Garrison and Miller 1982).

Bocaccio are ovoviviparous (Garrison and Miller 1982, Hart 1973). Love et al. (1990) reported the spawning season to be protracted and last almost year-round (>10 months). Parturition occurs during January to April off Washington, November to March off northern and central California, and October to March off southern California (MBC 1987). Two or more broods may be born in a year in California (Love et al. 1990). The spawning season is not well known in northern waters. Males mature at 3 to 7 years with 50% mature in 4 to 5 years. Females mature at 3 to 8 years with 50% mature in 4 to 6 years(MBC 1987).

Larval bocaccio often eat diatoms, dinoflagellates, tintinnids, and cladocerans (Sumida and Moser 1984). Copepods and euphausiids of all life stages (adults, nauplii and egg masses) are common prey for juveniles (Sumida and Moser 1984). Adults eat small fishes associated with kelp beds, including other species of rockfishes, and occasionally small amounts of shellfish (Sumida and Moser 1984). Bocaccio are eaten by sharks, salmon, other rockfishes, lingcod and albacore, as well as sea lions, porpoises, and whales (MBC 1987). Bocaccio directly compete with chilipepper and widow, yellowtail, and shortbelly rockfishes for both food and habitat resources (Reilly et al. 1992).

Splitnose rockfish (*Sebastes diploproa*) occur from Prince William Sound, Alaska to San Martin Island, Baja California (Miller and Lea 1972). Splitnose rockfish occur from 0-800 m, with most of survey catches occurring in depths of 100-450 m (Allen and Smith 1988). The relative abundance of juveniles (<21 cm) is quite high in the 91-272 m depth zone and then decreases sharply in the 274-475 m depth zone (Boehlert 1980). Splitnose rockfish have a pelagic larval stage and prejuvenile stage, and a benthic juvenile stage (Boehlert 1977). Benthic splitnose rockfish associate with mud habitats (Boehlert 1980). Young occur in shallow water, often at the surface under drifting kelp (Eschmeyer et al. 1983). The major types of vegetation juveniles are found under are Fucus sp. (dominant), eelgrass, and bull kelp (Schaffer et al 1995). Juvenile splitnose rockfish off southern California are the dominant rockfish species found under drifting kelp (Boehlert 1977).

Splitnose are ovoviviparous and release yolk sac larvae (Boehlert 1977). They may have two parturition seasons, or may possibly release larvae throughout the year (Boehlert 1977). In general, the main parturition season get progressively shorter and later toward the north (Boehlert 1977). Splitnose rockfish growth rates vary with latitude, being generally faster in the north. Splitnose mean sizes increase with depth in a given latitudinal area. Mean lengths of females are generally greater than males (Boehlert 1980). Off California, 50% maturity occurs at 21 cm, or 5 years of age, whereas off British Columbia 50% of males and females are mature at 27 cm (Hart 1973). Adults can achieve a maximum size of 46 cm (Boehlert 1980, Eschmeyer et al. 1983, Hart 1973). Females have surface ages to 55 years and section ages to 81 years.

Adult splitnose rockfish off southern California feed on midwater plankton, primarily euphausiids (Allen 1982). Juveniles feed mainly on planktonic organisms, including copepods and cladocerans during June and August. In October, their diets shift to larger epiphytic prey and are dominated by a single amphipod species. Juvenile splitnose rockfish actively select prey (Schaffer et al. 1995) and are probably diurnally active (Allen 1982). Adults are probably nocturnally active, at least in part (Allen 1982).

Yellowtail rockfish (*Sebastes flavidus*) range from San Diego, California, to Kodiak Island, Alaska (Fraidenburg 1980, Gotshall 1981, Lorz et al. 1983, Love 1991, Miller and Lea 1972, Norton and MacFarlane 1995). The center of yellowtail rockfish abundance is from Oregon to British Columbia (Fraidenburg 1980). Yellowtail rockfish are a common, demersal species abundant over the middle shelf (Carlson 1972, Fraidenburg 1980, Tagert 1991, Weinberg 1994). Yellowtail rockfish are most common near the bottom, but not on the bottom (Love 1991, Stanely et al. 1994). Yellowtail adults are considered semi-pelagic (Stanely et al. 1994, Stein et al. 1992) or pelagic which allows them to range over wider areas than benthic rockfish (Pearcy 1992). Adult yellowtail rockfish occur along steeply sloping shores or above rocky reefs (Hart 1973). They can be found above mud with cobble, boulder and rock ridges, and sand habitats; they are not, however, found on mud, mud with boulder, or flat rock (Love 1991, Stein et al. 1992). Yellowtail rockfish form large (sometimes greater than 1,000 fish) schools and can be found alone or in association with other rockfishes (Love 1991, Pearcy 1992, Rosenthal et al. 1982, Stein et al. 1992, Tagert 1991). These schools may persist at the same location for many years (Pearcy 1992).

Yellowtail rockfish are viviparous (Norton and MacFarlane 1995) and mate from October to December. Parturition peaks in February and March and from November-March off California (Westrheim 1975). Young-of-the-year pelagic juveniles often appear in kelp beds beginning in April and live in and around kelp, in midwater during the day, descending to the bottom at night (Love 1991, Tagert 1991). Male yellowtail rockfish are 34-41 cm in length (5-9 years) at 50% maturity, females are 37-45 cm (6-10 years) (Tagert 1991). Yellowtail rockfish are long-lived and slow-growing; the oldest recorded was 64 years old (Fraidenburg 1981, Tagert 1991). Even though they are slow growing, like other rockfish, they have a high growth rate when compared to other rockfish (Tagert 1991). They reach a maximum size of about 55 cm in approximately 15 years (Tagert 1991). Yellowtail rockfish feed mainly on pelagic animals, but are opportunistic, occasionally eating benthic animals as well (Lorz et al. 1983). Large juveniles and adults eat fish (small hake, Pacific herring, smelt, anchovies, lanternfishes, and others), along with squid, krill, and other planktonic organisms (euphausiids, salps, and pyrosomes) (Love 1991, Phillips 1964, Rosenthal et al. 1982, Tagert 1991).

Shortspine Thornyhead (*Sebastolobus alascanus*) are found from northern Baja California to the Bering Sea and occasionally to the Commander Islands north of Japan (Jacobson and Vetter 1996). They are common from southern California northward (Love 1991). Shortspine thornyhead inhabit areas over the continental shelf and slope (Erickson and Pikitch 1993, Wakefield and Smith 1990). Although they can occur as shallow as 26 m (Eschmeyer et al. 1983), shortspine thornyhead mainly occur between 100 and 1400 m off Oregon and California, most commonly between 100-1000 m (Jacobson and Vetter 1996).

Spawning occurs in February and March off California (Wakefield and Smith 1990). Shortspine thornyhead are thought to be oviparous (Wakefield and Smith 1990), although there is no clear evidence to substantiate this (Erickson and Pikitch 1993). Eggs rise to the surface to develop and hatch. Larvae are pelagic for about 12-15 months. During January to June, juveniles settle onto the continental shelf and then move into deeper water as they become adults (Jacobson and Vetter 1996). Off California, they begin to mature at 5 years; 50% are mature by 12-13 years; and all are mature by 28 years (Owen and Jacobson 1992). Although it is difficult to determine the age of older individuals, Owen and Jacobson (Owen and Jacobson 1992) report that off California, they may live to over 100 years of age. The mean size of shortspine thornyhead increases with depth and is greatest at 1000-1400 m (Jacobson and Vetter 1996).

Benthic individuals are sit-and-wait predators that rest on the bottom and remain motionless for extended periods of time (Jacobson and Vetter 1996). Off Alaska, shortspine thornyhead eat a variety of invertebrates such as shrimps, crabs, and amphipods, as well as fishes and worms (Owen and Jacobson 1992)._ Longspine thornyhead are a common item found in the stomachs of shortspine thornyhead. Cannibalism of newly settled juveniles is important in the life history of thornyheads (Jacobson and Vetter 1996).

Longspine Thornyhead (*Sebastolobus altivelis*) are found from the southern tip of Baja California to the Aleutian Islands (Eschmeyer et al. 1983, Jacobson and Vetter 1996, Love 1991, Miller and Lea 1972, Smith and Brown 1983) but are abundant from southern California northward (Love 1991). Juvenile and adult longspine thornyhead are demersal and occupy the sediment surface (Smith and Brown 1983). Off Oregon and California, longspine thornyhead mainly occur at depths of 400-1400+ m, most between 600 and 1000 m in the oxygen minimum zone (Jacobson and Vetter 1996). Thornyhead larvae (Sebastolobus spp). have been taken in research surveys up to 560 km off the California coast (Cross 1987, Moser et al. 1993). Juveniles settle on the continental slope at about 600-1200 m (Jacobson and Vetter 1996). Longspine thornyhead live on soft bottoms, preferably sand or mud (Eschmeyer et al. 1983, Jacobson and Vetter 1996, Love 1991). Longspine thornyheads neither school nor aggregate (Jacobson and Vetter 1996).

Spawning occurs spawn in February and March at 600-1000 m (Jacobson and Vetter 1996, Wakefield and Smith 1990). Longspine thornyhead are oviparous and are multiple spawners, spawning 2-4 batches per season (Love 1991, Wakefield and Smith 1990). Eggs rise to the surface to develop and hatch. Floating egg masses can be seen at the surface in March, April, and May (Wakefield and Smith 1990). Juveniles (<5.1 cm long) occur in midwater (Eschmeyer et al. 1983). After settling, longspine thornyhead are completely benthic (Jacobson and Vetter 1996). Longspine thornyhead can grow to 38 cm (Eschmeyer et al. 1983, Jacobson and Vetter 1996, Miller and Lea 1972) and live more than 40 years (Jacobson and Vetter 1996). Longspine thornyhead reach the onset of sexual maturity at 17-19 cm TL (10% of females mature) and 90% are mature by 25-27 cm (Jacobson and Vetter 1996).

Longspine thornyhead are sit-and-wait predators (Jacobson and Vetter 1996). They consume fish fragments, crustaceans, bivalves, and polychaetes and occupy a tertiary consumer level in the food web. Pelagic juveniles prey largely on herbivorous euphausiids and occupy a secondary consumer level in the food web (Love 1991, Smith and Brown 1983). Longspine thornyhead are commonly seen in shortspine thornyhead stomachs. Cannibalism in newly settled longspine thornyhead may occur because juveniles settle directly onto adult habitat (Jacobson and Vetter 1996). Sablefish commonly prey on longspine thornyhead.

Darkblotched rockfish *(Sebastes crameri*) are found from Santa Catalina Island off southern California to the Bering Sea (Miller and Lea 1972, Richardson and Laroche 1979). Off Oregon, Washington, and British Columbia it is primarily an outer shelf/upper slope species (Richardson and Laroche 1979). Distinct population groups have been found off the Oregon coast between lat. 44 30' and 45 20'N (Richardson and Laroche 1979). Adults occur in depths of 25-600 m and 95% are between 50 and 400 m (Allen and Smith 1988). Off central California, young darkblotched rockfish recruit to soft substrate and low (<1 m) relief reefs (Love et al. 1991). Darkblotched rockfish make limited migrations after they have recruited to the adult stock (Gunderson 1997).

Darkblotched rockfish are viviparous (Nichol and Pickitch 1994). Insemination of female darkblotched rockfish occurs from August to December, fertilization and parturition occurs from December to March off Oregon and California, primarily in February off Oregon and Washington (Hart 1973, Nichol and Pickitch 1994, Richardson and Laroche 1979). Females attain 50% maturity at a greater size (36.5 cm) and age (8.4 years) than males (29.6 cm and 5.1 years) (Nichol and Pickitch 1994). Adults can grow to 57 cm (Hart 1973). Pelagic young are food for albacore (Hart 1973).

Yelloweye rockfish *(Sebastes ruberrimus*) range from the Aleutian Islands, Alaska to northern Baja California; they are common from central California northward to the Gulf of Alaska (Eschmeyer et al. 1983, Hart 1973, Love 1991, Miller and Lea 1972, O'Connell and Funk 1986). Yelloweye rockfish occur in water 25-550 m deep; 95% of survey catches occurred from 50 to 400 m (Allen and Smith 1988). Yelloweye rockfish are bottom dwelling, generally solitary, rocky reef fish, found either on or just over reefs (Eschmeyer et al. 1983, Love 1991, O'Connell and Funk 1986). Boulder areas in deep water (>180 m) are the most densely-populated habitat type and juveniles prefer shallow-zone broken-rock habitat (O'Connell and Carlile 1993). They also reportedly occur around steep cliffs and offshore pinnacles (Rosenthal et al. 1982). The presence of refuge spaces is an important factor affecting their occurrence (O'Connell and Carlile 1993).

Yelloweye rockfish are ovoviviparous and give birth to live young in June off Washington (Hart 1973). The age of first maturity is estimated at 6 years and all are estimated to be mature by 8 years (Echeverria 1987). Yelloweye rockfish can grow to 91 cm (Eschmeyer et al. 1983, Hart 1973). Males and females probably grow at the same rates (Love 1991, O'Connell and Funk 1986). The growth rate of yelloweye rockfish levels off at approximately 30 years of age (O'Connell and Funk 1986). Yelloweye rockfish can live to be 114 years old (Love 1991, O'Connell and Funk 1986). Yelloweye rockfish are a large predatory reef fish that usually feeds close to the bottom (Rosenthal et al. 1988). They have a widely varied diet, including fish, crabs, shrimps and snails, rockfish, cods, sand lances and herring (Love 1991). Yelloweyes have been observed underwater capturing smaller rockfish with rapid bursts of speed and agility. Off Oregon the major food items of the yelloweye rockfish include cancroid crabs, cottids, righteye flounders, adult rockfishes, and pandalid shrimps (Steiner 1978). Quillback and yelloweye rockfish have many trophic features in common (Rosenthal et al. 1988).

Cowcod *(Sebastes levis)* occur from Ranger Bank and Guadalupe Island, Baja California to Usal, Mendocino County, California (Miller and Lea 1972). Cowcod range from 21 to 366 m (Miller and Lea 1972) and is considered to be parademersal (transitional between a midwater pelagic and benthic species). Adults are commonly found at depths of 180-235 m and juveniles are most often found in 30-149 m of water (Love et al. 1990). MacGregor (MacGregor 1986) found that larval cowcod are almost exclusively found in southern California and may occur many miles offshore. Adult cowcod are primarily found over high relief rocky areas (Allen 1982); they are generally solitary, but occasionally aggregate (Love et al. 1990). Solitary subadult cowcod have been found in association with large white sea anemones on outfall pipes in Santa Monica Bay (Allen 1982). Juveniles occur over sandy bottom and solitary ones have been observed resting within a few centimeters of soft-bottom areas where gravel or other low relief was found (Allen 1982). Although the cowcod is generally not migratory; it may move to some extent to follow food (Love 1980). Cowcod are ovoviviparous, and large females may produce up to three broods per season (Love et al. 1990). Spawning peaks in January in the Southern California Bight (MacGregor 1986). Cowcod grow to 94 cm (Allen 1982). Larvae are extruded at about 5.0 mm (MacGregor 1986). Juveniles eat shrimp and crabs and adults eat fish, octopus, and squid (Allen 1982).

Bank rockfish (*Sebastes rufus*) are found from Newport, Oregon, to central Baja California, most commonly from Fort Bragg southward (Love 1992). Bank rockfish occur offshore (Eschmeyer et al. 1983) from depths of 31 to 247 m (Love 1992), although adults prefer depths over 210 m (Love et al. 1990). Observations of commercial catches indicate juveniles occupy the shallower part of the species range (Love et al. 1990). Bank rockfish are a midwater, aggregating species that is found over hard bottom (Love 1992), over high relief or on bank edges (Love et al. 1990), and along the ledge of Monterey Canyon (Sullivan 1995). It also frequents deep water over muddy or sandy bottom (Miller and Lea 1972). Spawning ranges from December to May (Love et al. 1990). Peak spawning in the Southern California Bight is January, in central and northern California it is February. Off California, bank rockfish are multiple brooders (Love et al. 1990). Females grow to a larger maximum size (50 cm) than males (44 cm), but grow at a slightly slower rate (Cailliet et al. 1996). Males reach first maturity at 28 cm, 50% maturity at 31 cm, and 100% at 38 cm. Females reach first maturity at 31 cm, 50% at 36 cm, and 100% maturity at 39 cm (Love et al. 1990). Bank rockfish are midwater feeders, eating mostly gelatinous planktonic organisms such as tunicates, but also preying on small fishes and krill (Love 1992).

Black rockfish (*Sebastes melanops*) are found from southern California (San Miguel Island) to the Aleutian Islands (Amchitka Island), and they occur most commonly from San Francisco northward (Hart 1973, Miller and Lea 1972, Phillips 1957, Stein and Hassler 1989). Black rockfish occur from the surface to greater than 366 m, however they are most abundant at depths less than 54 m (Stein and Hassler 1989). Off California, black rockfish are found along with the blue, olive, kelp, black-and-yellow, and gopher rockfishes (Hallacher and Roberts 1985) Adults are usually observed well up in the water column (Hallacher and Roberts 1985). The abundance of black rockfish in shallow water declines in the winter and increases in the summer (Stein and Hassler 1989). Densities of black rockfish decrease with depth during both the upwelling and non-upwelling seasons (Hallacher and Roberts 1985, PFMC 1996). Off Oregon larger fish seem to be found in deeper water (20-50 m) (Stein and Hassler 1989). Black rockfish off the northern Washington coast and outer Strait of Juan de Fuca exhibit no significant movement. However, fish appear to move from the central Washington coast southward to the Columbia River, but not into waters off Oregon. Movement displayed by black rockfish off the northern Oregon coast is primarily northward to the Columbia River (Culver 1986). Black rockfish form mixed sex, midwater schools, especially in shallow water (Hart 1973, Stein and Hassler 1989). Black rockfish larvae and young juveniles (<40-50 mm) are pelagic but are benthic at larger sizes (Laroche and Richardson 1980).

Black rockfish have internal fertilization and annual spawning (Stein and Hassler 1989). Parturition occurs from February-April off British Columbia, January-March off Oregon, and January-May off California (Stein and Hassler 1989). Spawning areas are unknown, but spawning may occur in offshore waters because gravid females have been caught well offshore (Dunn and Hitz 1969, Hart 1973, Stein and Hassler 1989). Black rockfish can live to be more than 20 years in age. The maximum length attained by the black rockfish is 60 cm (Hart 1973, Stein and Hassler 1989). Off Oregon, black rockfish primarily prey on pelagic nekton (anchovies and smelt) and zooplankton such as salps, mysids, and crab megalops. Off central California, juveniles eat copepods and zoea, while adults prey on juvenile rockfish, euphausiids, and amphipods during upwelling periods; during periods without upwelling they primarily consume invertebrates. Black rockfish feed almost exclusively in the water column (Culver 1986). Black rockfish are known to be eaten by lingcod and yelloweye rockfish (Stein and Hassler 1989).

Blackgill rockfish *(Sebastes melanostomus)* are distributed from Washington to Punta Abreojos (Love 1991, Moser and Ahlstom 1978). Adult blackgill rockfish are found offshore at depths of 219-768 m (Eschmeyer et al. 1983). Blackgill rockfish usually inhabit rocky or hard bottom habitats, along steep drop-offs, such as the edges of submarine canyons and over seamounts (Love 1991). However, they may also occur over soft-bottoms (Eschmeyer et al. 1983). Blackgill rockfish are a transitional species, occupying both midwater and benthic habitats (Love et al. 1990), although they are rarely taken at more than 9 m above the bottom (Love 1991). Blackgill are considered an aggregating species (Love 1991).

Blackgill rockfish spawn from January-June (peaking in February) off southern California, and in February off central and northern California (Love 1991, Love et al. 1990, Moser and Ahlstom 1978). The largest blackgill rockfish on record is 61 cm (Eschmeyer et al. 1983, Love 1991, Love et al. 1990). Blackgill rockfish primarily prey on such planktonic prey as euphausids and pelagic tunicates, as well as small fishes (e.g., juvenile rockfishes and hake, anchovies and lantern fishes) and squid (Love et al. 1990).

Redstripe rockfish *(Sebastes proriger)* occur from San Diego, California to the Bering Sea (Allen and Smith 1988, Hart 1973, Miller and Lea 1972). Redstripe rockfish inhabits the outer shelf and upper slope and are most common between 100 and 350 m (Allen and Smith 1988). Adults are semi-demersal, while larvae and juveniles are pelagic to semi-demersal (Garrison and Miller 1982). Young redstripe rockfish can occur in estuaries (Kendall and Lenarz 1986). Redstripe rockfish are generally found slightly off the bottom over both high and low relief rocky areas (Starr et al. 1996). Redstripe rockfish are very sedentary, exhibiting little or no movement from a home habitat or range (Matthes et al. 1986).

Redstripe rockfish are ovoviviparous (Garrison and Miller 1982). Off Oregon, larvae are released between April and July, but later off northern and central California, during July through September (Kendall and Lenarz 1986). Redstripe rockfish may grow to reach 61 cm (Hart 1973). Larvae and juveniles of this species were found to feed primarily on copepods, their eggs, and copepod nauplii, as well as all stages of euphausiids (Kendall and Lenarz 1986). Food of adult redstripe rockfish consists of small fish such as anchovies, herring and early stages of other groundfish, as well as squid (Starr et al. 1996). Redstripe rockfish may compete for food and habitat resources with widow, squarespot , shortbelly, and canary rockfishes, as well as lingcod and spiny dogfish (Erickson et al. 1991).

Sharpchin rockfish *(Sebastes zacentrus)* occur from San Diego, California, to the Aleutian Islands, Alaska (Allen and Smith 1988). Sharpchin rockfish occur from 25 to 475 m, but about 96% occur from 100 to 350 m (Allen and Smith 1988). Sharpchin rockfish can occur over soft bottoms (Eschmeyer et al. 1983), but they apparently prefer mud and cobble substrate and are associated with boulder and cobble fields (Stein et al. 1992)._ Parturition occurs from March through July off Oregon and from May through June off northern and central California (Echeverria 1987). Shortratker rockfish can grow to 33 cm (Miller and Lea 1972).

Silvergrey Rockfish *(Sebastes brevispinis)* are found from Santa Barbara Island, southern California, to the Bering Sea (Allen and Smith 1988, Hart 1973). Silvergray rockfish are included in the shelf rockfish assemblage (Hart 1973, Nagtegaal 1983) and inhabit the outer shelf-mesobenthal zone (Allen and Smith 1988)._ They occur in depths from 0 to 375 m with 95% of survey catches taken in depths of 100 to 300 m (Allen and Smith 1988)._ Off Oregon young are probably released in late spring or summer (Hart 1973, Allen and Smith 1988)._ Off Washington young are released in June (Hart 1973). They achieve a maximum size of 71 cm (Hart 1973).

Yellowmouth rockfish (Sebastes reedi) occur from Sitka, Alaska to Point Arena, California. Yellowmouth rockfish occupy a depth range from 137-366 m (Miller and Lea 1972)) usually 275-366 m over rough bottom (Kramer et al. 1995). Off Oregon, yellowmouth rockfish release their young from February through June (150). Yellowmouth females mature at 33 cm or larger (9 years old), and males mature at lengths greater than 31 cm (9 years old). They grow to 54 cm and can live to 34 years of age (Hart 1973).

"Other Rockfish" are those rockfish species that do not have individual ABC/OYs. Life history descriptions of these species may be found in the Essential Fish Habitat West Coast Groundfish which was prepared for amendment 11 to the FMP. This document may be requested from the Council office and is available http://www.nwr.noaa.gov/1sustfsh/efhappendix/page1.html

"OTHER FISH" are those groundfish species that do not have individual ABC/OYs. Life history descriptions of these species may be found in the Essential Fish Habitat West Coast Groundfish which

was prepared for amendment 11 to the FMP. This document may be requested from the Council office and is available http://www.nwr.noaa.gov/1sustfsh/efhappendix/page1.html

3.2.2 Endangered Species

West Coast marine species listed as endangered or threatened under the Endangered Species Act (ESA) are discussed below in sections 3.2.5 (Marine Mammals,) 3.2.6 (Seabirds,) 3.2.7 (Sea Turtles,) and 3.2.8 (Salmon). Under the ESA, a species is listed as "endangered" if it is in danger of extinction throughout a significant portion of its range and "threatened" if it is likely to become an endangered species within the foreseeable future throughout all, or a significant portion, of its range. The following species are subject to the conservation and management requirements of the ESA:

Table 3.2.2.1. West Coast Endangered Species
Marine Mammals
Threatened: • Steller sea lion (*Eumetopias jubatus*) Eastern Stock, Guadalupe fur seal (*Arctocephalus townsendi*), and Southern sea otter (*Enhydra lutris*) California Stock.
Seabirds
Endangered: Short-tail albatross (*Phoebastria (=Diomedea) albatrus*), California brown pelican (*Pelecanus occidentalis*), and California least tern (*Sterna antillarum browni*). **Threatened:** Marbled murrelet (*Brachyramphs marmoratus*).
Sea Turtles
Endangered: Green turtle (*Chelonia mydas*) Leatherback turtle (*Dermochelys coriacea*) Olive ridly turtle (*Lepidochelys olivacea*) **Threatened:** • Loggerhead turtle (*Caretta caretta*)
Salmon
Endangered: Chinook salmon (*Oncorhynchus tshawytscha)* Sacramento River Winter; Upper Columbia Spring Sockeye salmon (*Oncorhynchus nerka)* Snake River Steelhead trout (*Oncorhynchus mykiss)* Southern California; Upper Columbia **Threatened:** Coho salmon (*Oncorhynchus kisutch)* Central California, Southern Oregon, and Northern California Coasts Chinook salmon (*Oncorhynchus tshawytscha*) Snake River Fall, Spring, and Summer; Puget Sound; Lower Columbia; Upper Willamette; Central Valley Spring; California Coastal Chum salmon (*Oncorhynchus keta)* Hood Canal Summer; Columbia River Sockeye salmon (*Oncorhynchus nerka)* Ozette Lake Steelhead trout (*Oncorhynchus mykiss)* South-Central California, Central California Coast, Snake River Basin, Lower Columbia, California Central Valley, Upper Willamette, Middle Columbia, Northern California

3.2.3 Marine Mammals

The waters off Washington, Oregon, and California (WOC) support a wide variety of marine mammals. Approximately thirty species, including seals and sea lions, sea otters, and whales, dolphins, and porpoise, occur within the EEZ. Many marine mammal species seasonally migrate through West Coast waters, while others are year round residents. Table 3.2.3.1 identifies marine mammals of the WOC by community association.

There is limited information documenting the interactions of groundfish fisheries and marine mammals, but marine mammals are probably affected by many aspects of groundfish fisheries. The incidental take of marine mammals, defined as any serious injury or mortality resulting from commercial fishing operations, is reported to NMFS by vessel operators. In the West Coast groundfish fisheries, incidental take is infrequent and primarily occurs in trawl fisheries (Forney *et al.* 2000). Indirect effects of groundfish fisheries on marine mammals are more difficult to quantify due to a lack of behavioral and ecological information about marine mammals. However, marine mammals may be affected by increased noise in the oceans, change in prey availability, habitat changes due to fishing gear, vessel traffic in and around important habitat (e.g., areas used for foraging, breeding, raising offspring, or hauling-out), at-sea garbage dumping, and diesel or oil discharged into the water associated with commercial fisheries.

The Marine Mammal Protection Act (MMPA) and the ESA are the federal legislation that guide marine mammal species protection and conservation policy. Under the MMPA on the West Coast, NMFS is responsible for the management of cetaceans and pinnipeds, while the U.S. Fish and Wildlife Service (FWS) manages sea otters. Stock assessment reports review new information every year for strategic stocks (those whose human-caused mortality and injury exceeds the potential biological removal [PBR]) and every three years for non-strategic stocks. Marine mammals whose abundance falls below the optimum sustainable population (OSP) are listed as “depleted” according to the MMPA.

Fisheries that interact with species listed as depleted, threatened, or endangered may be subject to management restrictions under the MMPA and ESA. NMFS publishes an annual list of fisheries in the Federal Register separating commercial fisheries into one of three categories, based on the level of serious injury and mortality of marine mammals occurring incidentally in that fishery. The categorization of a fishery in the list of fisheries determines whether participants in that fishery are subject to certain provisions of the MMPA, such as registration, observer coverage, and take reduction plan requirements. The WOC groundfish fisheries are in Category III, indicating a remote likelihood of, or no known serious injuries or mortalities, to marine mammals.

Of the marine mammal species incidentally caught in WOC groundfish fisheries, the Steller sea lion is listed as threatened under the ESA, the northern elephant seal may be within their OSP range, and there is insufficient data to determine the status of the harbor seal, California sea lion, Dall’s porpoise, and Pacific white-sided dolphin relative to their OSP. None of these species are classified as strategic stocks under the MMPA. Based on its Category III status, the incidental take of marine mammals in the WOC groundfish fisheries does not significantly impact marine mammal stocks.

Table 3.2.3.1 **Marine Mammal Communities of the WOC**

Region	Nearshore	Shallow Shelf	Slope
Southern California	Harbor Porpoise Long-beaked dolphin Inshore bottlenose dolphin Minke whale Offshore bottlenosed dolphin Fin whale Dall's porpoise Risso's dolphin	Harbor Porpoise Inshore bottlenose dolphin N. right whale dolphin Bairds beaked whale Pacific white-sided dolphin Humpback whale Minke whale Offshore bottlenosed dolphin Killer whale Cuvier's beaked whale Fin whale Dall's porpoise Risso's dolphin Blue whale Short-finned pilot whale N. Right whale dolphin Mesoplodont beaked whales	Striped dolphin Offshore bottlenosed dolphin Cuvier's beaked whale Fin whale Blue whale N. Right whale dolphin Mesoplodont beaked whales
Central and Northern California	Harbor Porpoise Inshore bottlenose dolphin Killer whale Fin whale Dall's porpoise Blue whale	Harbor Porpoise Inshore bottlenose dolphin N. right whale dolphin Bairds beaked whale Pacific white-sided dolphin Humpback whale Minke whale Offshore bottlenosed dolphin Killer whale Cuvier's beaked whale Fin whale Dall's porpoise Risso's dolphin Blue whale Short-finned pilot whale N. Right whale dolphin Mesoplodont beaked whales	Sei whale Pygmy sperm whale Bryde's whale Offshore bottlenosed dolphin Killer whale Cuvier's beaked whale Fin whale Dall's porpoise Risso's dolphin Blue whale Short-finned pilot whale N. Right whale dolphin Mesoplodont beaked whales
Oregon - Brithish Coulmbia	Harbor Porpoise	Harbor Porpoise N. right whale dolphin Bairds beaked whale Pacific white-sided dolphin Humpback whale Minke whale Killer whale Fin whale Dall's porpoise Risso's dolphin Short-finned pilot whale N. Right whale dolphin	Bairds beaked whale Killer whale Cuvier's beaked whale Fin whale Dall's porpoise Risso's dolphin Mesoplodont beaked whales

3.2.4 Seabirds

Over sixty species of seabirds occur in waters off the coast of WOC within the EEZ. These species include: loons, grebes, albatross, fulmars, petrels, shearwaters, storm-petrels, pelicans, cormorants, frigate birds, phalaropes, skuas, jaegers, gulls, kittiwakes, skimmers, terns, guillemots, murrelets, auklets, and puffins. The migratory range of these species includes commercial fishing areas; fishing also occurs near the breeding colonies of many of these species.

Interactions between seabirds and fishing operations are wide-spread and have led to conservation concerns in many fisheries throughout the world. Abundant food in the form of offal (discarded fish and fish processing waste) and bait attract birds to fishing vessels. Of the gear used in the groundfish fisheries on the West Coast, seabirds are occasionally taken incidentally by trawl and pot gear, but they are most often taken by longline gear. Around longline vessels, seabirds forage for offal and bait that has fallen off hooks at or near the water's surface and are attracted to baited hooks near the water's surface during the setting of gear. If a bird becomes hooked while feeding on bait or offal, it can be dragged underwater and drowned. Of the incidental catch of seabirds by longline groundfish fisheries in Alaska, northern fulmars represented about 66% of the total estimated catch of all bird species, gulls contributed 18%, Laysan albatross 5%, and black-footed albatross about 4% (Stehn *et al.* 2001). Longline gear and fishing strategies in Alaska are similar to some, but not all, of those used in WOC longline fisheries.

Besides entanglement in fishing gear, seabirds may be indirectly affected by commercial fisheries in various ways. Change in prey availability may be linked to directed fishing and the discarding of fish and offal. Vessel traffic may affect seabirds when it occurs in and around important foraging and breeding habitat and increases the likelihood of bird storms. In addition, seabirds may be exposed to at-sea garbage dumping and the diesel and oil discharged into the water associated with commercial fisheries. The FWS is the primary federal agency responsible for seabird conservation and management. Under the Magnuson-Stevens Act, NMFS is required to ensure fishery management actions comply with other laws designed to protect seabirds.

3.2.5 Sea Turtles

Sea turtles are highly migratory; four of the six species found in U.S. waters have been sighted off the West Coast. Little is known about the interactions between sea turtles and West Coast commercial fisheries. The directed fishing for sea turtles in WOC groundfish fisheries is prohibited, because of their ESA listings, but the incidental take of sea turtles by longline or trawl gear may occur. Sea turtles are known to be taken incidentally by the California-based pelagic longline fleet and the California halibut gillnet fishery. Because of differences in gear and fishing strategies between those fisheries and the WOC groundfish fisheries, the expected take of sea turtles by groundfish gear is minimal. The management and conservation of sea turtles is shared between NMFS and FWS.

Sea turtles may be also indirectly affected by commercial fisheries. Sea turtles are vulnerable to collisions with vessels and can be killed or injured when struck, especially if struck with an engaged propeller. Entanglement in abandoned fishing gear can also cause death or injury to sea turtles by drowning or loss of a limb. The discard of garbage at sea can be harmful for sea turtles, because the ingestion of such garbage may choke or poison them. Sea turtles have ingested plastic bags, beverage six-pack rings, styrofoam, and other items commonly found aboard fishing vessels. The accidental discharge of diesel and oil from fishing vessels may also put sea turtles at risk, as they are sensitive to chemical contaminates in the water.

3.2.6 Salmon

Salmon caught in the U.S. West Coast fishery have life cycle ranges that include coastal streams and river systems from central California to Alaska and oceanic waters along the U.S. and Canada seaward into the north central Pacific Ocean, including Canadian territorial waters and the high seas. Some of the more critical portions of these ranges are the freshwater spawning grounds and migration routes.

Chinook or king salmon (*Oncorhynchus tshawytscha*) and coho or silver salmon (*O. kisutch*) are the main species caught in Council-managed ocean salmon fisheries. In odd-numbered years, catches of pink salmon (*O. gorbuscha*) can also be significant, primarily off Washington and Oregon. Ocean salmon are caught with commercial and recreational troll gear. No other gears are allowed to take and retain salmon in the ocean fisheries. Small amounts of rockfish and other groundfish are taken as incidental catch in salmon troll fisheries.

NMFS issued Biological Opinions under the ESA on August 10, 1990, November 26, 1991, August 28, 1992, September 27, 1993, May 14, 1996, and December 15, 1999 pertaining to the effects of the groundfish fishery on chinook salmon (Puget Sound, Snake River spring/summer, Snake River fall, upper Columbia River spring, lower Columbia River, upper Willamette River, Sacramento River winter, Central Valley, California coastal), coho salmon (Central California coastal, southern Oregon/northern California coastal, Oregon coastal), chum salmon (Hood Canal, Columbia River), sockeye salmon (Snake River, Ozette Lake), and steelhead (upper, middle and lower Columbia River, Snake River Basin, upper

Willamette River, central California coast, California Central Valley, south-central California, northern California, southern California).

3.2.7 Nongroundfish Species Interactions

Coastal Pelagic Species (CPS) CPS are schooling fish, not associated with the ocean bottom, that migrate in coastal waters. These species include: northern anchovy (*Engraulis mordax*), Pacific sardine (*Sardinops sagax*), Pacific (chub) mackerel (*Scomber japonicus*), jack mackerel (*Trachurus symmetricus*) and market squid (*Loligo opalescens*). These species are managed under the Coastal Pelagic Species Fishery Management Plan.

Sardines inhabit coastal subtropical and temperate waters and at times have been the most abundant fish species in the California current. During times of high abundance, Pacific sardine range from the tip of Baja California to southeastern Alaska. When abundance is low, Pacific sardine do not occur in large quantities north of Point Conception, California. Pacific (chub) mackerel in the northeastern Pacific range from Banderas Bay, Mexico to southeastern Alaska. They are common from Monterey Bay, California to Cabo San Lucas, Baja California, and most abundant south of Point Conception, California. The central subpopulation of northern anchovy ranges from San Francisco, California to Punta Baja, Mexico. Jack mackerel are a pelagic schooling fish that range widely throughout the northeastern Pacific, however much of their range lies outside the U.S. EEZ. Adult and juvenile market squid are distributed throughout the Alaska and California current systems, but are most abundant between Punta Eugenio, Baja California and Monterey Bay, Central California.

CPS are taken incidentally in the groundfish fishery. Incidental take is well documented in the at-sea and shore-based whiting fishery. Preliminary data for 2001 indicates approximately 321mt of jack mackerel, 469 mt of Pacific mackerel, and 55 mt of squid was incidentally taken in the at-sea whiting fishery. There is little information on the incidental take of CPS by the other segments of the fishery, however given CPS are not associated with the ocean bottom, the interaction is expected to be minimal.

Dungeness Crab The Dungeness crab (*Cancer magister*) is distributed from the Aleutian Islands, Alaska, to Monterey Bay, California. They live in bays, inlets, around estuaries, and on the continental shelf . Dungeness crab are found to a depth of about 180 m. Although it is found at times on mud and gravel, this crab is most abundant on sand bottoms; frequently it occurs among eelgrass. The Dungeness crab, which are typically harvested using traps (crab pots), ring nets, by hand (scuba divers) or dip nets, are incidentally taken or harmed unintentionally by groundfish gears.

Pacific Pink Shrimp Pacific pink shrimp (*Pandalus jordani*) are found from Unalaska in the Aleutian Islands to San Diego, California, at depths of 25 to 200 fm (46 to 366 m). Off the U.S. West Coast these shrimp are harvested with trawl gear from northern Washington to central California between 60 and 100 fm (110 to 180 m). The majority of the catch is taken off the coast of Oregon. Concentrations of pink shrimp are associated with well-defined areas of green mud and muddy-sand bottom. Shrimp trawl nets are usually constructed with net mesh sizes smaller than the net mesh sizes for legal groundfish trawl gear. Thus, it is shrimp trawlers that commonly take groundfish in association with shrimp, rather than the reverse.

Pacific Halibut Halibut (*Hippoglossus stenolepis*) belong to a family of flounders called Pleuronectidae. Halibut are usually found in deep water (40 to 200 m). The International Pacific Halibut Commission (IPHC) report, "Incidental Catch and Mortality of Pacific Halibut, 1962-2000" contains estimates of the incidental catches of halibut in the coastal trawl fisheries (groundfish and shrimp trawls). Estimates of incidental catches of halibut, based on the at-sea observer data collected in the Enhanced Data Collection Program conducted from 1995 through 1998, results in an estimated mortality level of legal-sized halibut incidentally taken in shrimp and groundfish trawl fisheries will be 254 mt (560,000 pounds) in 2002.

Forage Fish Forage fish are small, schooling fish which serve as an important source of food for other fish species, birds and marine mammals. Examples of forage fish species are herring (*Clupea harengus* *pallasi*), smelt (*Osmeridae*), anchovies, and sardine. Many species of fish feed on forage fish. Major predators of herring include Pacific cod (42% of diet), whiting (32%), lingcod (71%), halibut (53%), coho (58%), and chinook salmon (58%) (Environment Canada 1994). Many species of seabirds depend heavily on forage fish for food as well. Marine mammals consuming forage fish include: harbor seals, California sea lions, Stellar sea lions, harbor porpoises, Dall's porpoises, and Minke whales (Calambokidis and Baird 1994). Forage fish are most commonly found in nearshore waters and within bays and estuaries, although some do spend of their lives in the open ocean where they may be incidentally taken by groundfish gears, particularly in trawls. Preliminary data from the 2001 at-sea whiting fishery indicates the fishery encounters very minor amounts of forage fish species (Pacific herring less than 5 mt and less than 1 mt of smelt and sardines combined). There is little information on the incidental take of forage fish by the other segments of the fishery, however given they are not associated with the ocean bottom, the interaction is expected to be minimal.

Miscellaneous Species Little information is available on nongroundfish species incidentally captured in the groundfish fishery. Other than those species mentioned above, documentation from the whiting fishery indicates species such as American shad and walleye pollock are taken incidentally. American shad, introduced in 1885, have flourished throughout the lower Columbia River, producing a record run of 2.2 million fish in 1988 (ODFW and WDFW 1989). American shad was also taken in the shore-based whiting fishery. Walleye pollock are found in the waters of the Northeastern Pacific Ocean from the Sea of Japan, north to the Sea of Okhotsk, east in the Bering Sea and Gulf of Alaska, and south in the Northwestern Pacific Ocean along the Canadian and U.S. West Coast to Carmel, California.

3.3 SOCIO-ECONOMIC ENVIRONMENT

Protecting Overfished Species Within the Specifications and Management Measures Process. The major goal of management of the groundfish fishery throughout the 1990's was to prevent overfishing while achieving the OYs and providing year-round fisheries for the major species or species groups. One of the primary goals of the Pacific Coast groundfish FMP is to keep the fishery open throughout the entire year for most segments of the fishery (See FMP goals and objectives at section 2.0). Harvest rates are constrained by annual harvest guidelines, two-month or one-month cumulative period landings limits, individual trip limits, size limits, species-to-species ratio restrictions, bag limits in the recreational fisheries and other measures, all designed to control effort so that the allowable catch is taken at a slow rate that will stretch the season out to a full year. Cumulative period catch limits are set by comparing current or previous landings rates with the year's total available catch. Landings limits have been used to slow the pace of the fishery and stretch the fishing season out over as many months as possible, so that the overall harvest target is not reached until the end of the year.

By 2000, lower OYs and growing awareness of reduced productivity of the groundfish resource had made it apparent that the goal of a year-round fishery was no longer achievable for a number of species. In addition, new legislative mandates under the Magnuson-Stevens Act gave highest priority to preventing overfishing and rebuilding overfished stocks to their MSY levels. The National Standard Guidelines at 50 CFR 600.310 interpreted this as "weak stock management,'' which means that harvest of healthier stocks must be curtailed to prevent overfishing or to rebuild overfished stocks. To meet initial rebuilding requirements for the three species declared overfished in 1999, bocaccio, lingcod, POP, the Council developed a new management strategy that diverts effort off the sea floor of the continental shelf, where many of the overfished species are found. Overfished species protection measures initially applied in 2000 included more restrictive trip limits for continental shelf species, reduced seasons for commercial hook-and-line gear and recreational fisheries off central and southern California, and trawl gear restrictions limiting the species and quantities of groundfish that could be taken with trawl nets using footropes of greater than 8 inches in diameter.

These 2000 restrictions were relatively severe when compared against allowable landings limits in the 1990s. At the urging of their coastal communities, the governors of the three West Coast states asked the Secretary of Commerce, through NMFS, to declare the West Coast groundfish fishery a commercial fishery failure. At the time, NMFS estimated that allowable landings limits in 2000 would reduce the commercial harvest value of West Coast groundfish by 25% from 1999 harvest levels. NMFS did declare the groundfish fisheries to be a commercial fishery failure in January 2000 (Dalton, 2000). In its declaration, NMFS cited the potential causes of the fishery resource disaster to be declining productivity in groundfish stocks associated with recently discovered oceanic regime shifts, advancements in scientific information about West Coast rockfish productivity that showed West Coast rockfish stocks to be generally less productive than many similar rockfish species worldwide. Since 2000, management measures intended to eliminate directed catch and minimize incidental catch of overfished species have increased in number and in restrictiveness. Although year-round groundfish landings opportunities continue to be available to some gears in some areas, fishing opportunities have been eliminated for many vessels.

Bycatch and Discard Accounting Groundfish management measures include provisions to reduce trip limit-induced discards and to account for those discards when monitoring harvest levels (OYs). Historically, NMFS and the Council have accounted for dead discards by estimating the amounts of certain species OYs that would be discarded dead, and then subtracting those amounts from the total catch OYs to get landed catch levels for those species. These discard rates have been expressed as a percent of total catch OY, so that a 16 percent discard rate for a species meant that 16 percent of that species' total catch OY would be deducted to derive that species' landed catch OY. Then, management measures were set to achieve the landed catch OY for that species.

Using discard rates was intended to account for dead fish either as dead discard or in landed catch. For all species except lingcod, sablefish, and nearshore rockfish species, it is assumed that discarded fish are generally dead upon discard or die soon after being discarded. Rockfish, particularly deepwater species, are severely stressed by decompression and temperature shock; however, lingcod discard mortality studies show about a 50 percent discard survival rate. There is no exact measure of discard amounts in most fisheries. Assumed amounts are taken into account to determine the true fishing mortality level and to prevent overall harvest from exceeding the OYs.

For the 2002 specifications and management measures, the Council's Groundfish Management Team (GMT) and Scientific and Statistical Committee (SSC) considered how to improve historic methods of setting discard rates in annual groundfish management. In particular, analysts looked at ways to characterize the ratios of overfished species occurrence in fisheries targeting health groundfish stocks. This new approach for re-evaluated discard rates for five overfished species: bocaccio, lingcod, POP, canary rockfish, and darkblotched rockfish. The GMT also revised discard rates for other rockfish and rockfish complexes as a result of the new analysis.

This new bycatch and discard analysis calculated the co-occurrence of each of the five overfished species with healthy targeted stocks. To make these co-occurrence calculations, the analysis evaluated data on a suite of trawl fishery target strategies (targeting the deepwater DTS complex, targeting arrowtooth flounder, etc). Each target strategy was separated into six two-month periods to set a baseline of co-occurrence rates of overfished stocks throughout an entire calendar year. Not surprisingly, the analysis found seasonal variations in the co-occurrence rates between healthy and overfished stocks. The Council then used these baseline co-occurrence rates to set the discard rates for each of the overfished species that were to be deducted from their respective OYs. Further, the Council recommended setting a combination of trip limits and seasons intended to concentrate targeting on healthy stocks during times and in areas where incidental catch of overfished species was lowest. For any inseason management changes made during the year, the bycatch rate analysis was intended to guide Council decisions to ensure that no alterations could be made to trip limits for healthy stocks that would result in greater overfished species discard. Additional information on the bycatch analysis used in setting the 2002 specifications and management measures is available in the preambles to the proposed and final rules implementing that regulatory package, at 67 FR 1555 (January 11, 2002) and 67 FR 10490 (March 7, 2002,) respectively. Discard rates for individual groundfish species or species groups are provided in the footnotes to Table 1 of this notice.

In setting its 2003 specifications and management measures, the Council's advisory bodies did not re-evaluate the data and methods used in the 2002 specifications bycatch analysis. NMFS anticipates revising the co-occurrence rates in the bycatch analysis in early 2003, based the agency's evaluation of how those rates compare with rates recorded in the first year (August 2001 through August 2002) of the federal at sea observer program. Revised co-occurrence rates will be used to guide Council decisions on inseason actions in 2003, just as the original bycatch analysis guided those decisions in 2002.

To develop management measures for 2003 that would minimize bycatch and discard, the GMT and the SSC primarily discussed how best to modify the bycatch analysis so that it would account for varying fishing strategies by depth. As discussed earlier in this notice, the Council has introduced new closed areas for 2003, intended to prevent vessels from fishing in waters where overfished species are commonly found. The Council and its advisory bodies expected that introducing new depth-based management measures would require adjusting the bycatch analysis to better recognize fishing patterns in the areas remaining open to fishing. Additionally, 2003 depth-related revisions to the bycatch analysis would have to account for expected effort shift by vessels that had historically operated in the formerly open areas.

To account for varying fishing patterns by depth, the GMT estimated the percentage of effort shift to the remaining open fishing areas, then estimated the percentage of target species OYs that would be taken in the nearshore and offshore open areas. Some deepwater species, such as sablefish, may only be taken in the offshore open area, with similar harvest patterns in the nearshore open area for primarily nearshore species. Other species, such as Dover sole, are distributed more broadly and may be taken in both the nearshore and offshore open areas. Once it had set formulas to account for effort shift and target species availability in open fishing areas, the GMT could address expected bycatch rates within those open areas.

Using the bycatch rates approved by the Council for the 2002 groundfish fisheries, the GMT analyzed bycatch rates for the same combinations of healthy and overfished stocks shown by depth and by two-month fishing period in trawl logbooks. Because the bycatch rates shown in trawl logbooks for the total fishing area were less conservative than those chosen by the Council for 2002 management, the GMT assumed that depth-specific bycatch rates shown in the trawl logbooks were also not adequately conservative to meet the Council's guidance on bycatch rates. Thus, the GMT adjusted depth-specific trawl logbook bycatch rates by the ratio between the Council's 2001/2002 selected rates for all areas and the logbook rates for all areas. From these adjustments, the GMT set new depth and fishing period-specific bycatch rates that were compatible with the more conservative all areas bycatch rates the Council set in 2002. In designing trip limits, season closures, and other management measures, the GMT crafted trip limit scenarios for target and bycatch species taken in the open areas that were calculated to keep the total catch (landed + discard) of healthy target species and overfished species below their respective OYs.

3.3.1 Depth-Based Management.

Since 1998, groundfish management measures have been shaped by the need to rebuild overfished groundfish stocks. The over 80 species in the West Coast groundfish complex mix with each other to varying degrees throughout the year and in different portions of the water column. Some species, like Pacific whiting, are strongly aggregated, making them easier to target with relatively little bycatch of other species. Conversely, other species like canary rockfish may occur in species specific clusters, but are also found co-occurring with a wide variety of other groundfish species. Over the past several years, groundfish management measures have been more carefully crafted to recognize the tendencies of overfished species to co-occur with healthy stocks in certain times and areas.

With the 2002 specifications and management measures, the Council introduced a new bycatch analysis model, discussed earlier, that allowed managers to set trip limits so that more abundant stocks were more strongly targeted in times when they were less likely to co-occur with overfished stocks. The 2002 management measures primarily varied by time (two-month period) and by north-south management area (north of Cape Mendocino, between Cape Mendocino and Point Conception, south of Point Conception, etc). For 2003, the Council has recommended using a new management tool, depth based areas where fishing is restricted. Depth-based areas are intended to prevent vessels from fishing in depths where overfished species commonly occur while still allowing some fishing for more abundant stocks in the open areas.

Depth based management restrictions for the continental shelf were first introduced on September 13, 2002 (67 FR 57973,) with an emergency rule that closed trawling in the months of September-December 2002 in waters north of 40°10' N. lat. (approximately at Cape Mendocino) at depths where darkblotched rockfish commonly occurs. At its June 2002 meeting, the Council had found that the darkblotched rockfish estimated total catch was expected to exceed the OY before the end of 2002. In order to protect darkblotched rockfish from overharvest while still allowing fisheries access to underharvested healthy stocks, the Council asked NMFS to implement an emergency rule that would allow trawl gear only shoreward of 100 fm (184 m) and offshore of 250 fm (461 m). NMFS reviewed and implemented the Council's request, revising the restrictions to allow fishing shoreward of 100 fm (184 m) only in October-December and offshore of 250 fm (461 mt) in September-December, to prevent overharvest of canary rockfish and darkblotched rockfish in September.

The September-December 2002 closure was intended to specifically protect darkblotched rockfish, which are commonly caught by trawl gear in waters of 70-250 fm (128-457 m) depth. In designing 2003 management measures, the Council considered depth restrictions that would provide protection for several overfished species. Different closed areas are provided for different gear types, as not all gear types encounter each overfished species at the same rate or in similar areas. POP, for example, is almost exclusively caught in trawl fisheries, whereas yelloweye rockfish tends to be caught by hook-and-line gear.

For the limited entry bottom trawl fisheries north of 40°10' N. lat., canary rockfish tends to be available in 20-200 fm (37-366 m) depths, with higher catches in more shallow areas during the summer. As mentioned earlier, darkblotched rockfish tends to be found in 70-250 fm (128-457 m). To provide protection for all of these stocks in 2003, the Council recommended a closed area for bottom trawl fisheries north of 40°10' N. lat. of 100-250 fm (184-461 m) depths, with the inshore closed area boundary line moving to 75 fm (137 m) for the months of July-August. This closure is expected to protect canary and darkblotched rockfish in areas where they have historically been taken by trawl fisheries. In the months of January-February and November-December, the offshore closed area boundary would be revised to allow some bottom trawling in areas where petrale sole tends to aggregate. This closed area is also expected to protect other northern continental shelf and slope overfished species, such as lingcod, widow rockfish, POP, and yelloweye rockfish. Large footrope bottom trawling would be prohibited shoreward of the closed areas. Midwater trawling, as defined at 50 CFR §660.322(b)(6) would be permitted within the closed area for Pacific whiting, yellowtail and widow rockfish because these fishing strategies have historically encountered only small amounts of overfished species as bycatch. Trawling with open access exempted gear for species other than groundfish (spot prawn off Oregon and pink shrimp north of 40°10' N. lat) would be permitted within the closed area. However, the states require groundfish excluder devices to be used in the pink shrimp fishery.

In the limited entry bottom trawl and open access exempted trawl fisheries south of 40°10' N. lat., bocaccio tend to be found in 45-160 fm (82-293 m) depths and the greatest number of bocaccio tend to be taken between 40°10' N. lat. and 34°27' N. lat. (Point Conception). Although darkblotched rockfish are considered a northern species, they are also found between 40°10' N. lat. and 38° N. lat. To protect these overfished species, the Council recommended closing bottom trawling between 40°10' N. lat. and 38° N. lat. in 60-250 fm (110-457 m) depths, except that the inshore closed area boundary would be at 50 fm (91 m) in January-February. Between 38° N. lat. and 34°17' N. lat., bottom trawling would be closed in 60-150 fm (110-274 m) depths, except that the inshore closed area boundary would be at 50 fm (91 m) in January-February. South of 34°27' N. lat., bottom trawling would be permitted along the mainland coast (not off California islands) inside of 100 fm (183 m). Around the California islands, bottom trawling would be prohibited shoreward of 150 fm (274 m). Midwater trawling, as defined at 50 CFR §660.322(b)(6), would be permitted within the closed areas only for widow rockfish and whiting. For all areas, large footrope bottom trawling would be prohibited shoreward of the closed areas. Small footrope trawls are less able to fish in the rocky habitat preferred by many of the overfished rockfish species. In addition to these depth restrictions, the Cowcod Conservation Areas (CCAs) will remain closed to fishing offshore of 20 fm (37 m).

North of Cape Mendocino, limited entry fixed gear and open access hook-and-line fisheries have a greater effect on yelloweye rockfish and a lesser effect on darkblotched rockfish than trawl gear fisheries. Thus, depth restrictions for these fisheries were designed to prevent hook-and-line gear from operating in depths where yelloweye rockfish are commonly found, 100 fm (183 m) and shallower. The Council has recommended closing limited entry and open access hook-and-line fishing shoreward of the 100 fm (183 m) contour off the Washington coast, and between 27 fm (49 m) and 100 fm (183 m) off the Oregon coast and off California north of 40°10' N. lat. The 27 fm (49 m) contour occurs entirely in state waters off the state of Washington and commercial fishing for groundfish is prohibited in state waters off Washington, making an inshore closed area boundary moot for that state. Fishing is permitted shoreward of the 27 fm (49 m) boundary off Oregon and northern California because this area tends to be inshore of the areas where overfished species occur.

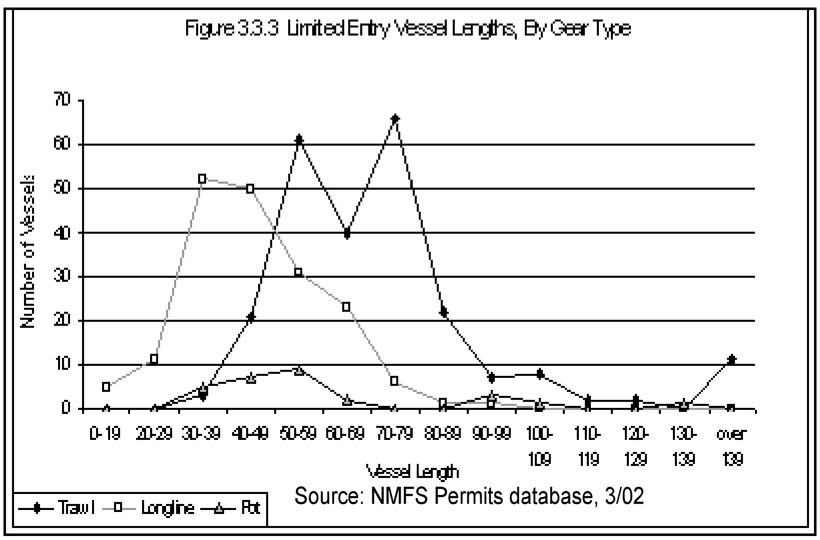
South of 40°10' N. lat., limited entry fixed gear and open access fisheries will be primarily constrained by management measures to protect bocaccio. Fishing will be prohibited between the 20 fm (37 m) and 150 fm (274 m) depth contours throughout the year. The Council recommended an exception to this prohibition for commercial vessels using hook-and-line gear with no more than 12 hooks per line and up to 1 lb (.45 kg) weight per line, using hooks no larger than “Number 2” hooks, which measure 11 mm (0.44 inches) point to shank. This type of gear is used by vessels fishing for Pacific sanddabs, an abundant species that does not usually co-occur with overfished species. Hook-and-line vessels will also be permitted to fish in waters of 20-60 fm (37-110 m) depths during July and August. In addition to these depth restrictions, the Cowcod Conservation Areas (CCAs) will remain closed to fishing offshore of 20 fm (37 m).

Recreational fisheries off Washington, Oregon, and California north of 40°10' N. lat. will be subject to fewer depth restrictions than the commercial fisheries, primarily because most recreational vessels tend to operate in the nearshore area inside state waters. Off Washington, recreational fishing for groundfish and halibut will be prohibited inside the Yelloweye Rockfish Conservation Area (YRCA,) a C-shaped closed area off the northern Washington coast. Coordinates for the YRCA will be defined at 50 CFR §660.304(d). Off Oregon and California north of 40°10' N. lat., recreational fishing for groundfish will be closed outside of 27 fm (49 m) if either the yelloweye or canary rockfish recreational fisheries set asides are projected to be achieved.

As in past years, recreational fisheries off California south of 40°10' N. lat., will be constrained by depth in order to reduce catch of bocaccio and other overfished rockfish species. Recreational fishing for groundfish will be prohibited entirely in waters offshore of the 20 fm (37 m) depth contour. The Cowcod Conservation Areas (CCAs) will also remain closed to fishing offshore of 20 fm (37 m). Coordinates defining the CCAs have changed modestly to ensure that the CCAs comply with depth-based restrictions for waters off southern California. CCA coordinates will be defined at 50 CFR 660.304(c).

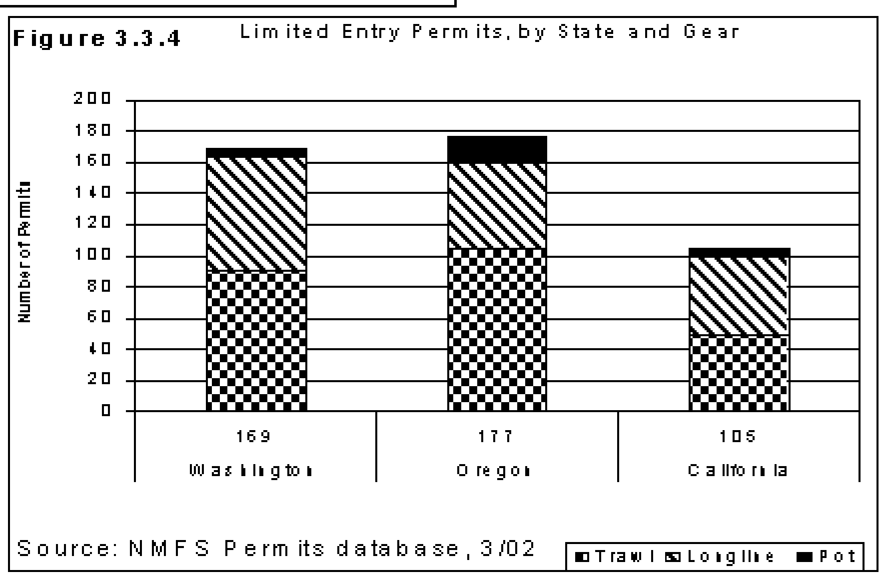
Many of the closed areas and boundary lines are generally described using a fathom contour line. All of these lines, except the 20 fm (37 m) contour off California south of 40°10' N. lat. and the 3 nautical mile state management line off California, are specifically defined in the regulations at IV.A. (19), using latitude/longitude waypoints. These waypoint coordinates provide straight-line boundaries that approximate the depth-contours to provide clarity to the closed area boundaries for enforcement purposes. To ensure that consistent nomenclature is used coastwide, an area closed to fishing for groundfish will be referred to as a “Groundfish Conservation Area” in general, regardless of whether the boundaries of that area change during the year. The YRCA and the CCA are defined by coordinates that are fixed throughout the year. The larger, gear or sector-specific closed areas described by depth contour boundaries for the 2003 fishing year will be referred to as “Rockfish Conservation Areas,” or RCAs. For example, there will be both a trawl RCA and a non-trawl RCA north of 40°10' N. lat. Boundaries for the RCAs will be referred to as either the “inshore boundary,” meaning the RCA boundary or borderline that is

closest to shore, or the “offshore boundary,” meaning the RCA boundary or borderline that is farthest offshore.
At its September meeting, the Council adopted the state of California’s recommendation to create a California Rockfish Conservation Area (CRCA) in waters south of 40°10' N. lat. To ensure consistent coastwide nomenclature, this area will be referred to as an RCA in federal regulations. NMFS anticipates that the Council and the state of California may continue to refer to the CRCA in management discussions. This RCA south of 40°10' N. lat. will be an area of restricted or no fishing intended to protect overfished rockfish species. This restricted area is proposed as ocean waters of 20-250 fm (37-457 m) depth between 40°10' N. lat. and 38° N. lat and waters of 20-150 fm (37-274 m) depth between 38° N. lat. and the U.S. border with Mexico. The restrictions for that area that apply to the groundfish fisheries and the exceptions to those restrictions are described earlier in the section on depth based management. Any vessel allowed to fish within the CRCA based on an exception to a fishing restriction would be required to accommodate a state or federal observer, if requested. In creating this RCA, the Council and the state of California wished to ensure that they had accounted for all fisheries that operate in waters where overfished rockfish species occur, whether state or federally managed. Several of the restrictions within the RCA affect only state-managed species and will be implemented through state regulations. Other restrictions affect federally-managed species other than groundfish, such as salmon, and will be implemented through federal salmon regulations.



3.3.2 Commercial Fisheries

Limited Entry Groundfish Fisheries. The Pacific Coast groundfish fishery is a year-round, multi-species fishery that takes place off the coasts of Washington, Oregon, and California. Most of the Pacific Coast non-tribal, commercial groundfish harvest is taken by the limited entry fleet. The groundfish limited entry program was established in 1994 for trawl, longline, and trap (or pot) gears with Amendment 6 to the FMP; a license limitation program intended to restrict vessel participation in the directed commercial groundfish fisheries off Washington, Oregon, and California. The limited entry permits that were created through that program specify the gear type that a permitted vessel may use to participate in the limited entry fishery, and the vessel length associated with the permit. A vessel may only participate in the fishery with the gear designated on its permit(s) and may only be registered to a permit



appropriate to the vessel's length. Since 1994, the Council has created further license restrictions for the limited entry fixed gear (longline and fish pot gear) fleet that restrict the number of permits useable in the primary sablefish fishery (Amendment 9) and that allow up to three sablefish-endorsed permits to be used per vessel (Amendment 14).

During 2001, 424 vessels were registered to Pacific Coast groundfish limited entry permits, of these 257 were trawl vessels, 140 were longline vessels, 11 were trap vessels, and 16 vessels that were capable of using a combination of gears. Of the 424 vessels that were registered to limited entry permits in 2001, only 386 actually landed groundfish, this included 233 trawl vessels, 129 longline vessels and 24 pot vessels. Trawl vessels that landed whiting in the at sea sector were included in this estimate. It should be noted that the number of vessels registered for use with limited entry permits has decreased since the 2001 implementation of the permit stacking program for sablefish-endorsed limited entry fixed gear permits.

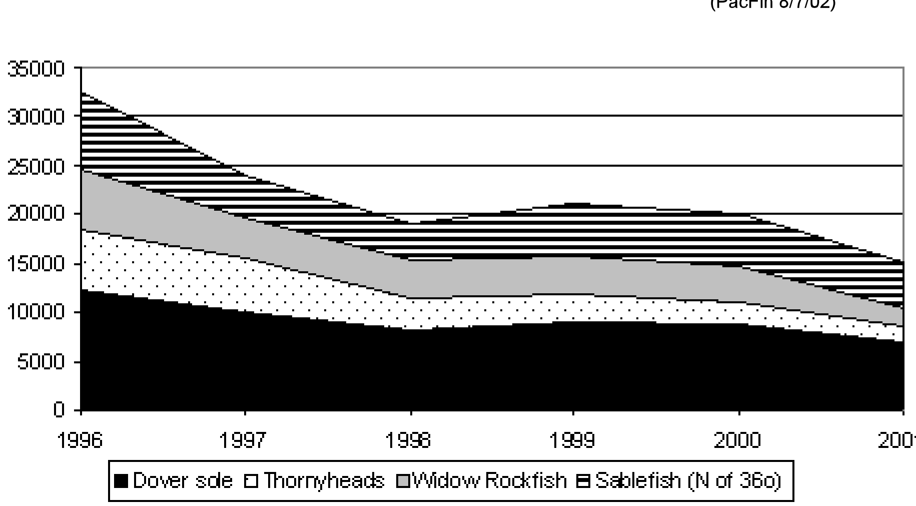
Table 3.3.2.1 Limited Entry Vessels by gear, 2001

	Gear group	Number of Limited Entry Vessels
Vessels registered to limited entry permits	Trawl (including catcher processors) Longline Pot Combined gears	257 140 11 16
	TOTAL	**424**
Vessels registered to limited entry permits that landed groundfish, including at-sea whiting, in 2001	Trawl (including catcher processors) Longline Pot	233 129 24
	TOTAL	**386**

Source: (Permits Database 10/02)

Because limited entry permits may be sold and leased out by their owners, the distribution of permits between the three states often shifts. In 2002, roughly 23 percent of the limited entry permits were assigned to vessels making landings in California, 39 percent to vessels making landings in Oregon, and 37 percent to vessels making landings in Washington. In 1999, this division of permits was approximately 41 percent for California, 37 percent for Oregon, and 21 percent for Washington. This change in state distribution of limited entry permits may also be due to the implementation of the fixed-gear permit stacking program. Vessels operating from northern ports may have purchased or leased sablefish-endorsed permits from vessels that had been operating out of California ports.

Figure 3.3.5 Groundfish Landings (Selected Species) 1996-2001, in metric tons (PacFin 8/7/02)



Limited entry fishers focus their efforts on many different species, with the largest landings by volume (other than Pacific whiting) being from the following species: Dover sole, arrowtooth flounder, petrale sole, sablefish, thornyheads, and yellowtail rockfish. There are 55+ rockfish species managed by the Pacific Coast groundfish FMP, of which seven species have been declared overfished in the past four years. Protective fisheries regulations intended to reduce the directed and incidental catch of overfished rockfish and other depleted species have significantly reduced the harvest of rockfish in recent years.

By weight, Pacific whiting represents the vast majority of West Coast groundfish landings. The whiting mid-water trawl fishery is a distinct component from the trawl groundfish trip limit fisheries. In 2001, whiting accounted for about 85 percent, by weight, of all commercial shore-based groundfish landings. Whiting is taken by treaty tribe catcher vessels delivering to a mothership (17.5% of total OY in 2002,) by non-tribal catcher vessels delivering to shore-based processing plants (42% of non-tribal OY,) by non-tribal catcher-vessels delivering to motherships (24% of non-tribal OY,) and by non-tribal catcher-processor vessels (34% of the non-tribal OY). In 2001, 29 catcher vessels delivered whiting to shore-based processing plants. This number is down from previous years, when the number of participating vessels was in the mid- to upper-30s. Some vessels move between the West Coast and Alaska fisheries; some remain entirely off Washington, Oregon, and California. In 2001, the v ast majority of whiting (about 73%) was landed in Oregon; Washington landings represented 24% of the total and California landings represented about 3.1%. Approximately 20 catcher vessels delivered to five motherships in 2001, and seven catcher-processor vessels participated in the whiting fishery. Also in 2001, four tribal catcher vessels delivered whiting to one mothership.

Catcher vessel owners and captains employ a variety of strategies to fill out a year of fishing. Fishers from the northern ports may fish in waters off of Alaska, as well as in the West Coast groundfish fishery. Others may change their operations throughout the year, targeting on salmon, shrimp, crab, or albacore, in addition to various high-value groundfish species, so as to spend more time in waters close to their communities. Factory trawlers and motherships fishing for or processing Pacific whiting off of the West Coast usually also participate in the Alaska pollock seasons, allowing the vessels and crews to spend a greater percentage of the year at work on the ocean. Commercial fisheries landings for species other than groundfish vary along the length of the coast. Dungeness crab landings are particularly high in Washington state, squid, anchovies, and other coastal pelagics figure heavily in California commercial landings, with salmon, shrimp, and highly migratory species like albacore more widely distributed, and varying from year to year.

Table 3.3.2.2. Number of at-sea whiting processors by sector, 1997 - 2001

	Catcher-processor	Mothership	Tribal
1997	10	6	1[1]
1998	7	6	1[1]
1999	6	6	1[1]
2000	8	6	1[1]
2001	7	5	1[1]

Summarized from NMFS NORPAC observer data
1/ this vessel participates in both the tribal and mothership fisheries

Table 3.3.2.3. Whiting landings (retained) by at-sea processing sectors, 1997 - 2000, metric tons

	Catcher-processor	Mothership	Tribal	All Sectors
1997	68,796	49,460	24,748	143,004
1998	69,692	49,705	23,846	143,243
1999	67,679	47,580	25,844	141,103
2000	67,649	46,710	6,251	120,610
2001	58,422	35,658	6,080	100,160

Summarized from NMFS NORPAC observer data

Table 3.3.2.4 Summary whiting catch and ex-vessel value by sector for the 2001 fishery

Number of motherships	Catch of Pacific whiting (mt) 1/	Range of Pacific whiting caught by catcher vessels (mt)	Average catch of Pacific whiting per catcher vessel (mt) 1/	Estimated Pacific whiting revenue per mothership ($1000) 2/	Estimated average Pacific whiting revenue per catcher vessel ($1000) 2/
5	35,823	5 - 4,339	1,327	553	106

Number of catcher processors	Pacific whiting (mt) 1/	Estimated revenue per catcher processor for Pacific whiting ($1000) 2/
7	58,628	646

Number of states with shoreside processors	Catch of Pacific whiting (mt) 3/	Estimated revenue per state for Pacific whiting ($1000) 2/
3	73,326	1,886

Number of tribal processors	Catch of Pacific whiting (mt) 1/	Range of Pacific whiting caught by catcher vessels (mt)	Average catch of Pacific whiting per catcher vessel (mt) 1/	Estimated Pacific whiting revenue per mothership ($1000) 2/	Estimated average Pacific whiting revenue per catcher vessel ($1000) 2/
1	6,080	881 - 1,900	1,517	469	117

1/ The source of catch information was NORPAC observer data.
2/ The price ($.035/lb) of whiting was obtained from PacFin. It is the price for July 2001; July had the greatest number of whiting landings coastwide.
3/ The source of catch information was the report "Shoreside Whiting Observer Program: 2001" prepared by Steve Parker, Marine Resource Program, Oregon Department of Fish and Wildlife, Newport, Oregon, 97365.

Figure 3.3.6b Groundfish Hook-and-Line (Includes Open Access) Vessel Participation in Non-Groundfish Fisheries

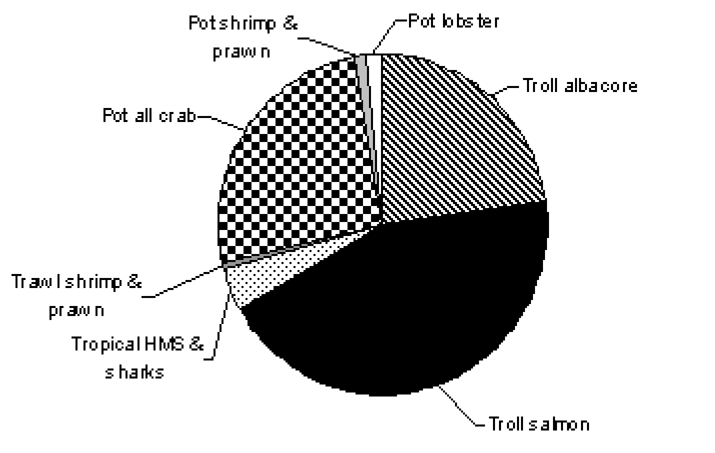


Figure 3.3.6c Groundfish Pot (Including Open Access) Vessel Participation in Non-Groundfish Fisheries

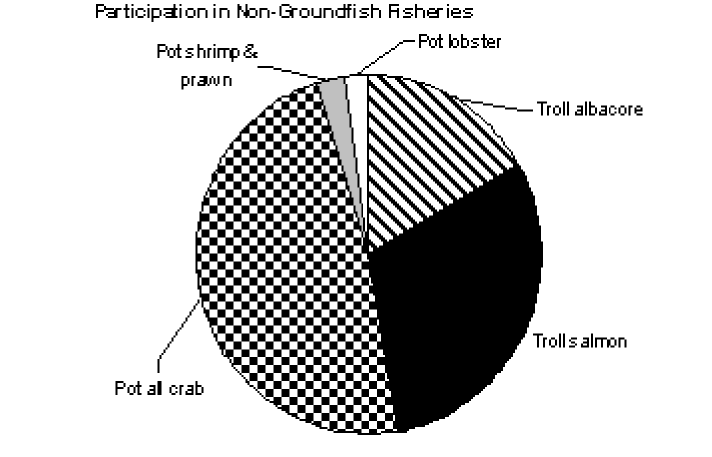
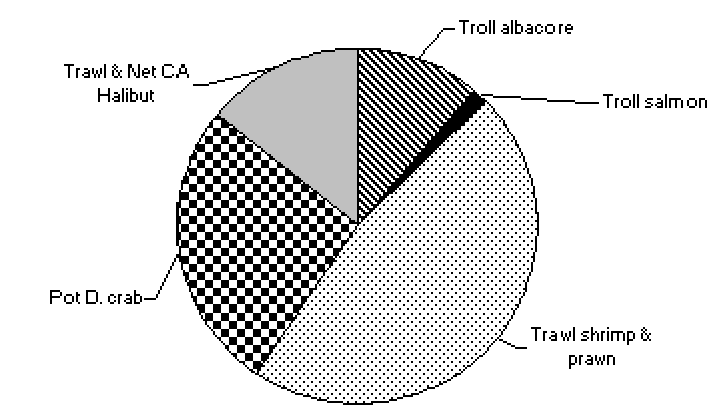


Figure 3.3.6a Groundfish Trawl Vessel Participation in Non-Groundfish Fisheries



Figures 3.3.6a-c, based on data from an ongoing project by Council staff to create an economic profile of groundfish fishery participants, shows the approximate concentration of groundfish vessels in fisheries for non-groundfish West Coast species, 1994-1998. These pie charts exclude some non-groundfish fisheries (such as lobster, urchin, sea bass, and California gillnet complex) where participation by groundfish vessels was so minimal that a viewer could not reasonably see the corresponding portion of the pie chart. Data for these charts came from an ongoing Council staff project to create a socio-economic profile of groundfish fishery participants.

It is clear from these three charts that there is some degree of gear loyalty for groundfish vessels participating in non-groundfish fisheries. For example, a notable proportion of the non-groundfish fishery participation by groundfish trawl vessels occurs in the shrimp and prawn trawl fisheries. Similarly, the hook-and-line groundfish fisheries show high participation in the troll albacore and troll salmon fisheries. And, while all three gear groups participate in pot fisheries for crab, groundfish pot vessels show the greatest percentage of gear group participation in pot fisheries for crab and other crustaceans.

Open Access Groundfish Fisheries. Unlike the limited entry sector, the open access fishery has unrestricted participation and is comprised of vessels targeting or incidentally catching groundfish with a variety of gears, excluding groundfish trawl gear. While the open access groundfish fishery is under federal management and does not have participation restrictions, some state and federally managed fisheries that land groundfish in the open access fishery have implemented their own limited entry (restricted access) fisheries or enacted management provisions that have affected participation in groundfish fisheries.

The commercial open access groundfish fishery consists of vessels that do not necessarily depend on revenue from the fishery as a major source of income. Many vessels that predominately fish for other species inadvertently catch and land groundfish. Or, in times and areas when fisheries for other species are not profitable, some vessels will transition into the groundfish open access fishery for short periods. The commercial open access fishery for groundfish is split between vessels targeting groundfish (*directed fishery*) and vessels targeting other species (*incidental fishery*). The number of unique vessels targeting groundfish in the open access fishery between 1995-1998 coastwide was 2,723, while 2,024 unique vessels landed groundfish as incidental catch (1,231 of these vessels participated in both) (SSC's Economic Subcommittee, 2000).

In the directed open access fishery, fishers target groundfish in the "dead" and/or "live" fish fishery using a variety of gears. The terms dead and live fish fisheries refers to the state of the fish when they are landed. The dead fish fishery has historically been the most common way to land fish. The dead fish fishery made up 80% of the directed open access landings by weight coastwide in 2001. More recently, the market value for live fish has increased landings of live groundfish. The other component of the open access fishery is the incidental catch of groundfish in fisheries targeting other species (e.g., shrimp, salmon, highly migratory species, squid). Combining both the directed and incidental fisheries, the commercial groundfish open access fishery is potentially very large and includes a variety of gear types.

Table 3.3.2.5. Open Access Fishery Landings in 1996 and 2001, by state, weight and value (PFMC 2002)

Open Access Sector	1996 landings by weight	2001 landings by weight
Coastwide Directed	3,291 mt	1,086 mt
Coastwide Incidental	802 mt	197 mt
Washington Directed	225 mt	66 mt
Washington Incidental	296 mt	28 mt
Oregon Directed	458 mt	237 mt
Oregon Incidental	384 mt	98 mt
California Directed	2,608 mt	776 mt
California Incidental	122 mt	70 mt

Landings, Revenue, and Participation by State Fisheries are generally distributed along the coast in patterns governed by factors such as location of target species, location of ports with supporting marine supplies and services, and restrictions/regulations of various state and federal governments. For the open access directed groundfish fishery, the majority of landings by weight that target groundfish occur off California. Oregon's directed groundfish open access fishery has the next highest landings, followed by Washington's. In the incidental groundfish fisheries, Oregon and California both have similar landings in their open access fisheries. Washington again has the lowest landings by weight of incidental groundfish (PFMC 2001e). Participation in "both directed and bycatch components of the open access fishery is much greater in California than in Oregon and Washington combined. For instance, in 1998, 779 California boats, 232 Oregon boats and 50 Washington boats participated in the directed fishery. In that same year, 520 California boats, 305 Oregon boats and 40 Washington boats participated in the bycatch fishery" (SSC's Economic Subcommittee, 2000).

Open access fisheries have been examined for their landings in the years 1996 and 2001, two randomly chosen years following the implementation of the limited entry program. Overall and in each individual state, open access landings decreased between 1996 and 2001. Federally, open access landings limits were sharply reduced between 1996 and 2001. Ex-vessel value for open access groundfish fisheries also decreased coastwide between 1996 and 2001. The directed fishery decreased from over $7 million in 1996 to under $5 million in 2001 and the incidental fishery decreased by half, from roughly $800,000 in 1996 to roughly $400,000 in 2001.

Table 3.3.2.3 Estimated Number of Open Access Incidental Catch Vessels by Fishery and the Number Estimated to Fish Within Any of the Conservation Areas

	Depth range of fishery	Number of vessels (2001) g/	Proportion estimated to operate within any of the conservation areas during 2003
North of 40°10 min			
Dungeness Crab	10- 50 fm c/ 10-40 fm c/	WA - 190 (232 permits) a/ OR - 306 (1999) a/ CA north - 330 a/	WA - 100% (190 -9 mo/year) OR - 50% est. (153 -9 mo/yr) CA - 50% est. (165- 8 mo/yr)
Pink shrimp- Trawl	25-200 fm a/	WA - 19 and OR - 84 a/	100% - 103
Spot prawn Trawl d/ Trap	80 -110 fm b/	WA-3 a/, OR-2 WA-10 a/, OR-10	100% - 25 (trap only WA)
Pacific Halibut	Primarily found 20-300fm	184 (238 including LE sablefish vessels) e/	100% - 184
Coastal Pelagic Species - wetfish	10-???	WA-11(44 permits) OR-15 (60 permits) CA -6 a/	WA-100% - 11 OR-50% est- 8 CA-50% est- 3
Sea cucumber	20-50 fm /f	OR- 0 (26 permits)	100% - 0
Other fisheries (Hagfish)	Fishery occurs out to 110 **	7 e/	100% - 7
South of 40°10 min			
CA Halibut Trawl Other	Primarily 20-50 fm, but some years inside 20 /f	92 h/ 356 h/	100%-448
Coastal Pelagic Species - squid	8-25 fm c/	115 a/ (197 permits c/)	20% est- 23
Coastal Pelagic Species - wetfish	10-???	107 a/	50% est - 54
Dungeness Crab	10-40 fm c/	central CA- 100 c/	50% est - 50
Gillnet complex	>50 fm some inside 20 fm f/	127 c/	80% est - 102 (6" footrope)
Pink shrimp - Trawl	25-200 fm a/	8 a/	100% - 8
Ridgeback prawn	25-88 fm a/	32 a/	100% -32
Sea cucumber	20-50 fm f/	13 a/	100% -13
Spot Prawn Trawl d/ Trap	25-267 fm a/ 100-180 fm (S. CA bight) a/	41 a/ 12 a/	100% - 53 (trap only)
CA Sheephead	<45 fm c/	124 c/	50% est - 62
Other fisheries	spiny lobster <70 fm c/	spiny lobster -251permits rock crab, sheep crab, surfperch, shark ???	50% est - 125 Others Unknown
Fisheries that occur both North and South of 40°10 min			
Salmon troll	??	1,194 a/	100% -1,194
Highly Migratory Species Longline Pole/line Gillnet/Driftnet Purse Seine		41 a/ 222 a/ 71 a/ 15 a/	0%
Total Number of Vessels (vessels that fish in multiple fisheries may be counted more than once)		**All commercial..... 4,098** **All OA................. 3,840**	**All Commercial..... 3,013** **All OA.................. 2,881**

a/ Based the Pacific Coast Groundfish Open Access Fishery Report, June 2002
b/ Personal communication with ODF&W staff
c/ CA living Marine Resources: Status Report
d/ Most prawnfishing will be pot only in 2003
e/ IPHC personal communication
f/ 2003 annual specification and management measures EIS
g/ Vessels that fished in multiple fisheries may be represented more than one time
h/CDFG personal communications

3.3.3 Tribal Groundfish Fisheries.

In addition to the non-tribal commercial fisheries, members of the Makah, Quileute, Hoh, and Quinault tribes participate in commercial, and ceremonial and subsistence fisheries for groundfish off the Washington coast.

In 1994, the U.S. government formally recognized that the four Washington Coastal Tribes (Makah, Quileute, Hoh, and Quinault) have treaty rights to fish for groundfish, and concluded that, in general terms, the quantification of those rights is 50 percent of the harvestable surplus of groundfish available in the tribes' usual and accustomed (U and A) fishing areas (described at 60 CFR 660.324). West Coast treaty tribes have formal allocations for sablefish, black rockfish, and Pacific whiting. Members of the four coastal treaty tribes participate in commercial, ceremonial, and subsistence fisheries for groundfish off the Washington coast. Participants in the tribal commercial fisheries operate off Washington and use similar gear to non-tribal fishers. Groundfish caught in the tribal commercial fishery pass through the same markets as non-tribal commercial groundfish catch.

In 2002, tribal sablefish longline fisheries were allocated 10% of the total catch OY (436.7 mt) and then were discounted 3% of that allocation for discard mortality, for a landed catch allocation of 424 mt. For the commercial harvest of black rockfish off Washington State, the treaty tribes have a harvest guideline of: 20,000 lb (9,072 kg) north of Cape Alava (48°09'30" N. lat.) and 10,000 lb (4,536 kg) between Destruction Island (47°40'00" N. lat.) and Leadbetter Point (46°38'10" N. lat.). In 1999 and 2000 32,500 mt of whiting was set aside for treaty Indian tribes on the coast of Washington state, resulting in a commercial OY of 199,500 mt for 2000. In 2001 and 2002 the landed catch OY declined to 190,400 mt and 129,600 mt, respectively, and the tribal allocations for those years were also reduced to 27,500 mt and 22,680 mt, respectively.

There are several groundfish species taken in tribal fisheries for which the tribes have no formal allocations. For some species on which the tribes have a modest harvest, no specific allocation has been determined. Rather than try to reserve specific allocations of these species, the tribes annually recommend trip limits for these species to the Council that accommodate modest tribal fisheries. Tribal trip limits for groundfish species without tribal allocations are usually intended to constrain direct catch and incidental retention of overfished species in the tribal groundfish fisheries.

The bulk of tribal groundfish landings occur during the March-April halibut and sablefish fisheries. Most continental shelf species taken in the tribal groundfish fisheries are taken during the halibut fisheries and most slope similarly taken during the tribal sablefish fisheries. Approximately one-third of the tribal sablefish allocation is taken during an open competition fishery, in which member vessels from the sablefish tribes all have access to this portion of the overall tribal sablefish allocation. The open competition portion tends to be taken during the same period as the major tribal commercial halibut fisheries in March and April. The remaining two-thirds of the tribal sablefish allocation are split between the sablefish tribes according to a mutually agreed-upon allocation scheme. Tribe-specific sablefish allocations are managed by the individual sablefish tribes, beginning in March and lasting into the autumn, depending on vessel participation management measures used. Participants in the halibut and sablefish fisheries tend to use hook-and-line gear, as required by the International Pacific Halibut Commission.

In addition to these hook-and-line fisheries, the Makah tribe annually harvests a whiting allocation using mid-water trawl gear. Since 1996, a portion of the U.S. whiting OY has been allocated to the Pacific Coast treaty tribes. The tribal allocation is subtracted from the whiting OY before allocation to the nontribal sectors. Since 1999, the tribal allocation has been based on a framework that is a sliding scale related to the U.S. whiting OY. To date, only the Makah tribe has fished on the tribal whiting allocation.

Table 3.3.3.1 Tribal Framework for Whiting Allocation, Adopted in 1999	
U.S. Optimum Yield	Tribal Allocation
Up to 145,000 mt	17.5% of the U.S. OY
145,001 mt to 175,000 mt	25,000 mt
175,001 mt to 200,000 mt	27,500 mt
200,001 mt to 225,000 mt	30,000 mt
225,001 mt to 250,000 mt	32,500 mt
Over 250,000 mt	35,000 mt

Makah vessels fit with mid-water trawl gear have also been targeting widow and yellowtail rockfish with mid-water gear in recent years.

Table 3.3.3.2 Treaty Tribe Groundfish Landings, 1995-2001. In pounds, except for whiting, which is in mt.

Species	1995	1996	1997	1998	1999	2000	2001
Lingcod	2,162	1,616	1,555	3,477	4,086	4,054	6,757
Rockfish (general)	110,673	38,105	48,969	54,638	41,379	32,827	131
Rockfish (red)	211	137	87	619	1,067	431	2,141
Widow Rockfish					73	2,012	8,445
Yellowtail Rockfish	734	1,087	2,528	10,370	29,281	71,124	150,254
Shortspine thornyhead	15,476	7,408	12,483	4,916	7,984	8,705	11,008
Sablefish	1,177,704	1,128,795	1,078,875	634,512	812,511	958,490	907,399
Whiting (in metric tons)		15,000	24,840	24,509	25,844	6,251	6,080

Twelve western Washington tribes possess and exercise treaty fishing rights to halibut, including the four tribes that possess treaty fishing rights to groundfish. Specific halibut allocations for the treaty Indian tribes began in 1986. The tribes did not harvest their full allocation until 1989, when the tribal fleet had developed to the point that it could harvest the entire Area 2A TAC. In 1993, judicial confirmation of treaty halibut rights occurred and treaty entitlement was established at 50 percent of the harvestable surplus of halibut in the tribes' combined U and A fishing grounds. In 2000, the courts ordered an adjustment to the halibut allocation for 2000-2007, to account for reductions in the tribal halibut allocation from 1989-1993. For 2000 through 2007, the non-tribal fisheries will be transferring at least 25,000 lb per year to the tribal fisheries, for a total of 200,000 lb to be transferred to the tribal fisheries over that period. Tribal allocations are divided into a tribal commercial component and the year-round ceremonial and subsistence (C &S) component.

Tribal commercial halibut fisheries have historically started at the same time as Alaskan and Canadian commercial halibut fisheries, generally in mid-March. The tribal halibut allocation is divided so that approximately 80 85% of allocation is taken in brief open competition derbies, in which vessels from all halibut tribes compete against each other for landings. In 2002, three of these “unrestricted” openings were held in the spring: a 48-hour opening on March 18th, a 24-hour opening on April 2nd, and a 36-hour opening on April 30th. In addition to these unrestricted openings, 15-20% of the tribal halibut allocation is reserved for “restricted” fisheries, in which participating vessels are restricted to a per trip and per day poundage limit for halibut. Two restricted opening opportunities were available in 2002, from March 20th through April 19th and from May 5th through 9th. Similar to the unrestricted openings, these restricted openings are available for vessels from all halibut tribes.

Table 3.3.3.3 Treaty Tribe Halibut Allocations and Catches, Dressed Weight, 1996-2001

Year	Commercial Allocation	Commercial Catch	C and S Allocation	C and S Catch
1996	168,000	166,200	14,000	15,000
1997	230,000	228,500	15,000	14,800
1998	272,000	296,600	15,000	10,500
1999	256,000	271,500	10,000	10,500
2000	305,000	300,100	10,500	17,500
2001	406,500	411,600	17,500	16,000

3.3.4 Recreational Fishery

The recreational or sport fishery, where fishing is done for pleasure and not sale, has been part of the culture and economy of West Coast fishing communities for more than 50 years. Most recreational anglers use hook and line gear that is held directly in the hand or is attached to a pole or rod that is held in the hand. Recreational fishing occurs along the entire coast. Anglers fish from man-made structures such as piers, jetties, docks; natural shore areas; privately owned or rental boats; and charter vessels.

Licenses for the individual sport anglers are issued by the states of Washington, Oregon and California , with each state having its own specific requirements. Sport fishing licences are issued to residents and non-residents and may vary in cost by the level of participation (i.e.: 1-day, 2-day, annual), fishery, and fishing location. In addition, there may be a few special days each year where anyone can fish without a fishing license. In California, anyone 16 years and older must have a fishing license to take any kind of marine fish, except for persons angling from a public pier in ocean or bay waters. Only a basic fishing license is required for fishing in the ocean north of Point Arguello (34° 35' N. lat.) in Santa Barbara County, while an Ocean Enhancement Stamp is required for ocean fishing south of Point Arguello (except when fishing under authority of a two-day sport fishing license). One-day Pacific Ocean-only licenses, with or without an Ocean Enhancement Stamp are also issued. In Oregon, anyone 14 years or older is required to have a general angling license to fish for or land marine fish except when fishing for smelt or when they are a resident landowner or member of their immediate family and are angling on land they own and reside upon. In Oregon, all anglers, regardless of age, need a Combined Harvest Tag to fish for salmon, steelhead, sturgeon, and halibut. When angling in the Pacific ocean within 3 miles of shore between Cape Falcon, Oregon and Leadbetter point, Washington, either a resident Washington license or an Oregon license is valid. In Washington, a saltwater license is required for anyone who is 16 years or older and allows the license holder to fish for any species existing in saltwater, including salmon, steelhead, sturgeon, halibut, rockfish, etc.

> In 1998, an economic survey funded by NMFS and coordinated with the PSMFC was conducted. Anglers were asked to participate in a telephone interview in addition to the interview conducted in the field. The following are some highlights from the survey that provide general socio-economic information on the recreational fishery:
>
> 1) 81% of the 37,570 anglers interviewed in California, Oregon and Washington provided trip information, including fishing expenditures.
>
> 2) Average year of birth for anglers was 1953.
>
> 3) Average rank of saltwater fishing ability on a scale of 1 to 5 was 3.2.
>
> 4) Average years of saltwater fishing experience was 20 years.
>
> 5) Average annual personal income before taxes was $57,000.
>
> 6) Average annual household income before taxes was $58,000.
>
> 7) Average hourly wage was $20.
>
> 8) Average hours worked per week was 45.
>
> 9) Average annual expenditure on fishing gear was $545.
>
> 10) Average annual expenditure on fishing licenses was $82.
>
> 11) Average annual expenditure on maintenance and repair of boats used for saltwater fishing was $640.
>
> 12) 20% of anglers stayed away from home overnight when they went fishing.
>
> 13) 64% of anglers whose fishing involved an overnight stay away from home indicated that the primary purpose of their trip was fishing
>
> 14) Average expenditure per trip for gear, bait, boat fuel, boat fees, parking fees and daily license was $29.
>
> 15) For those anglers who gave up income to make a fishing trip, average income foregone for such trips was $162.

Similarly, the states register and issue licenses for recreational boats owned and operated by state residents. The registration requirements and fees vary between the states and are based on type and size of vessel. In California, every sail-powered vessel over 8 feet in length (except wind surfing boards) and every motor driven boat not registered by the U. S. Coast Guard that is used in California state waters is subject to registration. In Oregon, the Oregon State Marine Board is responsible for registering and titling all recreational boating vessels. Registration and title fees and marine fuel taxes support boating facilities, marine law enforcement and boating safety education. All motorized boats, regardless of length or type, must be registered and sailboats 12 feet or longer must also be registered, In Oregon . In Washington state, motorized vessels and any vessel that is 16 feet or longer must be registered with the state.

Charter fishing as defined in section 2101(21a) of title 46, United States Code, is fishing from a vessel that is hired to carry passengers who engage in recreational fishing. In the Pacific Coast groundfish fishery, there are two categories of charter vessels, party boats (also called “Six-Packs”) and U.S.C.G. Certified passenger vessels (also called commercial passenger fishing vessels). The party boats are authorized by the U.S. Coast Guard to carry no more than six paying passengers. In general, these boats are smaller (although not necessarily small), are not required to pass rigorous Coast Guard inspection requirements and can be operated by skipper with a lower license rating. Commercial passenger fishing vessels are certified by the U.S. Coast Guard to carry a specific number of passengers. The vessels undergo a rigorous inspection every two years and must meet strict standards. Captains must also have a license to operate the vessel. In addition, if the certified boat is out for more than 12 hours, as in an over night trip, a second licensed captain must be on board. Table 3.3.4.1 shows the number of recreational charter vessels by port for 2001.

Within the recreational fishery, groundfish are both targeted and caught incidentally when other species such as salmon, are targeted. Until recent years, it was thought that commercial fisheries took the vast majority of marine fishery catch in the EEZ. However, recent data indicate that catches by the recreational fisheries are a significant portion of the total landings of some groundfish species. For some overfished species, such as lingcod (55% of OY for recreational fishery), canary rockfish (34% of OY for recreational fishery), bocaccio (25% of OY for recreational fishery), and yelloweye rockfish (% of OY for recreational fishery), there are significant recreational catches. Table 3.3.4.2 shows the relationship of recreational and commercial total rockfish harvests, 1993-2001.

Table 3.3.4.1 Number of Recreational Charter Vessels Fishing in Ocean Waters in 2001, by Port

State	Port/area	Number of Recreational Charter Vessels
Washington	Neah Bay	15
	La Push	2
	Westport	32
	Ilwaco	28
	TOTAL	77
Oregon	Astoria	22
	Tillamook	51
	Newport	45
	Coos Bay	13
	Brookings	15
	Unknown	86
	TOTAL	232
California	Crescent City	1
	Eureka	4
	Fort Bragg	14
	San Francisco	67
	Monterey	33
	Conception (north)	129
	San Diego	95
	Unknown	72
	TOTAL	415
	TOTAL FOR ALL STATES	724

Table 3.3.4.2 Landings of All Rockfish by Commercial and Recreational Sectors 1993- 2001 (PacFin/RecFin)

Year	Recreational (mt)	Commercial (mt)	Total	Percent Recreational
1993	2,741	38,274	41,015	7%
1994	2,378	31,656	34,034	7%
1995	1,726	30,257	31,983	5%
1996	2,141	28,919	31,060	7%
1997	2,583	24,680	27,263	9%
1998	2,325	20,867	23,192	10%
1999	2,580	14,952	17,532	15%
2000	2,578	13,358	15,936	16%
2001	1,985	7,674	9,659	21%

Data source: PacFin data were extracted November 25, 2002

Marine recreational fishing on the West Coast has been on an increasing trend since 1996 (PFMC 2002). In 2001, 2.5 million marine recreational anglers took 5.2 million trips (1 million of these trips occurred in the federal EEZ) and are estimated to have caught 11,676 mt of fish of which 3,084 mt were groundfish. Most angling occurs during the summer months with fewer anglers fishing northward during the winter. Eighty eight percent of the trips in all ocean waters (state and federal waters) were made in California, followed by 9 percent in Washington, and 3 percent in Oregon. The number of participants has increased from 1.6

million in 1999 and 2.2 million in 2000. The number of trips has also increased from 3.1 million (0.64 million in the Federal EEZ) in 1999 and 4.6 million in 2000 (1.1 million in the Federal EEZ).

A portion of the increased recreational fishing effort is likely the result of longer salmon seasons that are associated with increased abundance and availability of salmon. Prior to 1996 when salmon seasons were shortened to protect declining populations, target effort shifts from recreational salmon fishing to groundfish targeting likely occurred. It is uncertain how much groundfish catch contributes to the overall incentive to engage in a recreational fishing. However, it seems likely that the frequency of groundfish catch on a trip adds to overall enjoyment and perceived value. Tables 3.3.4.3-3.3.4.5 identify the number of participants, fishing trips, and catch by fishing mode for 2001.

In southern California, most angling effort takes place from private/rental boats (43% of all ocean and trips or 49% of trips into the EEZ) and from charter vessels (27% of all ocean and trips or 51% of trips into the EEZ). Approximately 13 percent of the charter vessels take spear fishing divers. The recreational fishery in southern California targets a variety of species including: shelf and nearshore rockfishes (including California scorpion fish); lingcod; cabezon; California barracuda; yellowtail; ocean whitefish; tuna (including yellowfin and albacore); flatfish (including California halibut and sanddabs); kelp bass; barred sand bass, and spotted sandbass; white sea bass and California sheephead. Salmon are infrequently taken in southern California. Shelf rockfish, lingcod, California barracuda, yellowtail, ocean whitefish, and tunas are primarily taken by anglers aboard private/rental and charter vessels. The other species are taken by anglers from all modes. Divers primarily take nearshore rockfishes, lingcod, California sheephead, and Kelp bass.

In northern California, most of recreational angling effort takes place from private/rental boats and from shore (46% of all ocean and trips or 61% of trips into the EEZ). Spear fishing represents a very small amount of the effort with less than 2 percent of the charter vessels catering to divers. The recreational fishery in northern California primarily targets shelf and nearshore rockfishes, lingcod and salmon. In addition, cabezon, greenling, albacore, and flatfish (including sanddabs and California halibut) may be targeted. Shelf rockfish, lingcod, salmon, and albacore are primarily taken by charter vessels and private/rental boats. Greenling are primarily taken by private /rental boats and shore anglers. The other species are taken by anglers from all modes.

In Oregon, most recreational angling effort takes place from private/rental boats (62% of all ocean and trips or 67% of trips into the EEZ). The recreational fishery in Oregon primarily targets shelf and nearshore rockfishes, lingcod, greenling, Pacific halibut, salmon, cabezon, and albacore. Salmon and nearshore species such as greenling and cabezon are primarily taken by private/rental vessels, while the remaining species are more equally divided between the charter and private/rental boats.

In Washington, most recreational angling effort takes place from private/rental vessels (57% of all ocean trips or 58% of trips into the EEZ). The recreational fishery in Washington primarily targets shelf, and nearshore rockfishes, lingcod, greenling, Pacific halibut, salmon, sablefish, and albacore. Nearshore rockfish is primarily taken by charter vessels, while catch of the other species are more closely divided between the charter and private/rental boats.

Table 3.3.4.3 Estimated Number of Anglers in Ocean Fisheries 2001, by Fishing Mode, Thousands of Anglers (MRFSS)

	Coastal Residents	Non-coastal Residents	Out-of state Residents	Total
Southern California	1,054	15	185	1,255
Northern California	454	72	63	589
Oregon	312	30	84	426
Washington	571	36	49	655
Coastwide	2,390	154	n/a	2,544

Table 3.3.4.4 Estimated Number of Fishing Trips in Ocean Waters 2001 by Fishing Mode, Millions of Trips (EEZ only) (MRFSS)

	Party/charter Vessel	Private/Rental Vessel	Shore	Total
Southern California	0.99 (0.32)	1.39 (0.31)	0.86	3.24 (0.63)
Northern California	0.26 (0.09)	0.62 (0.14)	0.46	1.34 (0.23)
Oregon	0.10 (0.02)	0.31 (0.04)	0.09	0.50 (0.06)
Washington	0.05 (0.05)	0.08 (0.07)	0.01	0.14 (0.12)
Total	1.40 (0.47)	2.41 (0.56)	1.41	5.22 (1.03)

Table 3.3.4.5. Estimated Recreational Groundfish Catch in Ocean Waters 2001 by Fishing Mode, Metric Tons (MRFSS)

	Party/charter Vessel	Private/Rental Vessel	Total
Southern California	165	252	419
Northern California	728	945	1,675
Oregon	370	387	759
Washington	182	48	231
Total	1,445	1,632	3,084

Regulatory management measures available to manage the West Coast recreational groundfish catch include, but are not limited to, harvest guidelines, quotas, landing limits, frequency limits, gear restrictions, time/area closures, bag and size limits, permits, other forms of effort control. For 2003, recreational fisheries effort will be constrained to protect overfished species, particularly for lingcod, canary rockfish, bocaccio, and yelloweye rockfish. Washington, Oregon, and California will adopt through state regulation seasons, bag limits, and size limits to best fit the needs of their recreational fisheries in their states while also meeting conservation goals of the FMP.

For 2003, recreational fisheries management off Washington and Oregon have been structured to maintain low yelloweye rockfish catch, an overfished species primarily taken with hook and line gear.. In reviewing the take of yelloweye rockfish in their recreational fisheries, the states of Washington and Oregon found that yelloweye rockfish is most frequently taken by vessels that travel offshore to target Pacific halibut. However, yelloweye rockfish are not taken while the vessel is fishing for halibut, but rather after the vessel has completed its halibut fishing and is headed for port. Recreational fishing restrictions proposed by California are intended to ensure that fishing mortality of bocaccio, canary rockfish, cowcod, and lingcod do not exceed limits associated with rebuilding these overfished species. Because California's recreational fisheries management measures were not sufficiently conservative to prevent their fisheries from exceeding their set asides for overfished rockfish species in 2001 and 2002, more restrictive measures will be used for 2003. South of 40°10' N. lat., where the significant majority of California recreational fisheries occur, recreational fishing will be closed entirely January through June and open only shoreward of 20 fm (37 m) July through December. The season was restructured to maximize recreational harvest opportunity while ensuring that nearshore groundfish, California scorpionfish, and lingcod shoreward of 20 fm (37 m) are not overharvested. Management measures adopted for 2003 are fully described in the proposed rule for 2003 Annual Specifications and Management Measures (January 7, 2003; 68 FR 936).

In addition to the leisure benefits that recreational anglers receive from participating in marine fisheries, they generate monetary benefits in the form of sales, income, and employment throughout the Pacific Coast region. A wide variety of goods and services are purchased by anglers from sporting goods stores, speciality stores, bait and tackle shops, guide services, marinas, grocery stores, automobile service stations, and restaurants. The economic impacts of these purchases occur throughout the Pacific Coast economy and provide income and jobs in manufacturing, transportation industries, and service sectors. Across Washington, Oregon, and California, it is estimated that recreational anglers spent $4.5 billion on marine recreational fishing in 2000, with Southern California anglers spending the most ($2.5 billion). Nationwide, recreational fishing expenditures total $21 billion (Genter et al. 2001). The recreational fishery in Washington, Oregon, and California are associated with $254 Million in personal income and almost 10,000 jobs; the groundfish fishery represented $71 Million and 2,800 jobs, respectively or about 28% of the total (Genter et al. 2001) (Table 3.3.4.7).

Table 3.3.4.6 Recreational Fishery Harvest by Region for Party/charter Boats and Private/rental Boats, 2001, in Metric Tons (RecFin)

	Lingcod	Nearshore Rockfish	Shelf Rockfish	Other Nearshore Groundfish	Other Shelf Groundfish	Other Groundfish	Total Groundfish	Salmon	Halibut	Highly Migratory Species	Other	Total
Washington												
Charter	17	153	11	1	0	0	182	33	105	0	0	320
Private	15	20	10	3	0	0	48	38	103	0	0	189
Total	32	175	21	3	0	0	231	70	208	0	0	509
Oregon												
Charter	53	274	33	10	0	0	370	91	21	0	7	489
Private	60	282	12	33	0	0	387	1,108	3	11	176	1,685
Total	114	557	46	42	0	0	759	1,199	24	11	183	2,176
Northern California												
Charter	41	351	316	20	0	0	728	187	0	80	53	1,048
Private	90	290	111	439	15	0	945	1,384	0	387	1,048	3,764
Total	131	642	426	460	16	0	1,675	1,572	0	467	1,100	4,814
Southern California												
Charter	4	26	73	47	14	1	165	0	0	348	1,088	1,601
Private	19	15	112	78	26	2	252	0	0	411	1,907	2,570
Total	23	41	186	125	41	3	419	0	0	759	2,999	4,177
Coastwide												
Charter	115	804	433	78	14	1	1,445	311	126	428	1,148	3,458
Private	184	607	245	553	41	2	1,632	2,530	106	809	1,148	3,458
Total	**300**	**1,415**	**679**	**630**	**57**	**3**	**3,084**	**2,841**	**232**	**1,237**	**4,282**	**11,676**

Table 3.3.4.7. Total Pacific Coast Region Expenditures by Resident Status, 2000 (millions of dollars) (Gentner et al. 2001)

Pacific Coast Region	Total	Upper Bound	Lower Bound	Total	Upper Bound	Lower Bound
Trip Expend		Residents ($)			Non- Residents ($)	
Private Transportation	111	142	80	32	35	29
Food	75	81	70	13	14	12
Lodging	32	36	28	16	19	14
Public Transportation	3	4	2	49	60	38
Boat Fuel	46	51	40	3	4	2
Party/Charter Fees	64	70	58	8	9	6
Access/Boat Launching	10	11	9	1	2	1
Equipment Rental	8	10	7	7	9	5
Bait and Ice	31	34	27	3	3	2
Trip Sub-Totals	380	413	347	132	144	120
Annual Expenditures						
Rods and Reels	144	160	128			
Other Tackle	115	127	103			
Gear	27	30	23			
Camping Equipment	16	21	11			
Binoculars	5	6	3			
Clothing	19	23	15			
Magazines	5	5	4			
Club Dues	4	5	3			
License Fees	72	78	66			
Boat Accessories	371	462	279			
Boat Purchase	1,066	1,234	899			
Boat Maintenance	304	343	266			
Fishing Vehicle	1,326	1,669	983			
Fishing Vehicle Maintenance	285	332	239			
Vacation Home	98	161	34			
Vacation Home Maintenance	103	199	8			
Equipment and Durable Goods Sub-total	3,959	4,361	3,546			
All Sub-totals	4,339	4,743	3,925	132	144	120
Pacific Coast Region Total	4,471	4,875	4,057			

Table 3.3.4.8 Coastal Community Income Impacts for the Recreational Fishery by Area, 2001 (PFMS 2002)

Area		Charter ($1000s)	Private ($1000s)	Total ($1000s)	Jobs
Washington Coast	**Total**	$5,335	$3,285	$8,620	392
	Groundfish	$1,134	$385	$1,519	69
Oregon	**Total**	$6,382	$4,911	$11,293	514
	Groundfish	$4,227	$783	$5,011	228
California	**Total**	$99,616	$135,195	$234,811	8,899
	Groundfish	$43,983	$21,481	$64,465	2,468
Total	**Total**	$111,332	$143,392	$254,724	9,823
	Groundfish	$48,345	$22,649	$70,994	2,765

Processing Sector. With the exception of the portion of Pacific whiting catch that is processed at sea, all other Pacific Coast groundfish catch is processed in shore-based processing plants along the Pacific coast. By weight, 1998 commercial groundfish landings were distributed among the three states as follows: Washington, 13%; Oregon, 69%; California, 18%. By value, commercial groundfish landings are distributed among the three states as follows: Washington, 15%; Oregon, 43%; California, 41% (PFMC 2002). The discrepancies between the Oregon and California portions of the landings are expected because Oregon processors handle a relatively high percent of the shore-based whiting landings, a high volume, low value fishery. Conversely, California fishers land more of the low volume, high value species as a proportion of the total state-wide catch than Oregon fishers.

Shorebased Sector. Several thousand entities have permits to buy fish on the West Coast. Of these 1,780 purchased fish caught in the ocean area and landed on Washington, Oregon, or California state fish tickets in the year 2000 (excluding tribal catch) and 732 purchased groundfish. Larger buyers tend to handle groundfish more than smaller buyers. Of the 546 buyers purchasing in excess of $20,000 of West Coast landings, 59% bought groundfish. These 546 buyers bought 99% of all Council managed groundfish. Of the 1,234 buyers purchasing less than $20,000 from West Coast vessels, 33% bought groundfish. The number of buyers handling groundfish from trawl vessels is substantially lower than all of those handling groundfish. Only 17% (125) of all groundfish buyers (732) handled fish from trawl vessels. These 125 vessels comprise only 7% of all buyers (1,780). Buyers of trawl caught groundfish are important to nontrawl vessels as well, handling 60% (by value) of the groundfish caught by nontrawl vessels. Table 3.3.4.9 displays the number of buyers as compared to the groundfish buyers, grouped by total expenditures for the year 2000 (excluding at-sea whiting).

Table 3.3.4.9 Number of West Coast Buyers and Groundfish Buyers in 2000 (excluding at-sea whiting)

Buyers' Total Expenditures on West Coast Harvests	All Buyers	Nongroundfish Buyers	Groundfish Buyers	Groundfish Buyers as % of all Buyers
>$2 Million	21	2	19	90%
$1-$2 Million	33	14	19	58%
$300 Thousand - $1 Million	98	36	62	63%
$100-$300 Thousand	121	49	72	60%
$20-$100 Thousand	273	123	150	55%
$5 -$20 Thousand	372	224	148	40%
<$5 Thousand	862	600	262	30%
Total	1,780	1,048	732	41%

The largest buyers tend to handle trawl vessels more than smaller buyers. Of the 38 largest buyers of groundfish (those with purchases in excess of $1 million), 73% (28) bought from trawl vessels Seventy-eight percent of all groundfish purchases from trawl vessels go to the 28 trawl buyers with total purchases of all species in excess of $1 million. These 28 buyers also handle 39% of the exvessel value of the nontrawl purchases.

Table 3.3.4.10 Number of West Coast Groundfish Buyers in 2000 by gear group (excluding at-sea whiting)

Buyers' Total Expenditures on West Coast Harvests	Groundfish Buyers	Trawl caught groundfish buyers	Non-trawl caught groundfish buyers
>$2 Million	19	17	2
$1-$2 Million	19	11	8
$300 Thousand - $1 Million	62	33	29
$100-$300 Thousand	72	23	49
$20-$100 Thousand	150	19	131
$5 -$20 Thousand	148	11	137
<$5 Thousand	262	11	251
Total	732	125	607

Mid-size buyers tend to have greater importance for nontrawl vessels than for trawl vessels. Fifty percent of all nontrawl sales go to buyers with total purchases of between $20 thousand and $1 million, as compared to 22% for trawl vessels (PFMC 2002). Absent cost and exprocessor sale price data, very rough assumptions must be made to consider possible levels of dependence of processors on groundfish. However, it is assumed here that gross exvessel value of purchases is a rough indicator of relative levels of dependence. Large buyers of groundfish tend to have a lesser percentage of their overall purchases from groundfish than smaller buyers. Table 3.3.4.11 displays the value of purchases by west coast processors in 2000 (excluding at-sea whiting).

Table 3.3.4.11 Value of Purchases by west coast buyers in 2000 (PFMC 2002)

	All buyers	Groundfish buyers	
	Total purchases ($1,000)	Total purchases of all species ($1,000)	Total purchases of groundfish ($1,000)
>$2 Million	95,742	90,762	28,680
$1-$2 Million	45,343	25,851	8,585
$300 Thousand - $1 Million	56,115	36,527	11,278
$100-$300 Thousand	21,427	12,543	3,269
$20-$100 Thousand	12,881	7,297	2,023
$5 -$20 Thousand	3,989	1,519	501
<$5 Thousand	1,278	426	218
Total	236,775	174,926	54,554

At-Sea Sector. There are two classes of vessels in the at-sea processing sector of the whiting fishery, catcher-processors that harvest and process their own catch, and mothership vessels that process unsorted catch received from smaller catcher vessels. The processing vessels are large (>250 ft in length) and carry crews of 65-200, who mostly work in shifts to keep the factories operating day and night.

The first year of implementation of a license limitation program in the Pacific groundfish fishery was 1994. Vessels that did not initially qualify for a permit had to buy or lease one from qualifying vessels to gain access to the fishery. To harvest whiting, all at-sea catcher-processors had to purchase or lease permits. This changed the composition of the at-sea processing fleet considerably, increasing the number of motherships, because permits are not required for vessels that only process (PFMC 1998). Unlike catcher/processors and catcher vessels, motherships do not have permits to harvest groundfish in the WOC.

In 2001, 20 catcher vessels delivered whiting to 5 non-tribal mothership processors and 4 tribal catcher vessels delivered whiting to a single tribal mothership. Some vessels may deliver catch exclusively to motherships off Alaska and the West Coast, but in recent years, about half of the non-tribal vessels also delivered whiting to shore-based processing facilities in Washington, Oregon and California. Similarly, the tribal mothership also processes whiting in the non-tribal sector before the start of the tribal fishery. In 2001, 7 catcher/processors participated in the whiting fishery.

Since May 1997, when the Department of Justice approved allocation of whiting shares among the members of the Whiting Conservation Cooperative, the catcher-processor fishery has operated as a voluntary quota share program where each of the catcher-processor companies has agreed to take a specific share of the harvest. With harvests assured, the catcher-processors are able to operate more cautiously to avoid areas of salmon and rockfish abundance. The motherships, however, operate under more competitive conditions (first come first served) for their sector's allocation. The U.S. whiting allocation has been fully utilized by domestic processors since 1992.

Whiting is a high volume species, but it commands a relatively low price per pound. The at-sea processing vessels have onboard surimi production capacity and were initially designed to fish for pollock in the groundfish fisheries off Alaska. Because whiting is a similar species to pollock, harvesting and processing technology and equipment used in the Alaskan fisheries is also used for whiting. In addition, to surimi, most of these vessels have the capacity to produce frozen fillet blocks and have fish meal plants to process small whiting, incidentally caught groundfish species and fish offal.

Communities
Fishing communities, as defined in the Magnuson-Stevens Act, include not only the people who actually catch the fish, but also those who share a common dependency on directly related fisheries-dependent services and industries. In commercial fishing this may include boatyards, fish handlers, processors, and ice suppliers. Similarly, entities that depend on recreational fishing may include tackle shops, small marinas, lodging facilities catering to out-of-town anglers, and tourism bureaus advertising charter fishing opportunities. People employed in fishery management and enforcement make up another component of fishing communities.

Fishing communities on the West Coast depend on commercial and/or recreational fisheries for many species. Participants in these fisheries employ a variety of fishing gears and combinations of gears. Naturally, community patterns of fishery participation vary coastwide and seasonally, based on species availability, the regulatory environment, and oceanographic and weather conditions. Each community is characterized by its unique mix of fishery operations, fishing areas, habitat types, seasonal patterns, and target species. While each community is unique, there are many similarities. For example, all face danger, safety issues, dwindling resources, and a multitude of state and federal regulations.

Individuals make up unique communities with differing cultural heritages and economic characteristics. Examples include a Vietnamese fishing community of San Francisco Bay and an Italian fishing community of Southern California. Native American communities with an interest in the groundfish fisheries are also considered. In most areas, fishers with a variety of ethnic backgrounds come together to form the fishing communities within local areas, drawn together by their common interests in economic and physical survival in an uncertain and changing ocean and regulatory environment.

The EIS prepared for the 2003 Annual Specification and Management Measures looks closely at fishing communities and provides futher information on the following: geographic distribution of commercial fishing fleet and revenue; geographic distribution of groundfish buyers; geographic distribution of personal income; dependence on and engagement in fishing and fishing-related activities;demographics, ethnic, and social characteristics social structure: networks, values, identity; impact on the built environment in fishing communities. As required by E.O. 12898 (Environmental Justice), low income and minority populations affected by this action are described in the EIS for the annual specifications and management process. In addition, supplemental county level economic and demographic information has been compiled for a general baseline description of West Coast fishing communities (PFMC 1999). This information may be accessed on the Council website (http://www.pcouncil.org/communities/comdoc.html).

Enforcement
Traditional fishery monitoring techniques include air and surface craft surveillance, declaration requirements, landing inspections, and analysis of catch records and logbooks. Current assets for patrolling offshore areas include helicopter and fixed wing aircraft deployed by the U.S. Coast Guard and state enforcement entities, one large 210 foot Coast Guard cutter, and smaller Coast Guard and state enforcement vessels. Only the aircraft and large cutter are suitable for patrolling the more distant offshore closed areas. The availability of Coast Guard assets may be challenged by other missions such as Homeland Security and search and rescue.

State enforcement assets may be compromised by pessimistic budget outlooks for next year that threaten to reduce these assets as state programs are rationalized under an increasingly more conservative fiscal environment. In 2002, State enforced declaration requirements were used to increase the efficiency of at-sea patrols and improve enforcement, particularly in areas closed to certain gear types or fishing strategies. Under declaration programs, legal incursions into closed areas must be reported to state enforcement authorities prior to fishing. This requirement is generally reserved for vessels that would otherwise appear to be fishing illegally when viewed from an at-sea patrol craft.

Shoreside enforcement activities complement at-sea monitoring and declaration requirements by inspecting recreational and commercial vessels for compliance with landing limits, gear restrictions, and seasonal fishery closures. State agencies are increasingly using dockside sampling as a means of assessing groundfish catch in recreational fisheries, which when combined with state and federal enforcement patrols at boat launches and marinas, provides a means of ensuring compliance with bag limits and fishery closures. Commercial landings are routinely investigated upon landing or delivering to buying stations or processing plants and can be tracked through fish ticket and logbook records.

4.0 IMPACTS OF THE ALTERNATIVES

Table 4.0.1 Summary of Biological and Socio-economic Impacts of the Monitoring System Alternatives from Sections 4.1 - 4.3.5

	Alternative 1 Status quo	**Alternative 2** Declarations	**Alternative 3** Basic VMS system with declaration reports	**Alternative 4** Upgraded VMS system with declaration reports	**Alternative 5** Observers with declaration reports
Biological indicators					
Fishing mortality -- Incidental catch of overfished species in the conservation areas	* Mortality based on fish ticket data with bycatch estimates from Hastie model	* Same as Alt. 1	* May be joined to data from observed trips to better estimate fishing mortality * Available for all trawl and fixed gears	* May be joined to data from observed trips to better estimate fishing mortality * Available for all trawl and fixed gears	* Observer catch composition data likely to be used for estimating total catch by species over large geographical area regardless of gear. Not available in real time.
Ability to understand effort shifts --To project impacts on juveniles, other fishery resources, or habitat	* Would continue to use unverified trawl logbook data for fishing location * Logbook data is not currently available from gears other than trawl	* Declaration reports may be used to estimate the number of vessels/trips in conservation area	* Accurate harvest location data over large geographical area for both trawl and fixed gears	* Same as Alt. 3	* Can be used to verify harvest location * Length and age structure data may be collected to understand total catch of juveniles * Observer data may be used to estimate incidental catch of other fishery resources
Socio-economic indicators					
Availability of information for enforcement -- for efficiency in the use of enforcement resources	* Continue to use limited air and surface craft	* Same as Alt. 1 plus * Aid in identifying vessels legally fishing in conservation areas	* Same as Alt. 1 and 2 plus * May act as deterrent * May be used to target landing and at-sea inspections *May be used to increase efficiency of surveillance patrols * May benefit homeland security activities * May be used as basis for enforcement action	* Same as Alt. 3 plus * 2-way communications allow for at-sea reporting of potential violations * Real-time data allow enforcement to respond to infractions	* May act as deterrent * Observer data could be used to verify vessel activity * May be used as basis for enforcement action
Availability of information for management -- for measuring the effectiveness of management measures	* Continue to use fishing logbooks to understand fishing location in relation to restrictions	* Same as Alt. 1 plus * Can be used to improve general understanding of depth ranges in which fisheries occur, particularly those fisheries currently without logbooks	* Same as Alt. 2 plus * Accurate harvest location data over large geographical area regardless of gear may be used to assess effectiveness of management regime * May be used in conjunction with observer data to improve bycatch management	* Same as Alt. 3	* Catch composition data would be available to assess bycatch and total catch levels in relation to OYs

The effects on harvesters, processors, and communities from more management regime	* Would likely result in more constrained harvest levels as compared to other alternatives, resulting in lost employment and fish for processors	* Similar to Alt. 1	* Most likely to maintain the integrity of conservation areas and allow higher harvest levels on healthy stocks and thereby provide processors with fish and employment opportunity	* Same as Alt. 3	* May allow fishery to sustain higher harvest levels on healthy stocks and thereby provide processors with fish and employment opportunity
Cost burden -- initial and long-term	* Would likely constrain the use of liberal management regimes that allow vessels to target healthy stocks in depth-based areas where overfished species are less likely to be taken incidentally	* Annual cost to transmit declaration report $24 per vessel (5 min/rpt- 12 time per year)	* Same as Alt. 2 * Allows the use of more liberal management regime where vessels can target healthy stocks in areas where overfished species are less likely to be taken incidentally * Capital costs would be $1,550-$3,800 ($800 unit may be approved by NMFS) unless unit was leased or paid for by NMFS * Installation costs: $65.50-$125.50 * Transmission cost: $1.67-$5/ fishing day - at 10 fishing days per mo cost would be $200- $600 per yr * Additional costs: $348 -$1,098 per year (declarations, maintenance, deprecation)	* Allows the use of more liberal management regime where vessels can target healthy stocks in areas where overfished species are less likely to be taken incidentally * Capital costs would be $2,750-$5,295 unless unit was leased or paid for by NMFS * Installation costs: $65.50-$405.50 * Transmission cost: $1-$3.5/ fishing day - 10 fishing days per mo the cost would be $120-$450 per year * Additional costs: $943 -$1,892 per year (declarations, maintenance, deprecation)	* If a direct pay system similar to the at-sea Pacific whiting fishery is used, for each day the observer is on the vessel the cost to the vessels would be $300/day. Training and debriefing costs would be an additional $1200/observer. * Including the costs of sampling equipment or infrastructure needed to support an increased number of observers and their data would likely increase the daily rate by 30% * Paying observer salaries would not be economically feasible for most vessels
Safety of human life -- search and rescue efficiency	* Varies between vessels due to fishing locations, equipment available on vessels, and how well equipment is maintained * When fishing opportunity is reduced and profits are marginal, vessels may display more risk prone behavior and may not adequately maintain equipment and vessels	* Same as Alt. 1	* Distress signal may reduce response time in emergency	* Same as Alt. 3 plus * 2-way communication can increase communications regarding vessel safety and medical issues	* Same as Alt. 1
Average per vessel VMS related costs	$0	$0	Year 1 - $2,163 -$5,623 Subsequent years - $548-$1,698	Year 1 - $3,878 -$7,607 Subsequent years - $1,063-$2,342	$0

4.1 Physical Impacts

Physical impacts associated with fishery management actions generally result from changes to the physical structure of the benthic environment as a result of fishing practices. This action pertains to a program that is expected to provide information needed to monitor fishing locations in relation to time area closures. There are no distinguishable differences in physical impacts between the alternatives. The physical impact of the proposed actions are not expected to be different from the status quo alternative (Issue 1, monitoring systems, Alternative 1). This is because the alternatives are for monitoring systems and are intended to monitor fishing activities that were adopted for the 2003 fishery and are already occurring under status quo. The Environmental Impact Statement prepared for the 2003 Annual Specifications and Management Measures addresses the physical impacts on the environment under the status quo alternative (PFMC 2002).

4.2 Biological Impacts

This section forms the analytic basis for comparing possible direct and indirect biological impacts across the alternatives. Direct effects are caused by the action and occur at the same time and place, while indirect effects occur later in time and are further removed in distance from the direct effects (40 CFR 1508.27). The impacts of each alternative on one or more components of the biological environment are discussed in sections 4.2.1 through 4.2.3 below.

4.2.1 Fishing mortality - incidental catch of overfished species

Direct effects on fishing mortality include the removal of target and non-target species (incidental catch) from the environment. Because this rulemaking would implement a program to monitor fishing location in relation to time-area closures, no direct biological impacts are expected to result from any of the alternatives. However, if the integrity of the closed areas are not adequately maintained, harvest assumptions could be inaccurate resulting in indirect effects such as unaccounted for removals. This is especially a concern for overfished species with low OYs.

For 2003, the Council sought a management strategy that would allow fishing to continue in areas and with gears that can harvest healthy stocks with little incidental catch of the low abundance or overfished species. The 2003 management measures are intended to keep harvests of overfished species within the OYs established for rebuilding. Large scale depth related areas, referred to as rockfish conservation areas, will be used to prohibit both commercial and recreational fishing across large portions of the continental shelf. Depth-based management lines will be used to define the conservation areas.

Depth-based management measures are gear-specific. Gear-specific measures are necessary, because the various overfished species are not encountered at the same rate by the different gear types. Prohibiting or restricting the use of a gear type that a particular overfished species is vulnerable to will reduce the incidental catch and keep the total catch of that species from exceeding the OY, while providing fishing opportunity for more abundant stocks in times and areas where incidental catch and discard of the depleted stocks is lowest.

The fishing mortality level (total catch level) for each species is the sum of retained catch and discarded catch (incidental or targeted catch that is not retained and landed by the vessel). To monitor the attainment of an OYs, the total catch level must be estimated for each species or species group. There is no exact measure of discard amounts in most fisheries. For all species except lingcod, sablefish, and nearshore rockfish species, it is assumed that discarded fish are dead or die soon after being returned to the sea. For 2003, NMFS will continue to use a 16 percent rate for estimating canary rockfish, bocaccio, and POP discards. For lingcod and darkblotched rockfish, NMFS will use a 20 percent rate for estimating discards. The preamble of the 2002 Annual Specifications and Management Measures (March 7, 2002, FR 10490) describes in full how discard rates have been derived. For 2003, depth-related discard assumptions have been made (detailed in the preamble of the proposed rule for the 2003 Annual

Specifications and Management Measures; January 7, 2003, 68 FR 936). The revised discard assumptions reflect the areas where vessel activity is expected to occur rather that where they historically operated. Data collected in the groundfish observer program (an ongoing information collection on catch composition with estimates of discarded catch) will be analyzed in 2003 with the intent of further refining discard assumptions to improve estimates of total catch.

If the integrity of the closed areas cannot be maintained, the risk of exceeding an OY is increased, with the risk being greatest for species that the closed areas are intended to protect. Incursions into the conservation areas and the use of prohibited gear types could result in higher catch of the protected species than had been estimated in discard assumptions. If the true discard rates are higher than the discard assumptions used to estimate total catch, the OYs could unknowingly be exceeded. If the OYs are substantially exceeded, the stocks ability to rebuild could be impaired. If a "rebuilding deficit" is created for an overfished stock, because the OY is exceeded, the stock may not be able to recover within the specified rebuilding time. For stocks in the precautionary zone (B25%-B40%) the stock biomass could be further reduced, leading to an overfished status.

The risk of exceeding the OYs for overfished species is greatest under Issue 1, Alternative 1, the status quo alternative. Under Issue 1, Alternative 1, total catch estimates would continue to be based on landings data combined with discarded catch estimates that are based on assumptions that reflect fishing effort in open areas, and enforcement would continue to use limited air and surface craft to identify incursions into the closed areas. Enforcement efforts would not be as effective in deterring incursions under Issue 1, Alternative 1 than could be expected under Issue 1, Alternatives 2 through 5. This is because considerable time may be spent investigating fishing vessels that appear on the enforcement vessel's radar whether they are legitimately fishing in the conservation areas or not. Issue 1, Alternative 2, declarations, has slightly less risk of exceeding the OYs for a given species than Issue 1, Alternative 1, yet it has more risk than Issue 1, Alternatives 3, 4 or 5. This is because declaration reports can be used to aid enforcement in identifying vessels that are legally fishing within conservation areas, and may deter some vessels from unlawfully fishing in conservation areas and with prohibited gears. However, the utility of declarations (Issue 1, Alternative 2) in identifying illegal fishing activity is minimal.

The risk of exceeding the OYs is lowest under Issue 1, Alternatives 3 and 4 in which VMS systems and declarations are required. One of the major benefits of VMS is its deterrent effect. If fishing vessel operators know that they are being monitored and that a credible enforcement action will result, then the likelihood of a vessel using a prohibited gear in a conservation area is significantly diminished. In addition, data collected with a VMS system can be used to better understand the distribution of fishing effort. Little is known about fishing patterns by depth in the Pacific Coast groundfish fishery, this is especially true for the non-trawl gears. How effort will shift to the remaining open fishing areas as a result of the 2003 management measures and the creation of the depth-based conservation areas needs to be understood to effectively estimate total catch and monitor the attainment of OYs.

If effort data collected through a VMS system can be joined with discard data from observed fishing trips, managers may be able to make more accurate estimates of total catch by species. Because VMS data is available in realtime, fishery managers may be better able to monitor the attainment of OYs during the season. As with Issue 1, Alternative 2, declaration reports would be required from any vessel registered to a limited entry permit, and any other commercial or tribal vessel using trawl gear; including exempted gear used to take pink shrimp, spot and ridgeback prawns, California halibut and sea cucumber, to identify their intent to fish within a conservation area specific to their gear type, in a manner that is consistent with the conservation area requirements. Declaration reports would aid enforcement in sorting out vessels that were legally fishing within conservation areas from those that were not, therefore, declaration reports may deter some vessels from fishing in restricted areas with prohibited gears. In the long-term, VMS would be expected to have a positive indirect effect on fishing mortality by providing fisheries managers with information needed to minimize the risks of exceeding the OYs for overfished species. Issue 1, Alternative 5, observers, would provide fishing location and catch composition data, that would allow fisheries managers to better understand total catch by species. Observer data is not expected to be available in realtime (observer data may become more rapidly available over time, but not early during the development of data systems and catch estimation methods)., and may be delayed considerably. Monitoring the attainment of OYs with observer data only is not expected to be as effective under this alternative as it would be under Issue 1, Alternatives 3 and 4. Issue 1, Alternative 5 is not expected to be as effective of a deterrent as Issue 1, Alternatives 3 and 4, because observer scientific duties may conflict with the observer's availability to verify positions. In addition, human error in reporting incorrect positions is increased under Issue 1, Alternative 5. The preferred alternative under Issue 1 is Alternative 3.

Issue 2, coverage, would apply if Issue 1, Alternatives 3, 4, or 5 were selected. Coverage refers to that portion of the overall fishing fleet that would be required to have VMS or observers on board in order to participate in the fishery. Issue 2, Alternative 5, would require all limited entry, open access, and recreational charter vessels to carry VMS or an observer regardless of where they fish. This alternative would be most beneficial in estimating fishing mortality in the long-term because it would provide the most amount of information on fishing location and effort by the largest number of participants. However, at this time there is very little data (observer or otherwise) on discarded catch levels from open access vessels and from recreational fishing vessels. In the short-term, using effort data obtained from a VMS system to estimate total catch and to monitor the attainment of OYs will be limited until more data becomes available. Issue 2, Alternative 4, would apply to all commercial and recreational charter fishing vessels that operate within the conservation areas. This group would not include vessels that fish shoreward (nearshore areas) or seaward of the conservation areas and is therefore a slightly smaller group than Issue 2, Alternative 5. Issue 2, Alternative 3 is very similar to Issue 2, Alternative 4 in that the existing information does not allow the impacts to be distinguished from one another. There are no differences between Issue 2, Alternatives 2A and 2B in the amount of effort and location data that each provide (only active vessels provide fishing data). Of all the alternatives under Issue 2, Alternatives 2A and 2B provide the least amount of data. However, there is more observer data available that can be used to better understand incidental catch rates by location from the limited entry portion of the fishery than is available for the other (open access, other commercial, or recreational) portions of the fishery.

Issue 3, expenditures, would apply if Issue 1, Alternatives 3 or 4 were selected. Issue 3 addresses the cost (primarily the capital costs) of a VMS program and the distribution of these costs between NMFS and the fishery participants. There is no difference in total fishing mortality between the alternatives under Issue 3.

4.2.2 Ability to understand effort shifts to project impacts on groundfish, other resources, or habitat

Very little is known about fishing patterns by location or how effort will shift from closed areas to the remaining open fishing areas. Because logbook data is only available for the limited entry trawl fleet, this lack of understanding is especially true for commercial vessels that are not part of that fleet. Little specific information on fishing locations and effort is available for recreational vessels.

To better recognize the shift in fishing from areas where vessels had historically operated to those that will remain open after the depth-based conservation areas are implemented, the bycatch analysis prepared in 2002 (March 7, 2002, 67 FR 10490) was amended. Limited entry trawl logbook data was used to amend the analysis. Knowing how the fishery geographically shifts as a result of the creation of depth-based conservation areas is important to understanding how other fishery resources and habitat may be affected. (discussion of bycatch and discard analysis in section 3.3)

Love et al, 2002 divides rockfish communities into five depth related categories that are similar to those used to establish depth-based management areas: 1) intertidal, 2) nearshore (Subtidal- 16 fm), 3) shallow shelf (16-55fm), 4) deep shelf (55-109 fm), and 5) slope (109+ fm). Table 4.2.2.1 shows juvenile and adult rockfish that are generally found in each of these communities (section 3.2 of this EA also discusses, by species, habitat where adult and juvenile groundfish species are typically found). Because fish communities can be somewhat mobile, these categories represent typical communities over a relatively broad depth and geographic area. For some species, the north-south distribution varies in that they are found in shallower depths in the northern part of their ranges as compared to the southern portions of their ranges. After parturition (when larva are released), all rockfish have a pelagic phase which usually consists of the larval and early juvenile stages. The duration of the pelagic phase varies by species as does the location occupied within the water column. With increasing size, many pelagic juveniles move deeper in the water column and closer to shore(Love et al. 2002). Eventually juvenile rockfish settle and become more closely associated with the benthic environment. Juvenile rockfish that have settled tend to be found in shallower water than adults and often occupy different communities. As juvenile rockfish mature, most tend to move to deeper habitats that are occupied by adults.

Table 4.2.2.1 Typical Rockfish Communities (Love et al. 2002)

Region	Rockfish Communities			
	Nearshore **(Subtidal- 16 fm)**	**Shallow Shelf** **(16-55fm)**	**Deep Shelf** **(55-109 fm)**	**Slope** **(109+ fm)**
Southern California Bight -Northern Baja California	**Adults** Black and Yellow Blue Brown Calico Gopher Grass Kelp Treefish **Juvenile** Bocaccio [1] Copper Striped tail Vermilion	**Adults** Blue Brown Calico Canary Chilipepper Copper Freckled Greenspotted Halfbanded Honeycomb Olive Pygmy Rosy Speckled Squarespot Starry Stripedtail Vermillion Whitespeckled **Juvenile** Bocaccio Cowcod Greenblotched Greenstriped Splitnose Stripetail Widow	**Adults** Bank Bocaccio Canary Cameleon Chilipepper Cowcod Flag Halfbanded Greenblotched Greenspotted Greenstriped Mexican Pink Pinkrose Pygmy Semaphore Shortbelly Splitnose Speckled Stripedtail Swordspine Vermillion Whitespeckled Widow Yellowtail [2]	**Adults** Aurora Bank Blackgill Bocaccio Bronzespotted Chameleon Chilipepper Cowcod Greenblotched Greenstriped Pink Pinkrose Shortbelly Spitnose Longspine Thornyhead Shortspine Thornyhead
Central California -Northern California [3]	**Adults** Black Black and Yellow Blue Brown China Copper Gopher Grass Kelp Vermillion **Juvenile** Bocaccio Canary Chilipepper Shortbelly Speckled Widow Yellowtail	**Adults** Black Blue Bocaccio Brown Canary Chilipepper China Copper Halfbanded Olive Pygmy Quillback Rosy Speckled Squarespot Starry Vermillion Yelloweye **Juvenile** Cowcod Greenspotted Greenstriped Stripedtail Widow	**Adults** Bank Bocaccio Canary Chilipepper Cowcod Flag Halfbanded Greenblotched Greenspotted Greenstriped Pygmy Redbanded Rosethorn Sharpshin Shortbelly Splitnose Stripedtail Vermillion Whitespeckled Widow Yellowtail Yelloweye **Juvenile** Splitnose	**Adults** Aurora Bank Blackgill Bocaccio Chilipepper Cowcod Darkblotched Greenblotched Greenstriped Pacific Ocean Perch Rosethorn Sharpshin Shortbelly Spitnose Longspine Thornyhead Shortspine Thornyhead
Oregon - Brithish Coulmbia [4]	**Adults** Black Blue China Copper Quillback Yellowtail **Juvenile** Bocaccio	**Adults** Black Blue Bocaccio Canary China Copper Greenstriped Pygmy Quillback Redstriped Rosethorn Silvergrey Tiger Widow Yelloweye **Juvenile** Stripedtail	**Adults** Bocaccio Canary Darkblotched Redstriped Harlequin Pacific Ocean Perch Puget Sound Pygmy Redbanded Redstriped Rosethorn Rougheye Sharpshin Shortbelly Silvergrey Splitnose Stripedtail Tiger Widow Yellowtail Yelloweye **Juvenile** Splitnose	**Adults** Aurora Bocaccio Darkblotched Greenstriped Harlequin Pacific Ocean Perch Redbanded Redstriped Rosethorn Rougheye Sharpshin Shortbelly Shortraker Silvergray Plitnose Tiger Yelloweye Yellowmouth Longspine Thornyhead Shortspine Thornyhead

1 Particularly around northern Channel Islands and in the Santa Barbara Channel.
2 Yellowtail rockfish are only abundant around San Miguel and Santa Rosa Islands of the northern Channel Islands.
3 Flag, greenblotched, greenspotted, kelp, speckled, starry, and rose rockfish become less abundant or absent in northern California. POP are uncommon south and chilipepper are relatively rare north of Cape Mendocino. Redbanded, sharpshin and yelloweye are abundant i the norther part of this region.
4 Blue and shortbelly are common at least as far north as Oregon. Bocaccio are sporadically abundant as far north as British Columbia. POP, redstriped, rougheye, silvergray, tiger, and yellowmouth are increaslingly common from Oregon northward. Harliquin and shortraker are common only as far south as British Columbia

Depth associations for other groundfish species including: the flatfishes (arrowtooth and starry flounder; butter, curlfin, Dover, English, flathead, petrale, rex, rock and sand sole; and Pacific sanddab), roundfishes (Cabezon, Kelp greenling, lingcod, Pacific cod, Pacific whiting, and sablefish), sharks and skates, and other species (finescale codling, Pacific rattail, and ratfish) are identified in section 3.2 and are shown in Table 4.2.2.2. These species are widely distributed both geographically and in depth distribution. Distribution within the water column also varies considerably between these species. As with juvenile rockfish, lingcod, sablefish, Dover sole, English sole, petrale sole, tend to occupy shallower waters as juveniles then move into deeper water habitats as they mature.

TABLE 4.2.2.2 Latitudinal and Depth Distributions of Adult Non-rockfish Groundfish Species (PFMC 2002)

Common Name	Scientific Name	Geographic Distribution	Depth Distribution	
			Range	Highest Density
Flatfish				
Arrowtooth flounder	*Atheresthes stomias*	N. 34˚ N.lat.	10-400	27-270
Buttersole	*Isopsetta isolepis*	N. 34˚ N.lat.	0-200	0-100
Curlfin sole	*Pleuronichthys decurrens*	Coastwide	4-291	4-50
Dover sole	*Microstomus pacificus*	Coastwide	10-500	110-270
English sole	*Parophrys vetulus*	Coastwide	0-300	40-200
Flathead sole	*Hippoglossoides elassodon*	N. 38˚ N.lat.	3-300	100-200
Pacific sanddab	*Citharichthys sordidus*	Coastwide	0-300	0-82
Petrale sole	*Eopsetta jordani*	Coastwide	10-250	160-250
Rex sole	*Glyptocephalus zachirus*	Coastwide	10-350	27-250
Rock sole	*Lepidopsetta bilineata*	Coastwide	0-200	summer 10-44 Winter 70-150
Sand sole	*Psettichthys melanostictus*	Coastwide	0-100	0-44
Starry flounder	*Platichthys stellatus*	Coastwide	0-150	0-82
Roundfish				
Cabezon	*Scorpaenichthys marmoratus*	Coastwide	0-42	0-27
Kelp greenling	*Hexagrammos decagrammus*	Coastwide	0-25	0-10
Lingcod	*Ophiodon elongatus*	Coastwide	0-233	0-40
Pacific cod	*Gadus macrocephalus*	North of 34°N lat.	7-30020-500	27-160
Pacific whiting	*Merluccius productus*	Coastwide	27->1,000	27-270
Sablefish	*Anoplopoma fimbria*	Coastwide		110-550
Shark and Skate				
Big skate	*Raja binoculata*	Coastwide	2-110	27-110
California skate	*Raja inornata*	Coastwide	0-367	0-10
Leopard shark	*Triakis semifasciata*	South of 46°N lat.	0-50	0-2
Longnose skate	*Raja rhina*	Coastwide	30-410	30-340
Soupfin shark	*Galeorhinus zyopterus*	Coastwide	0-225	0-225
Spiny dogfish	*Squalus acanthias*	Coastwide	0->640	0-190
Other Species				
Finescale codling	*Antimora microlepis*	Coastwide	190-1,588	190-470
Pacific rattail	*Coryphaenoides acrolepis*	Coastwide	85-1,350	500-1,350
Ratfish	*Hydrolagus colliei*	Coastwide	0-499	55-82

Data Source: Casillas et al. 1998, Eschmeyer et al. 1983, Hart 1973, Miller and Lea 1972, and NMFS survey data.

The depth-based conservation areas being adopted for 2003 will restrict particular gears from fishing on large portions of the continental shelf. This is expected to result in effort shifts to open areas that are shoreward and seaward of the conservation areas. Smaller vessels are generally not able to withstand rough seas as well as larger vessels. Because much of the groundfish fleet is comprised of small vessels, most of the effort shift is expected to be into waters that are shoreward of the conservation areas. Knowing the amount of fishing effort that shifts into shallower depths is critical to understanding the direct effects on the adult and juveniles of the various groundfish species from the 2003 management measures and the creation of conservation areas. The amount of information available for managers to understand where fishing effort is taking place and to evaluate possible impacts on the adult and juvenile groundfish species varies between the alternatives under Issue 1, the monitoring system.

Under Issue 1, Alternative 1, the status quo alternative, information on fishing effort by location would continue to be based on unverified limited entry trawl logbook data and limited observer data. Availability of logbook and observer data for management purposes is often delayed by months. The response time for management to address unintended impacts resulting from effort shifts would be lengthiest under this alternative. Declaration reports (Issue 1, Alternative 2), only provide information on the total number of vessels registered to limited entry permits and vessels using trawl gear (including open access and tribal vessels) that are intending to legally fish within a conservation area and are not in themselves beneficial to understanding effort shifts and distribution of effort outside the conservation areas. As with Issue 1, Alternative 1, information on fishing location and effort would continue to be based on unverified limited trawl logbook data and limited observer data under Issue 1, Alternative 2. The response time for management to address unintended impacts resulting from effort shifts would be similar to Issue 1, Alternative 1.

The VMS systems under both Issue 1, Alternative 3 and Alternative 4 would provide accurate harvest location data that could be used to estimate the distribution of fishing effort throughout the WOC. Because the VMS would transmit vessel positions 365 days a year, 24 hours per day, effort data from limited entry permitted vessels fishing in non-groundfish fisheries in the WOC would also be available. When this information is combined with data collected by at-sea observers, the impacts of the effort shift on adult and juvenile population could be better understood. The response time for management to address unintended impacts resulting from effort shifts would be quicker than either Issue 1, Alternative 1 or 2. However, ability to understand the extent of the impacts resulting from effort shifts on groundfish and other resources, would depend on the amount, availability and applicability of at-sea observer data for the different gears and sectors of the fishery.

Issue 1, Alternative 5, observers, could be used to verify harvest location as well as to collect catch composition and biological data from the catches. The observer information could be used to evaluate the total catch of juvenile fish and to estimate total catch by species. Because the information collected under Alternative 5 includes catch (retained and discarded) composition, it would be most beneficial in understanding the extent of the impacts of effort shifts on the resources in the long term. Data collected under Alternative 5 would not be available in realtime as would data collected under Alternatives 3 and 4.

For the limited entry trawl fleet operating north of Cape Mendocino (40°10' N. lat), bottom trawl gear will be limited to inside of 100 fm or outside 250 fm during January-June and September-December. During the summer months (July-August), the open areas for fishing will be limited to inside of 75 fm or outside 250 fm. Commercial fishing is prohibited in State waters off Washington and commercial fishing with trawl gear is prohibited in state waters off California. However, trawling is allowed in the nearshore areas off the State of Oregon. Canary rockfish has a low OY to allow for rebuilding. Because canary rockfish is vulnerable to trawl gear in the deeper shelf waters, it would be beneficial for projecting fishing impacts on the canary rockfish resource if the geographical distribution of limited entry trawl fishing effort where better understood. Other minor rockfish species found shoreward of the trawl conservation areas north of Cape Mendocino may benefit from having limited entry trawl effort data available, these species include: black, blue, china, copper, greenstriped, pygmy, quillback, redstriped, rosethorn, silvergrey, splitnose, stripedtail, and tiger. Having a better understanding of limited entry trawl effort seaward of the conservation area could be beneficial in projecting fishing impacts on thornyhead rockfishes. In addition, understanding fishing effort distribution could be beneficial in projecting fishing impacts on cabezon, lingcod, petrale, Dover sole, and sablefish (seaward and shoreward of the conservation area).

For the limited entry trawl fleet, south of Cape Mendocino to Point Conception (34°27' N. lat.), fishing will be limited to inside 60 fm (except Jan and Feb it is inside 50 fm) and outside of 250 fm, however, between Cape Mendocino and Point Reyes (38° N. lat.), fishing will be allowed outside 150 fm. For the limited entry trawl fleet, south of Point Conception (34°27' N. lat.), fishing will be limited to inside 100 fm and outside 150 fm. Trawl limits in the area south of Cape Mendocino will be severally restricted for minor shelf and nearshore rockfish species. Because canary, bocaccio (Monterey and Conception areas), and cowcod rockfish (Conception area) have very low OYs and because they are vulnerable to trawl gear, information that aids in understanding where limited entry trawl fishing effort is occurring would be beneficial to managers and scientist.

Other rockfish that may benefit from data on fishing effort shoreward of the conservation area include: chilipepper rockfish and several minor rockfish species (bank, black, blue, brown, calico, china, copper, flag, freckled, halfbanded, honeycomb, Mexican, olive, pink, pinkrose, pygmy, quillback, rosy, speckled, squarespot, starry, whitespeckled, and vermillion). Juvenile rockfish that may benefit from data on fishing effort shoreward of the conservation area include: copper, cowcod, greenspotted, greenstriped, splitnose, widow, vermillion, and stripedtail. Effort data for fishing seaward of the conservation area would also likely be beneficial for projecting fishing impacts on the thornyhead rockfishes. Similar to the northern area, information collected under a monitoring system would likely be beneficial to cabezon, lingcod, and sablefish (seaward and shoreward of the conservation area).

Limited entry and open access fixed gear will be open in nearshore waters off Oregon (inside 27 fm) and nearshore waters off California (inside 20 fm). Information on effort shifts into these shallow areas would likely be beneficial in understanding the fishing impacts on several minor nearshore species. North of Cape Mendocino, fixed gear will be permitted outside of 100 fm and outside 150 fm south of Cape Mendocino. Darkblotched and POP are not particularly vulnerable to fixed gear. For those deeper slope rockfish species, thornyheads and sablefish, understanding where limited entry trawl fishing effort is occurring would be beneficial for projecting fishing impacts.

Issue 2, coverage, would apply if Issue 1, Alternatives 3, 4, or 5 were selected. Coverage refers to that portion of the overall fishing fleet that would be required to have VMS or observers on board in order to participate in the fishery. Issue 2, Alternative 5, would require all limited entry, open access, and recreational charter vessels to carry an observer regardless of where they fish. This alternative would be most beneficial to understanding effort shifts and projecting impacts related to fishing effort in the long-term because it would provide the most amount of information on fishing location and effort by the largest number of participants. However, at this time there is very little data (observer or otherwise) on catch composition and discard levels from open access vessels and from recreational fishing vessels. In the short-term, using effort data obtained from a VMS system to estimate changes in effort and impacts on groundfish, will be limited until more data becomes available. Issue 2, Alternative 4, would apply to all commercial and recreational charter fishing vessels that operate within the conservation areas. This group would not include vessels that fish shoreward (nearshore areas) or seaward of the conservation areas and is therefore a slightly smaller group than Issue 2, Alternative 5. Issue 2, Alternative 3 is very similar to Issue 2, Alternative 4, existing information does not allow the impacts to be distinguished from one another. There are no differences between Issue 2, Alternatives 2A and 2B in the amount of effort and location data that each provide (only active vessels provide fishing data). Of all the alternatives under Issue 2, Alternatives 2A and 2B provide the least amount of data. However, there is more observer data available that can be used to better understand effort shifts and to project impacts related to fishing effort location from the limited entry portion of the fishery than is available for the other (open access, other commercial, or recreational) portions of the fishery.

Issue 3, expenditures, would apply if Issue 1, Alternatives 3 or 4 were selected. Issue 3 addresses the cost (primarily the capital costs) of a VMS program and the distribution of these costs between NMFS and the fishery participants. There is no difference between the alternatives under issue 3 in the ability to understand effort shifts and to project impacts related to fishing effort.

4.2.3 *Other Resources*

Nongroundfish species interactions
None of the management alternatives is expected to have an adverse effect on the incidental mortality levels of CPS, dungeness crab, Pacific pink shrimp, Pacific halibut, forage fish or miscellaneous species. However, knowing where fishing is occurring (Alternatives 3, 4 and 5) may be positive because it will allow observer data and data from other sources to be joined to better understand the extent of potential fishing related impacts on these species. In addition, Alternative 5 may provide data on incidental and total catch of these species.

Salmonids
None of the management alternatives is expected to have an adverse effect on the incidental mortality levels of listed salmon species. However, knowing where fishing is occurring (Alternatives 3, 4 and 5) may be positive because it will allow observer data and data from other sources to be joined to better understand the extent of potential fishing related impacts on salmonids. In addition, Alternative 5 may provide data on incidental and total catch of these species.

Marine Mammals
None of the proposed management alternatives are likely to affect the incidental mortality levels of marine mammals. The WOC groundfish fisheries are considered a Category III fisheries where the annual mortality and serious injury of a stock by the fishery is less than or equal to 1 percent of the PBR level. However, knowing where fishing is occurring (Alternatives 3, 4 and 5) may be positive because it will allow observer data and data from other sources to be joined to better understand the extent of potential fishing related impacts on various marine mammal species. In addition, Alternative 5 may provide data on incidental and total catch of these species.

Seabirds
None of the proposed management alternatives are likely to affect the incidental mortality levels of seabirds. However, knowing where fishing is occurring (Alternatives 3, 4 and 5) may be positive because it will allow observer data and data from other sources to be joined to better understand the extent of potential fishing related impacts on seabirds. In addition, Alternative 5 may provide data on incidental and total catch of these species.

Sea Turtles
None of the proposed management alternatives are likely to affect the incidental mortality levels of sea turtles. However, knowing where fishing is occurring (Alternatives 3, 4 and 5) may be positive because it will allow observer data and data from other sources to be joined to better understand the extent of potential fishing related impacts on sea turtles. In addition, Alternative 5 may provide data on incidental and total catch of these species.

Endangered Species
Species listed under the ESA are identified in section 3.2 of this EA. Specific discussion of species listed under the ESA can be found above in the sections titled salmonids, marine mammals, sea birds and sea turtles.

4.3 Socio-economic Impacts

4.3 Socio-economic Impacts
This section of the EA looks at impacts, positive and negative, on the socio-economic environment. To the extent possible, these impacts include: changes in harvest availability to the different sectors of the fishery; changes in income and revenue; costs to participants; the effectiveness and costs of enforcing the management measures, affect on fishing and low income communities; and how the actions affect safety of human life at sea

4.3.1 <u>Availability of information needed to maintain the integrity of conservation areas and the efficiency in using enforcement resources to maintain the integrity of conservation areas</u>

Implementing depth-based management measures over large geographic areas, such as from the U.S./Canada border to the US/Mexico border, marks the transition to a much greater dependence upon at-sea enforcement. Maintaining the integrity of the conservation areas will be largely dependent upon the ability to enforce such management measures.

In the past, fishery management measures, such as landing limits, size limits, and species landing restrictions were largely enforced by the relatively easy and inexpensive method of dockside enforcement. Enforcing depth-based closed areas represents a more costly and difficult challenge. To effectively enforce conservation areas, enforcement must be capable of patrolling the shoreward and seaward boundaries of the conservation areas. State agency patrol planes and vessels are too small and not capable of routinely patrolling the 250 fathom line, therefore, enforcement will need to rely heavily and possibly exclusively on USCG air and surface crafts. In order to patrol the conservation areas effectively, the USCG will need to supply an airplane, a helicopter, and a large cutter.

At the present time there are 4 NMFS agents (2 additional job positions are currently vacant) covering the Pacific Coast groundfish fishery. These officers and agents are responsible for enforcing all conservation regulations in the Pacific Coast groundfish fishery (e.g. size limits, trip limits, gear restrictions, etc).. They are also responsible for monitoring all other fisheries in those areas that are regulated by NMFS. In addition, there are 65 state enforcement officers (44 [with an additional 11 job vacancies] in California, ½ Oregon, and 20 for Washington with 4 stationed on the coast) that cover the groundfish fishery as well as other state fisheries. At this time, state enforcement resources (personnel and budgets) are extremely limited.

It is expected that the USCG will be performing the majority of the at-sea enforcement of conservation areas for 2003. Their estimated costs, those projected expenses needed to operate cutters and aircrafts offshore, are not expected to vary with the alternatives. Because the USCG engages in multi-purpose missions, some of the costs of at sea surveillance are associated with homeland defense, search and rescue, pollution response, law enforcement, and training. At any time, effort may be diverted from depth-based management patrols, should the need arise.

Historically, the USCG has spent 90 percent of their time patrolling in support of living marine resources, with 45 percent of that time based on groundfish enforcement. These patrol hours have been allocated for monitoring multiple fishery management plans, marine sanctuaries, protection of the U.S. EEZ from foreign fishing, and the enforcement of international fishery agreements. The broad geographic range covered by the Pacific Coast groundfish fishery and the large number of participants, and the numerous species covered by the FMP, present a significant challenge to enforcement and highlight the limitations of traditional monitoring alone. With respect to maintaining the integrity of conservation areas, the size of the restricted areas and the amount of legal activity within the area impair the likelihood of detection through traditional methods (Issue 1, Alternative 1). When the rate of detection is low, the likelihood of the illegal activity occurring is increased (Sutinen and Andersen 1985).

Under Issue 1, Alternative 1, the no action alternative, traditional enforcement methods would continue to be used to monitor the integrity of the conservation areas. Of the alternatives, Issue 1, Alternative 1 would be the least efficient in using limited state and federal enforcement resources and likely the least effective in monitoring the integrity of conservation areas. Issue 1, Alternative 2, which requires declaration reports for limited entry, open access fixed gear and tribal trawl vessels, would not replace or eliminate traditional enforcement measures, but would provide information that could aid enforcement in identifying vessels that are legally operating in the conservation areas from those that are fishing illegally. Because declaration reports could be used to direct traditional enforcement methods, it would result in a slightly more efficient and effective use of enforcement resources than would be expected under Issue 1, Alternative 1.

VMS, as presented under Issue 1, Alternatives 3 and 4, and observers under Issue 1, Alternative 5, would not replace or eliminate traditional enforcement measures such as aerial surveillance, boarding at sea via patrol boats, landing inspections and documentary investigation. Traditional enforcement measures may need to be activated in response to information received via the VMS or from observers. VMS positions can be efficient in identifying possible illegal fishing activity and can provide a basis for further investigation by one or more of the traditional enforcement measures. VMS positions in themselves can also be used as the basis for an enforcement action. Vessel positions provided by observers would likely not be received in real time and would therefore be less efficient than those received from a VMS transceiver.

Deterrent - One of the major benefits of VMS (Issue 1, Alternative 3 or 4) is its deterrent effect. This has been observed and reported on through practical experience in Australia, New Zealand and the USA . It has been demonstrated that if fishing vessel operators know that they are being monitored and that a credible enforcement action will result from illegal activity, then the likelihood of that illegal activity occurring is significantly diminished. In this context, VMS is a preventive measure rather than a cure.

To be effective as a deterrant, the VMS program must maintain its credibility in the eyes of the vessel operators and its use must be kept at the forefront of their minds if the deterrent effect is to be maintained. The credibility of the system can only be maintained if all operational issues are followed up, particularly those which effect a vessel, such as failure of the vessel to report on schedule. The presence of the VMS equipment on the vessel will be a reminder to operators of its monitoring operation. Use of the system for direct communication between vessel and monitoring agency (Issue 1, Alternative 4) further strengthens the presence of the monitoring function. Issue 1, Alternative 5, observers, could also be expected to be an effective deterrent, but less so than VMS because observer reported positions are at a greater risk of being recorded incorrectly or tampered with.

Probable Cause and Targeted Investigations: In an active sense VMS (Issue 1, Alternatives 3 or 4) will potentially show enforcement officers breaches of time/area restrictions. VMS can show officers those vessels which are following the rules as well those which are not. In doing so, it makes the activities of investigating officers much more cost effective because less time will be spent pursuing false trails and fishing operators who are following the rules. It may also be a requirement to have established "probable cause" before pursuing some types of investigations, for example, in obtaining a search warrant. VMS may be of assistance in this situation because while not being evidence of sufficient significance by itself, it could provide sufficient evidence to lead an officer to believe that an illegal act had occurred.

Issue 1, Alternative 5, observers, could also be used to identify probable cause and to target investigations. However, because observer data and reports are not received in real time they may be less effective than either Issue 1, Alternatives 3 or 4.

Landing and at sea inspections - In some cases, enforcement officers will have particular vessels or particular situations for which they may wish to conduct an at sea or landing inspection, sometimes without warning to the vessel operator. Without VMS, it is extremely difficult to determine where a vessel is located at sea or where, and at what time it might enter port. VMS (Issue 1, Alternatives 3 or 4) provides a good and reliable means of achieving this with potential savings in time and other expense in moving officers and aircraft or patrol vessels to the correct location at the appropriate time. Issue 1, Alternative 5, observers, would not be as effective as Alternatives 3 and 4 in directing landing and at-sea inspections because observer data and reports are not received in real time.

Increasing efficiency of surveillance patrols - Patrols by both sea and air will still be necessary for fully effective monitoring and management even with an effective VMS (Issue 1, Alternatives 3 or 4). A patrolling aircraft or vessel can spend considerable time and fuel investigating legitimate fishing vessels that will appear on their radar. Providing access to VMS data for patrol craft can minimize the effort spent confirming radar contacts of vessels fishing legitimately. Further, identifying legitimate fishing vessels to patrol craft via VMS may help them choose particular contacts for more productive investigation when several contacts are made by radar. Issue 1, Alternative 2, which requires declaration reports for limited entry, open access fixed gear and tribal trawl vessels, could be used to direct traditional enforcement methods. Issue 1, Alternative 5, observers, would not be as effective as Alternatives 3 and 4 in directing landing and at-sea inspections because observer data and reports are not received in real time.

Homeland security : Implementation of a VMS (Issue 1, Alternative 3 and 4) program clearly supports an enforcement mission and has indirect benefits to Homeland Security activities. NOAA believes that increased border security correlates directly with increased risk within our EEZ and along our coast line for illegal entry. In March 2002, the "Citizen Corps" initiative was announced, which includes the expansion of "Neighborhood Watch" to include the participation of ordinary citizens in detecting and preventing terrorism. Under "Coastal Watch", the Coast Guard requests fishers to report suspicious activities for investigation and intelligence purposes. Furthermore, critical decisions on the deployment of enforcement assets can be based on VMS surveillance reports. Satellite communication can also update essential information during a law enforcement response. VMS with two-way satellite communications capability (Issue 1, Alternative 4 -VMS upgrade), which can be used to report suspicious activities or vessels directly to NMFS Special Agents, Enforcement Officers and the U. S. Coast Guard. Investigative methodologies would be enhanced via surveillance data maintained within VMS, such as easily identifying potential witnesses to incidents, locating U.S. vessels in areas of suspicious activity for assistance and support and increased intelligence gathering capabilities. By expanding the number of U.S. fishing vessels operating with VMS, NOAA and fishers are expanding the capability to detect and prevent terrorism and other criminal activity in one of our most vulnerable areas, the U.S. Exclusive Economic Zone. VMS also supports the Coast Guard's "Coastal Watch" initiative, which was developed in response to their homeland defense activities.

4.3.2 Availability of information needed to measure the effectiveness of management measures

Data gathered from commercial and recreational fisheries are essential for assessing the effectiveness of management regulations. Logbooks, landing surveys, VMS, and observers are different fishery dependent methods used to collect data on harvest location. Interception at sea by an independent vessel can also be used to obtain harvest location data. The cost of collecting data from the fishery participants tends to be lower than collecting the data from an independent source. This is because it is a byproduct of the fishing activity. Some forms of fishery dependent data, particularly unverified logbooks and landing surveys, are more subject to bias than other methods and their collection and use in measuring the effectiveness of management measures require added care.

In the limited entry trawl fisheries, vessel operators are required to submit logbooks, which are detailed records of their fishing activities. Under Issue 1, Alternative 1, trawl fishing logbooks would continue to be used to understand fishing location in relation to time/area restrictions. For Washington, Oregon and California, there is a tri-state trawl logbook program coordinated by the Pacific States Marine Fisheries Commission. This is a non-federal logbook program. Logbooks typically provide the following data: 1) vessel identity, 2) date, time and position of activity (generally one position per haul or set as compared to a track line that can be obtained from VMS), 3) weather conditions, 4) gear used, 5) amount of activity (e.g., tow length, number of hooks), 6) targeted species, and 7) estimated catch of other species including protected species. To a limited extent, information in logbooks can be verified by comparing the data from unobserved trips with observed trips that employ a similar strategy. Logbook data is generally entered from paper forms and may not be available for assessing the effectiveness of management measures for months. Issue 1, Alternatives 1 and 2 provide similar levels of information that can be used to better understand the effectiveness of management measures.

Issue 1, Alternative 3 and 4 provide for VMS systems that have the potential of producing reliable and useful information for assessing the effectiveness of management measures. At a minimum, the data can be used to efficiently monitor fishing location and to verify times and dates reported on both logbooks and in observer data as well as assist in the interpretation of fishery data. It can also be used to provide information on days at sea and location data for sectors of the fleet (limited entry fixed gear and open access) where logbook data is not available. To a limited degree, data that identifies when fishing trips are occurring may help to determine if reporting and recordkeeping requirements are being met.

Understanding where fishing effort is occurring in realtime may provide insight into understanding information reported on fish tickets and be useful in understanding how management measures affect fishing behavior. Knowing where a vessel is fishing as compared to where the catch is being landed, may be valuable in assessing the effectiveness of trip limit management lines and differential trip limits. The data provided by VMS (Issue 1, Alternatives 3 and 4) are cost effective and accurate over large geographical areas. Accurate and timely data on fishing locations is necessary to assess effectiveness of closed areas and the overall results of the management scheme.

VMS data can be combined with observer data to assess the effectiveness of management measures. However, the value in combining observer data with VMS data for non-enforcement purposes depends on the amount of tow-by-tow observer data on catch and discards that is available from the different gears and fishing strategies. In the long term, when combined with observer data, VMS may provide information that results in a better understanding of fishery location and a spacial understanding of fish stocks. Unlike Issue 1, Alternative 5 (observers), VMS are limited in that there is not direct observation of the type of fishing gear being deployed. However, when VMS data are combined with information from declaration reports, as is proposed under Issue 1, Alternatives 3 & 4 (with VMS) and Alternative 5 (with observers), information on the gear type being used aboard the vessel when it intended to fish in a conservation area would be available.

The Northwest Fishery Science Center has developed a prototype electronic logbook for commercial fisheries off the West Coast. An electronic logbook can be considered to be similar to a conventional logbook, but with the fisher recording data in a computer rather than a paper logbook. The logbook uses personal computers combined with ship to shore communications and a secure onshore database. This system can be integrated with VMS transceivers that allow for two-way communications (Issue 1, Alternative 4). By combining the electronic logbook with the VMS system proposed under Issue 1, Alternative 4, it is possible that logbook data can be transmitted directly to NMFS from the vessel.

There are a number of benefits to electronic logbooks combined with a VMS system. First, there is only a single data entry function and this can be performed very soon after each fishing operation is completed. Paper logbooks must first be filled out by the fisher and then submitted to a government agency for data entry before logbook data can be used. In performing the data entry function, the fisher will interact directly with the editing checks for the data and a more complete and accurate data record can be required before the data record is accepted by the computer system. Having electronically recorded the data, the operator may produce a hard copy and also transmit the data to the fisheries agency or other recipients such as the fishing company, and may be easily incorporated into appropriate databases. As a result, improvements in timeliness, accuracy and reduced costs are possible. When the data is in the database and available to be analyzed, it can be used to improve the ability of managers to measure the effectiveness and economic impacts of management measures.

Observers (Issue 1, Alternative 5) are generally used to collect independent effort and catch data from commercial and recreational charter vessels. Observer data can be used to verify logbook data and provide information that makes it possible to manage by what is caught (total catch) not just what is landed and reported. Observer data can be extremely useful in assessing the effectiveness of management measures, however, observer coverage is expensive (see section 4.3.4 for more information on observer costs). Although the data collected by observers is critical to fisheries management, much of the data collected by observers extends beyond the need that has been identified for this action.

4.3.3 The effects on harvesters (tribal and non-tribal), processors, and communities

Time/area closures have long been used to restrict fishing activity in the Pacific Coast groundfish fishery in order to keep harvests within sector allocations and at sustainable levels or to prohibit the catch of certain species. For 2003, the Council sought a management strategy that would allow fishing to continue in areas and with gear that can harvest healthy stocks with little incidental catch of low abundance species. Recent stock assessments for bocaccio, yelloweye, canary and darkblotched rockfish, indicate little surplus production is available for harvest. Measures must be taken to protect these stocks and rebuild them to sustainable biomass levels. Therefore, the Council recommended that NMFS define additional management areas for the groundfish fishery that are based on bottom depth ranges where these low abundance species are commonly found. As discussed above, for 2003, large-scale depth-related areas, referred to as rockfish conservation areas, will be used to prohibit both commercial and recreational fishing across much of the continental shelf. Deep-water fisheries on the slope and nearshore fisheries will be permitted, but only in areas seaward or shoreward of the depth-based conservation areas.

The boundaries of the groundfish conservation areas are complex, involving hundreds of points of latitude and longitude to delineate nearshore and offshore fathom curves. The areas are vast, extending along the entire West Coast from Canada to Mexico, and the weather and sea conditions are frequently harsh. Some fishing, such as midwater trawling for pelagic species and shrimp trawling with finfish excluders, will be allowed to occur in the conservation areas. In addition, vessels intending to fish seaward of the westernmost boundary of a conservation area will be allowed to transit through the area, provided the gear is properly stowed. Ensuring the integrity of conservation areas using traditional enforcement methods is especially difficult when the closed areas are large-scale and the lines defining the areas are irregular. Furthermore, when some gear types and target fishing are allowed in all or a portion of the conservation area while other fishing activities are prohibited, it is difficult and costly to effectively enforce restrictions using traditional methods. Scarce resources also limit the use of traditional enforcement methods.

To allow for a more liberal depth-based management regime, as proposed by the Council for 2003, it is necessary to take action to establish a monitoring program to ensure the integrity of these large irregularly shaped depth-based conservation areas. With the 2003 Annual Specifications and Management Measures, the Council recommended several mitigating factors associated with depth-based management strategy, including implementation of a VMS monitoring system, to track movement of vessels through and within depth zones. Without a management strategy based on depth-based conservation areas, the fishery would be managed under more seriously constrained limits on healthy stocks that co-occur with overfished species. Geographically defined areas would likely revert to those that were in place before September 2002. These areas tended to be nearshore or defined by a simple latitude lines.

A more liberal depth-based management regime, such as that proposed by the Council for 2003, is only possible if the integrity of the depth-based conservation areas can be ensured. Maintaining the integrity of the conservation areas will be largely dependent upon the ability to enforce such management measures. Without the ability to ensure the integrity of the conservation areas, it is most likely that the depth-based management strategy will be discontinued. If this were the case, the management structure would revert back to more restrictive limits or no limits on healthy stocks in order to protect overfished species. Under Issue 1, Alternative 1, the no action alternative, there would be no program developed to monitor time/area closures in the Pacific Coast groundfish fishery and only traditional enforcement methods would be used to monitor the integrity of the conservation areas. It is likely that under Issue 1, Alternative 1 the integrity of the conservation areas could not be maintained and the management structure would revert back to those that were in place before September 2002 and more restrictive limits. Issue 1, Alternative 2 would have only a slightly better ability to maintain the integrity of closed areas than Issue 1, Alternative 1. Issue 1, Alternatives 3 and 4, the VMS alternatives, are most likely to maintain the integrity of conservation areas and allow depth-based conservation areas to continue to be used.

If the depth-based management strategy continues, the economic benefits to fishery participants, processors, and communities would be maintained. The economic benefits of a depth-based management regime are fully discussed in the EIS prepared for the 2003 Annual Specifications and Management Measures (PFMC 2002), including the tradeoffs in harvest levels with and without the depth-based management regime. Higher limits and an increased ability to obtain the OY for healthy stocks would provide processors with fish and continue to provide employment opportunity within the communities. Issue 1, Alternative 5, observers, may also allow fishery to sustain higher harvest levels on healthy stocks. Under Issue 1, Alternative 5, observers, could be an effective deterrant and be used to identify probable cause and to target investigations. However, because observer data and reports are not received in real time they may be less effective than either Alternatives 3 or 4.

If the fishery were to revert back to those areas that were in place prior to September 2002 (conducted without depth-based conservation areas), the fishery would likely have lower limits for healthy stocks and the ability to obtain the OY of the healthy stocks would be reduced. Reductions in revenue as a result of the reduced harvest level would be expected (see section 4.3.4 for further discussion). Reductions in harvest by the imposition of trip limits would reduce gross revenue from the species to which the limit applies. If the species is a minor part of the complex that is being fished (harvest that is incidental to the main target species) and the limits for other species are not reduced, the trip limit will result in similar amounts of effort at a similar harvest cost but less revenue. If the harvest limit is for a species that comprises a significant component of the incentive for a particular fishing strategy, there may be a reduction in effort such that the reduction in net benefits is the reduction in revenue less the reduction in harvest costs. The revenue reduction is not just the revenue associated with the trip limit species but also includes the revenue that would have been earned from the harvest of all other species that would have been caught and retained as part of the target complex as well as any incidental catch that would have been retained for use.

Cumulative limits are a kind of output control that do not tell fishermen when, where, or how to take their fish. Restrictions that meet conservation objectives by dictating the manner of fishing generally impose inefficiencies that increase costs. Depth restrictions prevent fishers from harvesting healthier stocks in areas where the incidental harvest of overfished groundfish species is likely to be high. Depth restrictions may also create inefficiencies if harvest of the healthier stocks is forced to occur outside the optimal catch areas, where the CPUE is likely to be lower, resulting in higher costs. To the degree that vessels target species by moving effort into areas remaining open, it is likely that CPUE would be lower than in normal fishing areas, resulting in higher cost per unit of harvest.

In general, managing a fishery without accurate and timely data (Issue 1, Alternatives 1 and 2) poses the greatest risk to the economic stability in the fishery participants, processors and communities. The integrity of the closed areas must be maintained to reduce the risk of exceeding the OYs for overfished species. In addition, reliable information on fishing effort including location is needed to merge with catch data from observed trips to more accurately account for total fishing mortality. If total fishing mortality is higher than estimated, trip limits and harvest allocations may be set too high, and the long term health of the stocks may be jeopardized. If total fishing mortality is lower than estimated, trip limits and harvest allocations may be set too low. By adopting regulations to support an effective monitoring program (Issue 1, Alternatives 3, 4, or 5) and maintaining the integrity of closed areas, the long-term impact on communities is expected to be positive, because it would be expected to reduce the likelihood of overfishing that would likely result in further harvest reductions.

Issue 2, coverage, would apply if Issue 1, Alternatives 3, 4, or 5 were selected. As noted above, coverage refers to that portion of the overall fishing fleet that would be required to have VMS or observers on board in order to participate in the fishery. Issue 2, Alternative 5, would require all limited entry, open access, and recreational charter vessels to carry VMS or an observer regardless of where they fish. This alternative would be most beneficial to maintaining the integrity of the conservation areas in the long-term because it would provide the most amount of information on fishing location and effort by the largest number of participants. Issue 2, Alternative 4, would apply to all commercial and recreational charter fishing vessels that operate within the conservation areas. This group would not include vessels that fish shoreward (nearshore areas) or seaward of the conservation areas and is therefore a slightly smaller group than Issue 2, Alternative 5. Issue 2, Alternative 3 is very similar to Issue 2, Alternative 4. Existing information does not allow the impacts to be distinguished from one another. There are no differences between Issue 2, Alternatives 2A and 2B in the ability to monitor the integrity of conservation areas. Of all the alternatives under Issue 2, Alternatives 2A and 2B provide the least amount of data, but cover that portion of the fleet with the greatest capacity and cover a very large portion of the overall harvests. The integrity of the closed areas is expected to be maintained under these alternatives.

4.3.4 Cost burden

Table 4.3.4.1 shows the estimated burden per vessel for the monitoring system alternatives described under Issue 1. These include the costs for installation, VMS transceiver unit, annual maintenance, replacement cost, cost to transmit hourly positions, declaration reports, and observer costs. Table 4.3.4.2 details components of shows the estimated cost to participants for preparing and submitting declaration reports**.** The following text also refers to Table 4.3-5b from the Final Environmental Impact Statement for the Proposed Groundfish Acceptable Biological Catch and Optimum Yield Specifications and Management Measures 2003 Pacific Coast Groundfish Fishery which has been incorporated into this document as Table 4.3.4.3.

Table 4.3.4.1. Estimated Burden, per Vessel, for the Monitoring System Alternatives Described under Issue 1

	Alternative 1 No action	Alternative 2 Declarations	Alternative 3 Basic VMS system with declaration reports	Alternative 4 Upgraded VMS system with declaration reports	Alternative 5 Observers with declaration reports
Installation - start up cost	$0	$0	* Minimal - not to exceed 4 hours or $120 * Most are do-it yourself installation * 5 min to complete installation report, $3 to send fax to NMFS	* Minimal - not to exceed 4 hours or $120, except for the Trimble Galaxy $400 * All except Trimble Galaxy are do-it yourself installation * If attached to personal computer may require dealer to install software * 5 min to complete installation report, $3 to send fax to NMFS	$0
VMS transceiver/transponder unit - start up cost	$0	$0	* $1,550-$3,800 ($800 if new units are approved by NMFS)	* $2750 ($1,550 for unit plus approx. $1,200 for computer) - $5,295	$0
Annual maintenance	$0	$0	* 4 hours or $120 per year	* 4 hours or $120 per year	$0
Annual replacement costs (unit cost/years of service - estimate based on 4 years of service)	$0	$0	* $200-$950 per year	* $675-$1,324 per year	$0
Annual cost to transmit 24 hourly position reports	$0	$0	* $1.67-$5/day	* $1-$3.5/day	$0
Annual cost to transmit exemption reports (4 min/rpt)	$0	$0	$0	$0	$0
Annual cost to transmit declaration report (4 min/rpt- 12 time per year)	$0	$0	$0	$0	$0
Observer costs to the vessels - if a direct pay system similar to the at-sea Pacific whiting fishery is used, for each day the observer is on the vessel the cost to the vessels would be $300/day. Training and debriefing costs would be an additional $1200/observer. NOTE: The costs of sampling equipment or infrastructure needed to support an increased number of observers and their data has not been included in this estimate. Including these costs is estimated to increase the daily rate by approximately 30%.	$0	$0	$0	$0	$18,000 year @ 5 fishing days per mo ($1,500) $36,000 year @ 10 fishing days per mo ($3,000) $72,000 @ 20 fishing days per mo ($6,000) $108,000 @ 30 fishing days per mo ($9,000) * Food for observer as much as $30/day

Declaration reports (Issue 1, Alternatives 2-5)
To assist enforcement in identifying vessels that are legally fishing in conservation areas, vessels registered to limited entry permits with trawl endorsements; any vessel using trawl gear, including exempted gear used to take pink shrimp, spot and ridgeback prawns, California halibut and sea cucumber; and any tribal vessel using trawl gear, would be required to send a declaration report before the vessel is used to fish in any trawl RCA or the CCA in a manner that is consistent with the requirements of the conservation areas (e.g. pelagic trawl during when permitted for yellowtail and widow rockfish or Pacific whiting or pink shrimp gear with a finfish excluder during the pink shrimp season). In addition, declaration reports would be required from vessels registered to limited entry permits with longline and pot endorsements, before the vessel can be used to fish in any Non-trawl RCA or the CCA, in a manner that is consistent with the requirements of those conservation areas. Vessels such as salmon troll and sport charter vessels are visually unique and would therefore not be required to provide declaration reports.

Each declaration report would be valid until cancelled or revised by the vessel operator. After a declaration report has been sent, the vessel cannot engage in any activity with gear that is inconsistent with that which can be used in the conservation area unless another declaration report is sent to cancel or change the previous declaration. Declaration reports would be sent to NMFS and vessel operators would receive confirmation that could be used to verify that the reporting requirement was met. It is necessary for a vessel owner, operator or representative to submit these reports because only they can make statements about where they intend to fish.

Improved technology would be used to reduce the reporting burden on NMFS and the fishery participants. Vessels will call in declaration reports by using an Interactive Voice Response (IVR) system . The IVR system, which is accessed by dialing a toll-free number, asks the caller to use the touch-tone telephone to respond to a series of questions. An IVR system allows vessels to quickly and easily submit their report 24 hours a day and will reduce the paperwork burden on both the fisherman and the NMFS, as it makes it easier to collate the information submitted in the reports and monitor fishing activity.

Aside from the cost in time to summarize and call in an IVR report, there will be no additional cost burden for respondents. All respondents are assumed to have access to a telephone. The telephone call will be placed through a toll-free number so the respondent will not pay for the call. Table 4.3.4.2 shows the estimated burden to the fishery participants with the coverage level described under Issue 2, Alternative 2A. Issue 2, Alternative 2B, 3, 4 and 5 would be slightly lower in cost since there would be 38 fewer respondents.

Table 4.3.4.2 Estimated burden to the fishery participants for declaration reports

Maximum total number of VMS respondents (424 limited entry + 294 exempted trawl + 5 tribal trawl)	723
Est. number of declaration reports per year (12 per respondent x 723 respondents)	8,676
Est. hours per response to prepare and submit declaration reports (4 minutes per response)	0.0667
Total hours for all respondents to prepare and submit declaration reports per year	578
Total hours per respondent per year to prepare and submit declaration reports (48 minutes)	0.8
Total cost per respondent per year to prepare and submit declaration reports (@$30 per hour)	$24

VMS (Issue 1, Alternatives 3 and 4)

Installation - The time burden for the actual installation of the units proposed under Alternatives 3 and 4 are estimated at 4 hours per vessel, or $120. Personnel costs are estimated to be $30 per hour. The actual installation time for a VMS unit is estimated to be less than two hours, but a higher estimate of 4 hours/vessel is used, based on a worst case scenario where the power source (such as a 12 volt DC outlet) is not convenient to a location where the VMS unit can be installed. Most of the systems being considered for type-approval under Issue 1, Alternatives 3 and 4 are do-it-yourself installations.

The ArgoNet MAR GE uses a single mobile transmitting unit mounted atop the vessel. The unit contains an Argos transceiver, an integrated global positioning system (GPS) receiver, a battery, and an antenna. The mobile transceiver unit is connected to a power junction box in the wheelhouse, which can be installed in less than 1 hour. The Qualcomm/Boatracs unit (Alternative 4), which is currently used in the Northeast scallop, Northeast multispecies, and Atlantic herring fisheries requires a dealer to install, but the cost of installation is included in the price of the transponder unit. The installation of the Inmarsat-C Thrane units are do-it-yourself while the Trimble units must be installed by Trimble-trained and Trimble-authorized support dealers. This is expected to result in an installation charge of $400. The installation of software and attachment of a personal computer to an Inmarsat-C unit (Alternative 4) may also require dealer assistance.

Installation/Activation Report - Given that the VMS hardware and satellite communications services are provided by third parties as approved by NMFS, there is a need for NMFS to collect information regarding the individual vessel's installation in order to ensure that automated position reports will be received. This information collection would not increase the time burden for installation of VMS, but would require that a certification and checklist be returned to NMFS prior to using the VMS transceiver to meet regulatory requirements. An installation checklist would be issued by NMFS and the VMS installer would certify the information about the installation by signing the checklist and returning it to NMFS.

The checklist indicates the procedures to be followed by the installers and, upon certification and return to NMFS, provides the Office of Law Enforcement with information about the hardware installed and the communication service provider that will be used by the vessel operator. Specific information that links a permitted vessel with a certain transmitting unit and communications service is necessary to ensure that automatic position reports will be received properly by NMFS. In the event that there are problems, NMFS will have ready access to a database that links owner information with installation information. NMFS can then apply troubleshooting techniques to contact the vessel operator and discern whether the problem is associated with the transmitting hardware or the service provider.

The time and cost burden of preparing and submitting installation information to NMFS is minor. Submission of a checklist would be required only for the initial installation or when the hardware or communications service provider changes. NMFS estimates a time burden of 5 minutes ($2.50 at $30 per hour) for completing the checklist and additional $3 for mailing/faxing to NMFS, for a total of $5.50 per occurrence. If all 424 vessels registered to limited entry permits were required to have VMS transceivers, there would be a time burden of 34 hours ($1,020 at $30 per hour) for all vessels to prepare the activation/installation report, and a cost of $1,272 to transmit the report to NMFS. For the estimated 386 vessels that actively fish in the WOC, there would be a time burden of 31 hours ($930) for all vessels to prepare the reports, and a cost of $1,158 to transmit the report to NMFS.

The ability for NMFS to ensure proper operation of the VMS unit prior to the vessel's departure will save time and money. The installation checklist and activation report will be made available over the internet. These reports would be faxed or mailed to NMFS.

VMS transceiver unit On September 23, 1993, NMFS published proposed VMS standards at 58 FR 49285. On March 31, 1994, NMFS published final VMS standards at 59 FR 15180. These notices stated that NMFS endorses the use of VMS and defined specifications and criteria for VMS use. On September 8, 1998, NOAA published a request for information (RFI) in the Commerce Business Daily in which it stated the minimum VMS specifications necessary for NOAA's approval. The information was used as the basis for approving the mobile transceiver units and communications service providers.

VMS Systems currently in use in other federally managed fisheries include: ArgosNet MAR YX, ArgosNet MAR GE, Analog Cell (AMPS) with Trimble crosscheck, Boatracs Omnitracs, and Inmarsat-C. Table 4.3.4.4. which was compiled by the OLE National VMS Steering committee, compares the primary features of the VMS equipment approved for use in various Federal fisheries. The two commonly-used systems are Inmarsat and Argos. Because these systems are widely used, they are more stable in the marketplace than lesser used systems (i.e. service providers and units are more likely to exist into the future compared with smaller start-up companies).

Currently, there are no VMS transceiver units type-approved for the Pacific Coast groundfish fishery. As units are tested and approved, a list of VMS mobile transponder units and communications service providers approved by NOAA for the Pacific Coast groundfish fishery will be prepared and published in the *Federal Register*. Each time the list is revised, it will be published in the *Federal Register*.

The North American Collection and Location by Satellite, Inc. (NACLS) is the sole service provider of the ArgoNet systems. The Argos Mar-GE and MAR-YX mobile transponder units costs $1,800 -$2,000 . The ArgoNet MAR GE uses NOAA polar-orbiting satellites, and, as such, it is considered a NOAA Data Collection and Location System. The use of any NOAA Data Collection and Location System is governed by 15 CFR part 911. Under these regulations, the use of a NOAA Data Collection and Location System can be authorized only if it is determined that there are no commercial services available that are adequate. In addition, special provisions have been made because of cost effectiveness to the Government, resulting in a temporary approval (3 year approval was granted for the Atlantic pelagic longline fishery). This unit meets the requirements of Issue 1, Alternative 3, but does not meet the requirements of Issue 1, Alternative 4 because the ArgoNet communications are one way only. Optional reports can be transmitted with the purchase of a handheld keypad ($400-$550). The unit contains a protected push button to request assistance from United States search and rescue authorities, however, search and rescue authorities still could not use the MAR GE transceiver to communicate with the vessel because it only accommodates one-way communications.

As of June 10, 2002, 50 CFR 679.7(a)(18), has required all vessels fishing in the Bering sea and Gulf of Alaska using pot, hook-and-line or trawl gear that are permitted to directly fish for Pacific cod, Atka mackerel or pollock to have an operable VMS transceiver. Approximately 49 vessels that had limited entry permits or participated in the WOC open access fishery in 2001 qualify for reimbursements to the Argos MAR-GE as a result of their participation in the Alaska groundfish fishery. This issue is further addressed in section 4.3.5 below. Allowing the use of Argos MAR-GE by WOC operating vessels that have purchased these units for participation in the Alaska groundfish fisheries would eliminate the cost of purchasing, installing and maintaining a second unit for these vessels. Similarly, allowing vessels to use units they have already purchased for other business purposes, providing they are a type-approved model with the required software and hardware, would also eliminate the cost of purchasing, installing and maintaining a second unit for these vessels. The number of vessels that currently have VMS transceivers is unknown.

The Boatracs/Omnitracs transponder unit costs about $5,300, including installation. Because the Boatracs/Omnitracs allows for continuous two-way communications 24 hours a day, it exceeds the requirements of Issue 1 Alternative 3 and meets the requirements of Issue 1, Alternative 4. For vessels in the Northeast Atlantic fisheries, Boatracs had offered a lease-to-own option with a 24 month or 36 month lease.

Inmarsat C transponders range from $1,550 to $3,800, not including a personal computer which would be approximately $1,200 more. Inmarsat-C units are simple and small enough to be hand-carried or fitted to almost any vessel. When fitted with a personal computer, two-way communications via the Inmarsat-C system are data or message-based, and meet the requirements of Issue 1, Alternative 4. Without the personal computers, these units meet the requirements of Issue 1, Alternative 3. Data can be coded into data bits and can be transmitted via Inmarsat-C. Most maritime Inmarsat-C terminals are equipped with a distress-alerting feature which, in the event of an emergency, automatically generates and sends a priority distress message, incorporating position and other information, to a rescue coordination center.

The Analog Cell (AMPS) with a Trimble Crosscheck transponder is approximately $800. Trimble Crosscheck systems use GPS and radio links to monitor vessels. These units have been widely used to track trucking fleets and automobiles in the continental US.

New units that have not yet been type-approved for any federal fisheries include the Inmarsat D+ with a transponder that costs about $800 and a waveburst/TMI which sells for about $2,300.

Most of the VMS transceiver units can be operated for extended periods from the same DC power source used to run other on board electronic equipment and so should increase power consumption only marginally.

Maintenance of transponder unit Vessel operators are required to operate the VMS unit continuously throughout the a year. This means that the vessel operator will maintain the transponder unit, antennas and the electrical sources that power the system.

When an operator is aware that transmission of automatic position reports has been interrupted, or when notified by NMFS that automatic position reports are not being received, they must contact NMFS and follow the instructions provided. Such instructions may include, but are not limited to, manually communicating to a location designated by NMFS the vessel's position or returning to port until the VMS is operable. There is a reporting burden associated with this requirement, but it is not expected to be substantial. The annual burden of these communications and the time required to maintain the antennas and electrical systems on the vessel operator is estimated to be approximately 4 hours per year or $120. In addition, some systems may require software to be updated. Many of the transponders can have their set of features upgraded by being reloaded/flashed with updated versions.

If a unit needs repair there may be fishing opportunity lost unless the unit can be quickly replaced or if there is access to rental units.

Replacement cost The various VMS transceivers have similar life spans of about 5 years before the units need to be replaced. Because of advancements in VMS systems or service providers that may no longer provide services, some models may become obsolete in less than 5 years. The purchase of these units may be considered as a tax deductible business expense during the first year of use. For depreciation purposes, VMS devices using satellite technology may qualify as "five-year property", although devices using cell phone technology probably will be treated similar to other cell phone equipment, as "seven-year property." For the purposes of this analysis, 4 years was used to estimate unit replacement costs identified in Table 4.3.4.1.

Cost to transmit hourly positions The primary costs after purchase and installation of a VMS is the charge for the messages that communicate the vessel's position. Once installed and activated, position reports are transmitted automatically to NMFS via satellite. Vessel operators are required to operate the VMS unit continuously throughout the year. The total costs for these messages depend on the system chosen for operation and the number of fishing days for units with a sleep function. Many of the systems have a sleep function. Position transmissions are automatically reduced when the vessel is in port. This allows for port stays without significant power drain or power shutdown. When the unit restarts, normal position transmissions automatically resume before the vessel goes to sea.

The estimated time per response varies with type of equipment and requirement. Upon installation, vessel monitoring or transponder systems automatically transmit data, which takes about 5 seconds. Under Issue 2, alternative 2A , there are estimated to be 424 vessels that will be required to have VMS and to continuously transmit position reports except, when issued a VMS exemption or when the vessel is inactive in port and the VMS goes into sleep mode.

Boatracs, Inc. charges a rate of $3.50/ day for one message each hour of every day, this would be $105 dollars per month or $1,260 annually if operating all 365 days in a year. Because vessels will not have to transmit position reports when moored in port (or otherwise inactive for extended periods), the number of messages will be reduced by the sleep mode function. With Boatracs, if a vessel averages 10 fishing days per month the monthly cost would be $35 and the annual cost would be $420. Inmarsat would cost $10 per month or $120 per year, and Argos GE $50 per month or $600 per year. Assuming 386 vessels being required to be equipped with a VMS (Issue 2 Alternative 2 B), and each operating 10 days per month, the total annual message costs of transmitting position reports would be about $162,120 with Boatracs, $ 46,320 with Inmarsat and $231,600 with Argos MAR-GE. Actual message costs will vary depending on how frequently a vessel fishes. At the extreme, if all 424 vessels were to fish 365 days per year, with 24 hourly reports per day, 3,714,240 position reports would be required, each taking about 5 seconds for a total transmission time of 5,159 hours annually. With transmission cost varying between $1 and $5 per day, the cost to the individual vessel would be $365-$1,825 per year, or a total of $154,760 - $773,800 for all respondents.

<u>Exemption reports</u>
Exemption Reports would be sent by the vessel owner or operator whenever they wanted their vessel to be excused from the requirement to operate the mobile transceiver unit continuously 24 hours a day throughout the calendar year (e.g. when the vessel will be operating outside of the EEZ for more than 7 consecutive days or the vessel will be continuously out of the water for more than 7 consecutive days). A vessel may be exempted from the requirement to operate the mobile transceiver unit continuously 24 hours a day throughout the calendar year if a valid exemption report, is received by NMFS OLE and the vessel is in compliance with all conditions and requirements of the exemption. An exemption report would be valid until a second report was sent canceling the exemption.

Improved technology would be used to reduce the reporting burden on NMFS and the fishery participants. Vessels will call in exemption reports by using an Interactive Voice Response (IVR) system . The IVR system, which is accessed by dialing a toll-free number, asks the caller to use the touch-tone telephone to respond to a series of questions. An IVR system allows vessels to quickly and easily submit their report 24 hours a day and will reduce the paperwork burden on both the fisherman and NMFS, as it makes it easier to collate the information submitted in the reports and to monitor fishing activity.

Aside from the cost in time to summarize and call in an IVR report, there will be no additional cost burden for respondents. All respondents are assumed to have access to a telephone. The telephone call will be placed through a toll-free number so the respondent will not pay for the call. Two exemption reports are estimated to be submitted per vessel annually under Issue 1, Alternatives 3 and 4, each report would require approximately 4 minutes to submit, for an average cost of $4 per vessel per year (at $30 per hour).

<u>Burden on Fishery Participants</u>

Table 4.3.4.3 (PFMC 2002) shows estimated vessel revenues under different 2003 management options, that were considered in the annual specifications and management process for the 2003 groundfish fishery. The alternative actions included the Councils preferred alternative and an alternative most similar to the preferred alternative, but without depth-based management. The alternative without depth-based management will be referred to as the allocation committee status quo depth management alternative. Estimated revenues under these two scenarios were used to assess the impact to the fishery of managing with and without depth-based measures under the fishing constraints adopted for the 2003 commercial season. For purposes of this analysis, the difference in exvessel revenue under the two scenarios can be thought of as a measure of the fishing opportunity gained by adopting a depth-based management regime, including the VMS requirement, compared with managing to comparable OY levels but without depth-based features.

Table 4.3.4.3 breaks in average exvessel revenue for different vessel classes. The vessels in this table that would be most directly affected by the VMS requirement are the limited entry trawl, longline and pot vessels, and the exempted trawl vessels from the two open access classes. From the table we see that 247 limited entry trawl vessels were estimated to earn an average of $180,000 exvessel revenue under the Council's preferred alternative, as compared with the average $154,000 under the allocation committee status quo depth management alternative, a difference of $26,000 per vessel. Similarly, we see that the 197 limited entry longline and pot vessels were estimated to earn an average $96,000 in exvessel revenue under the Council's preferred alternative, compared with an average of $82,000 under the allocation committee status quo depth management alternative, a difference of $14,000 per vessel. The difference in average revenues for the two classes of open access groundfish vessels is less, but still significant: $7,000 for the 516 vessels with less than 5% of revenue from groundfish, and $3,000 for the 771 vessels with more than 5% of revenue from groundfish.

While exvessel revenues appear higher on average for vessels likely to be required to use VMS under the depth-based management regime, it should be noted that non-VMS fishing costs may also be higher, offsetting some of the apparent gain. Unfortunately vessel cost data necessary to estimate this effect are not currently available. It is also important to keep in mind that using average revenues masks the variability of ex-vessel revenues in each vessel class. While on average, additional revenues appear greater than VMS-related costs, for some individual vessels in each class this will not be the case.

Table 4.0.1 shows that the average per vessel costs of adopting VMS under Monitoring System Alternative 3 range from $2,163 to $5,623 in the first year, and from $548 to $1,698 each subsequent year. Similarly under Monitoring System Alternative 4, VMS-related costs range from $3,878 to $7,607 in the first year, and from $1,063 to $2,342 each subsequent year. Comparing these per vessel average cost estimates with the average revenue gains derived above indicates that on average, and depending on how other non-VMS costs are affected, most vessels could potentially be better off with depth-based management, including VMS related costs, than under the likely alternative management regime. The obvious exception would be Open Access vessels with more than 5% of revenue from groundfish. Under most of the alternatives, the first year VMS-related costs would apparently outweigh the expected average benefit for these vessels (although once VMS is installed, in subsequent years, the annual operating, maintenance and replacement costs would generally be less than average additional revenues).

TABLE 4.3.4.3. Projected average exvessel revenue per vessel from all species by vessel length class from all sources recorded on West Coast fish landing receipts and vessels delivering to motherships.

Length Class	Number of Vessels	Alternative Baseline (11/00-10/01)	Low OY	High OY	Alloc Com (Status Quo Depth Mgmt)	Alloc Com with Depth Management	Preferred Option	Preferred Option (no caps)
		Average Exvessel Revenue Per Vessel ($ thousands, all species)						
Limited Entry Trawl								
<40'	5	75	59	68	57	66	67	67
40'-50'	31	111	92	107	90	105	105	105
50'-60'	64	161	135	166	120	154	156	156
60'-70'	57	245	183	222	179	204	207	207
70'-150'	84	278	192	245	199	220	222	222
Unspecified	6	96	62	86	71	71	71	71
Total	247	211	157	195	154	178	180	180
Limited Entry Longline and Fishpot								
<40'	85	56	44	58	41	49	53	54
40'-50'	71	97	72	98	79	83	90	90
50'-60'	25	173	139	171	139	146	158	158
60'-70'	11	290	239	295	243	247	270	270
70'-150'	4	280	236	285	242	243	263	263
Unspecified	1	5	3	6	3	3	4	4
Total	197	103	81	104	82	88	96	96
Open Access with > 5% of Revenue from Groundfish								
<40'	675	15	7	12	10	11	11	13
40'-50'	66	37	24	38	27	33	34	35
50'-60'	12	16	11	15	12	13	14	14
60'-70'	6	39	25	39	29	37	38	38
70'-150'	2	3	3	3	3	3	3	3
Unspecified	10	10	6	9	2	8	8	9
Total	771	17	9	15	11	13	14	15
Open Access with < 5% of Revenue from Groundfish								
<40'	324	38	32	38	32	38	38	38
40'-50'	109	57	50	57	51	57	57	57
50'-60'	29	120	113	120	112	120	120	120
60'-70'	28	191	177	191	178	190	191	191
70'-150'	25	209	198	209	197	208	208	208
Unspecified	1	3	3	3	3	3	3	3
Total	516	63	56	63	56	63	63	63
Nongroundfish Vessels								
<40'	1967	19	19	19	19	19	19	19
40'-50'	432	52	44	52	52	52	52	52
50'-60'	254	104	60	104	103	104	104	104
60'-70'	80	156	92	156	154	156	156	156
70'-150'	101	259	152	259	259	259	259	259
Unspecified	14	37	37	37	37	37	37	37
Total	2848	44	33	44	44	44	44	44

Table 4.3.4.4. VMS Equipment Currently in Use In Federally managed Fisheries (Compiled by the OLE National VMS Steering committee- 8/27/2002)

Communication Service	**Argos**	**Analog Cell (AMPS)**	**Argos**	**Qualcomm / Boatracs**	**Inmarsat-C**
Transceiver/transponder name	**MAR YX**	**Trimble Crosscheck**	**MAR GE**	**Boatracs Omnitracs**	**Trimble Galaxy TNL 7001 and 7005, Thrane and Thrane TT3022D**
Fisheries in use/Number of boats	Demonstration application on American Samoa Alia (Longline) vessels/2	Demonstration applications to date: Gulf of Mexico Shrimp and Trap, and Sea of Cortez Shrimp (Mexico)	AK Atka/8, AK Cod and Pollock/500, Atlantic Pelagic Longline (HMS), Pacific-West Coast Groundfish Demonstation/2	NE Scallop/284, NE Multispecies/42, Atlantic Herring/26	Hawaii Pelagic Longline/130, Hawaii Lobster/10, Foreign Settlement (Penalty)/25, Antarctic Krill/1, Atlantic Pelagic Longline (HMS) /4
Geographic coverage, when in line of sight of satellite or cell	Global	Various cellular coverage	Global	Contiguous US EEZ	Global to 78°N/S
Communication between ship shore	One-way, (ship-to-shore)	Two-way	One-way, (ship-to-shore)	Two-way	Two-way
Satellite type	Polar-orbiting, 4 NOAA meteorological	N/a	Polar-orbiting, 5 NOAA meteorological	Geo-Stationary, Qualcomm	Geo-Stationary, INMARSAT
Time between the vessel position fix and receipt at NMFS	Varies per latitude, Alaska 10-30min. avg. wait. HMS 60-90min. wait	Near real time, if within cell coverage	Varies per latitude, Alaska 10-30min. avg. wait. HMS 60-90min. wait	Near real time	Within 5-10 minutes
Ability to poll/query the transceiver	No	Yes	No	Yes	Yes
Interval between position reports	30 - 60 minutes depending upon latitudes	Various programming: 5 minutes to length of trip, or upon event (e.g. entering area)	30 - 60 minutes depending upon latitudes	Configurable	Configurable for 5 minutes to 24 hours
Ability to change the interval between position reports	Factory reprogramming	Manually set on the unit by OLE	Factory reprogramming	Remotely from service provider	Remotely from OLE
Position calculation (accuracy)	Integrated GPS (20m), reverts to Doppler when GPS blocked (350 or 1000m)	Integrated GPS (20m)	Integrated GPS (20m), reverts to Doppler when GPS blocked (350 or 1000m)	Qualcomm triangulation (300m)	Integrated GPS (20m)
Automatic anti-tampering and unit status messages	Yes	Yes	Yes	No	Yes
Distress signal	Yes	Yes?	Yes	Yes	Yes
Reduces power when stationary	Yes	No	Yes	No	Yes
Installation	Do-it-yourself	Do-it-yourself	Do-it-yourself	Dealer (costs included)	Dealer or electrician (costs not included), or do-it-yourself
Internal battery back-up	Primary power is internal battery	No	Yes, 48-hour	No	No
Log or memory buffer storing positions / number of positions	No/?	Yes/3000	Yes, must download manually/?	No	Yes, auto, remote or manual download/ Trimble 5000 Thrane 100
Can send logbook/catch report data	Limited status messages	?	Yes, with computer	Yes	Yes, with computer
Transceiver/transponder cost	$1800	$800	$2000 ($400 keypad optional)	$5300, including terminal	Thrane TT3022D $2650, TT3026M $1,550; Trimble $3800, optional computer for email not included
Daily communications cost for hourly positions	$5	$2	$5	$3.5	$1

Observer Costs (Issue 1, Alternative 5) - Under Issue 1, Alternatives 5, it is assumed that a direct pay system, similar to that used in the at-sea whiting fishery would be used to implement observer coverage. The costs of observers, would consist of 5 components: 1) paying observer's salaries (while training and on the vessel) 2) providing food and living accommodations, 3) providing adequate sample space and time for sampling, 4) carrying liability insurance, and 5) meeting safety requirements. The total costs to the individual vessel and to the fleet (and the number of vessels affected) would vary depending on the coverage alternative that was chosen under Issue 2.

The costs to the vessel to obtain a third party observer in the whiting fishery was approximately $300 per day at sea in 2002. In addition, vessels were responsible for paying training and debriefing costs that occurred before and after the observer's deployment. This would have been approximately $1,250 per observer. Vessels would also be responsible for providing the observer's living accommodations and food equivalent to that which is provided to the crew, under alternatives 5. The costs for an observer would vary between vessels and depend on the number of days fished. At 5 fishing days per month ($1,500/month) a vessel would pay $18,000 per year for an observer not including training and debriefing costs; at 10 fishing days per month ($3,000/month) a vessel would pay $36,000 per year for an observer not including training and debriefing costs; at 20 fishing days per month ($6,000/month) a vessel would pay $72,000 per year for an observer not including training and debriefing costs; and at 30 fishing days per month ($9,000/month) a vessel would pay $108,000 per year for an observer not including training and debriefing costs. In addition, each vessel would need to provide food for an observer which expected to increase costs to the vessel by as much as $30/observer day. The cost to the fleet to carrying observers to monitor fishing location in relationship to depth-based conservation areas depends on the coverage option that selected under Issue 2 and the number of vessels that would be required to carry an observer.

Information is not available to estimate indirect costs such as those associated with a possible reduction in crew size if crew members are displaced because of limited bunk space. Vessels may also incur costs if they choose to carry additional liability insurance. These costs would vary between individual vessels depending on the insurance carriers minimum allowed coverage period, and the coverage approach that is taken. Adequate information to estimate the costs to the vessel was not available for this analysis. It is also expected that additional time would be required in port for vessels to arrange for observer coverage.

Among the vessels in the open access and limited entry groundfish fisheries that could be selected to carry an observer, there are substantial differences in terms of annual ex-vessel value of their groundfish and WOC catch, the number of days fished per year, and the size of living and work space. It is likely that the smallest groundfish vessels would be most affected by the requirements under Issue 1, Alternative 5. Without minimal sample space, safe conditions, and adequate time to collect samples data quality cannot be assured. It may be determined that some vessels are simply too small to accommodate an observer and may need to be exempt from the requirement. Similarly, vessels with the least revenue may be excessively burdened if required to carry an observer over an extended period of time.

4.3.5 Vessels That Qualify for VMS Reimbursements in the Alaska Groundfish Fishery

On January 8, 2002, an emergency interim rule (67 FR 956) was issued by NMFS to implement Steller sea lion protection measures and 2002 harvest specifications for the groundfish fisheries in federal waters off Alaska. All vessels using pot, hook-and-line or trawl gear in the directed fisheries for pollock, Pacific cod or Atka mackerel are required to have an endorsement on their federal fisheries permit. As of June 10, 2002, Section 679.7(a)(18) requires all vessels using pot, hook-and-line or trawl gear that are permitted to directly fish for Pacific cod, Atka mackerel or pollock to have an operable VMS transceiver. Table 4.3.5.1 shows the number of vessels that landed groundfish in the WOC during 2001 that are also qualified for VMS reimbursement in the Alaska groundfish fisheries

For these fisheries, NMFS approved the ArgoNet MarGE transceiver, for which North American Collection and Location by Satellite, Inc. (NACLS) is the sole communications service provider. The Argos system was approved because of its ability to meet other specified VMS elements which could not be met by the other systems. Because the ArgoNet MAR GE uses NOAA polar-orbiting satellites, and, as such, it is considered a NOAA Data Collection and Location System (DCS). The use of any NOAA DCS is governed by 15 CFR part 911. Pursuant to those regulations, use of a NOAA DCS can be authorized only if it is determined that there are no commercial space-based services available that meet the user's requirements.

The list price of ARGOS MAR-GE units is $2,000 plus freight and installation. The cost per day is $5 for 24 hourly positions. After approximately 11.5 hours of inactivity, the unit goes into sleep mode, incurring only $5/week transmission costs until activity (movement) resumes. There is currently a reimbursement program for the initial VMS equipment purchase. The Pacific States Marine Fisheries Commission has received a grant of over $1.5 million for reimbursements to vessel owners who are required to purchase VMS units for Alaska groundfish fishery participation. Eligible participants receive reimbursements for up to $2,000 of the purchase price of the VMS unit.

Table 4.3.5.1 Vessels that landed groundfish in the WOC during 2001 that are also qualified for VMS for reimbursement Alaska groundfish fisheries

	Number of vessels
Number of WOC groundfish vessels that qualify for reimbursement for Argos Mar-GE VMS because of participation in the pollock, cod or Atka mackerel fisheries off Alaska	49
Number of vessels that have already purchase Argos Mar-GE VMS units	32
The number of vessels that have already been reimbursed	17

4.3.5 Safety of Human Life at Sea-- Search and Rescue Efficiency

There is a certain degree of danger associated with groundfish fishing, however, little is known about the connection between fisheries management measures and incident, injury, or fatality rates in the fishery. Moreover, little is known about risk aversion among fishers or the values placed on increases or decreases in different risks. Decreased harvest may lead to less investment in fishing vessels safety and less care by skippers. If this were to occur, the rate of safety related incidents, injury, or fatality rates could increase. However, if the number of harvesters decreases, and the time at sea decreases, the rates of safety related incidents, injury, or fatality could decrease.

The USCG has safety concerns with encouraging fishing outside 250 fathoms especially during the winter months. If fishing is poor in open shelf and nearshore areas, trawlers north of 40°10' N. Lat. may be required to transit approximately 40 miles offshore to reach open fishing grounds. These extended transits will result in longer exposure to harsh weather conditions, especially during winter months. This problem is compounded by the relatively small size (less than 60 feet) and slow speed of most of these fishing vessels. Small vessels are not able to withstand rough seas as well as larger vessels. In order for these small vessels to fish at depths greater than 250 fathoms, they will need to add cable to set their gear at deeper depths. Additional cable will result in gear and deck modifications that add weight topside, above the vessel’s center of gravity. The relatively slow speed of the trawl fleet will make it difficult for them to run from weather or return to port before sea conditions become hazardous.

Should the USCG need to assist a fishing vessel in distress, search and rescue missions are more dangerous during winter months. It usually takes USCG surface vessels longer to respond during harsh weather and if the weather is really bad, fishing vessels cannot afford to wait for assistance very long. Therefore, length and speed of the limited entry trawl fleet, gear and deck modifications necessary to fish a depths greater than 250 fathoms, in combination with weather and sea conditions, may reduce the safety margins available to fishers, observers, and enforcement officials during fall and winter months.

Much like enforcement costs, safety is expected to vary with the alternatives. It is expected that the safety will be inversely proportional to the length of time vessels attempt to access deepwater species. However, without better information, it is difficult to determine with a high degree of accuracy, the effect of a given alternative on safety to human life. Issue 1, Alternatives 3 and 4 will have the greatest safety benefits because the VMS system will provide for a distress signal that may reduce response time in an emergency. However, VMS cannot be used at this time as replacements for EPIRBS, but can be of assistance during an emergency. Some systems have distress buttons and allow for two-way communications. All the systems can show where a vessel is located. However, they become ineffective should power be lost or a vessel sink. EPIRBS have their own power source and are designed to release from the vessel should it go down. Issue 1, Alternative 4 has the greatest benefit because 2-way communication can increase communications regarding vessel safety and medical issues. Benefits under Issue 1, Alternative 1, 2 and 5 will vary considerably between vessels due to fishing locations, equipment available on vessels, and how well equipment is maintained. As noted above, when fishing opportunity is reduced and profits are marginal, vessels may display more risk prone behavior and may not adequately maintain equipment and vessels.

4.4 Cumulative Impacts

Cumulative effects must be considered when evaluating the alternatives to the issues considered in the EA. Cumulative impacts are those combined effects on quality of human environment that result from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions, regardless of what federal or non-federal agency undertake such actions (40 CFR 1508.7, 1508.25 (a), and 1508.25 (c))

The area that would be affected by actions in this documents is the Pacific Coast Groundfish Fishery in the EEZ (3 to 200 miles off shore) off the West Coast states. The proposed issues and alternative actions are summarized in Table 2.0.1. above. Potential direct and indirect effects of the alternative actions presented under each issue are summarized above in Table 4.0.1.

Of the past, proposed and foreseeable future actions that are also expected to affect these same waters and fishers, the most notable action was the Pacific Coast groundfish fishery specifications and management measures for 2003. For 2003, large-scale depth-based restrictions for fishing across much of the continental shelf were adopted and are intended to further the conservation goals and objectives of the FMP by allowing fishing to continue in areas and with gears that can harvest healthy stocks with little incidental catch of low abundance species. The effects of the 2003 groundfish specifications and management measures have been described and analyzed in a final Environmental Impact Statement (EIS) prepared by the staff of the Pacific Fishery Management Council. The EIS contains discussion on several mitigating factors that emerged during the development of the depth-based management regime adopted for 2003 fishery. With the implementation of a VMS system, used to track movement of vessels through and within depth zones, being one such factor. This proposed action creates a VMS program that will promote compliance with regulations that were put in place to support management of the fishery as defined for 2003.

Amendment 16 to the groundfish FMP will specify the required contents of rebuilding plans and defines species specific rebuilding plans. The proposed action will support rebuilding measures overtime by improving the ability to manage harvest levels established for rebuilding. By adopting regulations to support an effective monitoring program and maintaining the integrity of closed areas, the long-term impact on overfished stocks is expected to be positive, because it would be expected to reduce the likelihood of overfishing that would likely result in further harvest reductions.

Table 4.4.1 Expected Effects of NMFS preferred alternatives if affects accumulate over time	
Issue/Alternative	**Expected effects**
Issue 1, Alternative 3 : Basic VMS System Establishes standards for VMS transceiver and mobile communication service providers that are consistent with the VMS standards published on March 31, 1994 at 59 FR 15180, the specifications published by OLE in the Commerce Business Daily on September 8, 1998 . Requires operators of any vessel registered to a limited entry permit and any trawl vessel, including those using open access exempted trawl gear and tribal vessels, to provide notice regarding the intent to fish in a conservation area. This declaration notice requirement would affect approximately 386 limited entry vessels, 248 open access vessels and 5 tribal vessels. Provides for a basic VMS system that would transmit vessel positions, via secured satellite communications, to a central data processing center managed by the NMFS Office of Enforcement (OLE).	• Because VMS provides accurate harvest location data over a large geographical area and can be used to improve the general understanding of depth ranges in which fisheries occur; identify how fishing effort is distributed by depth; and help maintain the integrity of restricted areas. Data is especially needed for the fixed-gear fisheries in which effort data is not available from logbooks. If the integrity of depth-based conservation areas cannot be maintained, then such a management strategy would be discontinued. The depth-based management strategy allows higher harvest levels on healthy stocks and provides greater fishing opportunity for harvesters and fish for processors than would otherwise be allowed • Harvest location data can be joined with data from observed trips to better estimate fishing mortality; to assess effectiveness of bycatch management actions and depth-based management adopted as part of the 2003 management measures; develop management measures for the 2004 fishery; and assess the total mortality on overfished species as is required in proposed rebuilding plans. • The VMS and declaration systems will aid enforcement in identifying vessels legally fishing in conservation areas. This is expected to deter illegal fishing in restricted areas. VMS may be used to target landings and at-sea inspections; increase efficiency of surveillance patrols; and as a basis for enforcement action. Being able to easily identify vessels that are engaged in fishing may also benefit homeland security activities. • VMS promotes safety of human life by providing a distress signal that may reduce response time in an emergency.
Issue 2, Alternative 2A: All vessels registered to a limited entry permit. Beginning in 2003, require all trawl and fixed gear vessels registered to limited entry permits to have VMS as specified under issue 1. Vessels would be required to have VMS transceiver units on board at all times regardless of the fishery. ***NOTE TO THE READER*****:** The Council coverage recommendation was for all vessels registered to a limited entry permit and that fish in the EEZ off Washington, Oregon, and California. This variation falls between alternatives 2A and 2B and the information is not available to determine exactly how many vesssels will be affected. Alternative 2A was used for the purpose of the EA.	• Approximately 424 vessels, including catcher/ processors (257 trawl, 140 line, 11 pot , and 16 combined gears) that fish in the EEZ off Washington, Oregon, and California would be required to continuously operate VMS transceiver units. If a limited entry trawl vessel buy back were to occur in the near future the number of vessels would likely be reduced. • Enforcement would be able to use its resources to effectively monitor limited entry vessels for unlawful incursions into conservation areas while allowing legal incursions,such as midwater trawling, for Pacific whiting, yellowtail and widow rockfish and non-groundfish target fisheries to occur. The complexity of the 2003 groundfish regulations and recent cuts in state enforcement budgets has placed a heavy burden on the enforcement resources. Using the existing resources efficiently is expected to result in the increased ability to detect illegal activity and to pursue the appropriate action. This would be expected to result in an increased rate of compliance by fishers. Future groundfish regulation will likely remain similar to the current regulations. • A notable number of limited entry vessels also participate in non-groundfish fisheries that would continue to occur in the conservation area. These non-groundfish fisheries which incidentally take groundfish, include shrimp and prawn trawl fisheries, troll albacore and troll salmon fisheries, and the pot fisheries for crab. Because vessels would be required to have an operable VMS unit on board whenever the vessel is fishing in the EEZ position data could also be collected to supplement management data forsome non-groundfish fisheries. This data could be valuable to rebuilding measures, because many of these fisheries also interact with overfished species. • That portion of the fleet with the greatest fishing capacity would be covered. This would allow the integrity of the restricted areas to be maintained. More observer data is available from the limited entry fleet than the open access fleet. Observer data can be used to better understand effort shifts and to project impacts related to fishing effort.

Table 4.4.1 Expected Effects of NMFS preferred alternatives if affects accumulate over time, continued	
Issue 3, Alternative 1: Vessel pays all. The vessel owner/operator would be responsible for paying all costs associated with purchasing, installing and maintaining the VMS transceiver unit, as well as the costs associated with the transmission of reports and data from the vessel. This alternative would not preclude reimbursement for all or a portion of expenditures at a later point in time, if money were available.	• The average per vessel costs of adopting VMS under Monitoring System Issue 1, Alternative 3 range from $2,163 to $5,623 in the first year, and from $548 to $1,698 each subsequent year. For the vast majority of the fleet, the benefits to harvesters and processors from maintaining a depth-based management strategy outweighs the cost of providing for VMS. Given groundfish harvest reductions in recent years, fishers have indicated that they are operating without profit and further harvest reductions would result in financial losses. If a depth-based management strategy cannot be maintained more fishers will likely be operating at a loss than is currently occurring.

5.0 CONSISTENCY WITH THE FMP AND OTHER APPLICABLE LAWS

5.1 Consistency with the FMP

The socio-economic framework in the Pacific Coast Groundfish FMP requires that proposed management measures and viable alternatives be reviewed and consideration given to the following criteria: a) how the action is expected to promote achievement of the goals and objectives of the FMP; b) likely impacts on other management measures; c) biological impacts; d) and economic impacts, particularly on the cost to the fishing industry; and e) accomplishment of one of a list of factors.

GOALS AND OBJECTIVES OF THE FMP

The Council is committed to developing long-range plans for managing the Pacific Coast groundfish fisheries that prevent overfishing and loss of habitat, yet provide the maximum net value of the resource, and achieve maximum biological yield. Alternatives 2 and 3 are consistent with FMP goal 1-objective 1, and goal 3-objective 10.

> Goal 1- Conservation: Objective 1 -- maintain an information flow on the status of the fishery and the fishery resource which allows for informed management decisions as the fishery occurs.
>
> Goal 3- Utilization: Objective 10 -- strive to reduce the economic incentives and regulatory measures that lead to wastage of fish. Also, develop management measures that minimize bycatch to the extent practicable and, to the extent that bycatch cannot be avoided, minimize the mortality of such bycatch. In addition, promote and support monitoring programs to improve estimates of total fishing-related mortality and bycatch, as well as those to improve information necessary to determine the extent to which it is practicable to reduce bycatch and bycatch mortality.

ACCOMPLISHMENT OF ONE OF THE FACTORS LISTED IN FMP SECTION 6.2.3.

Under the socio-economic framework, the proposed action must accomplish at least 1 of the criteria defined in section 6.2.3 of the FMP. Alternatives 3, 4 and 5 are likely to accomplish objective 2 by providing information to avoid exceeding a quota, harvest guideline or allocation, and objective 13 by maintaining a data collection and means for verification.

5.2 Magnuson-Stevens Conservation and Management Act

The Magnuson-Stevens Act provides parameters and guidance for federal fisheries management, requiring that the Councils and NMFS adhere to a broad array of policy ideals. Overarching principles for fisheries management are found in the Act's National Standards. In crafting fisheries management regimes, the Councils and NMFS must balance their recommendations to meet these different national standards.

National Standard 1 requires that conservation and management measures shall prevent overfishing while achieving on a continuing basis, the optimum yield from each fishery for the United States fishing industry. The proposed action is to implement a monitoring program to monitor the integrity of closed areas that were established to protect overfished species. Information provided under Issue 1, Alternatives 3, 4 or 5 have the least risk of overfishing because they would provide information that could be used to reduce the likelyhood of overfishing while allowing for the harvests of healthy stocks

National Standard 2 requires the use of the best available scientific information. The proposed action is to implement a monitoring program to monitor the integrity of closed areas that were established to protect overfished species. Data collected under Issue 1, Alternative 5 would provide timely catch and biological data from the at-sea fishery. Data collected under Issue 1, Alternatives 3 or 4 would be used to understand the level of fishing effort and how it was distributed. When combined with data from the existing federal observer program it could be used to more accurately estimate total catch.

National Standard 3 requires, to the extent practicable, that an individual stock of fish be managed as a unit throughout its range, and interrelated stocks of fish shall be managed as a unit or in close coordination. This standard is not affected by the proposed action to implement a monitoring program to monitor the integrity of closed areas.

National Standard 4 requires that conservation and management measures not discriminate between residents of different States. None of the alternatives would discriminate between residents of different States.

National Standard 5 is not affected by the proposed actions because it does not affect efficiency in the utilization of fishery resources.

National Standard 6 requires that Conservation and management measures take into account and allow for variations among, and contingencies in, fisheries, fishery resources, and catches." All alternatives meet this standard

National Standard 7 requires that conservation and management measures to minimize costs and avoid unnecessary duplication. Several measures were taken to minimize the costs of a monitoring program to the industry. The council recommended that the basic VMS (Issue 1, Alternative 3) unit be implemented rather than an upgraded and more expensive model that allows for two-way communications (Issue 1, Alternative 4). Alternatives 2-5 require declaration reports for vessels that intened tolegally fish within a conservation area. To reduce the time burden and cost of declaration reports, they would only be required when vessel changes gears rather than on every trip.

National Standard 8 provides protection to fishing communities by requiring that conservation and management measures be consistent with the conservation requirements of this Act (including the prevention of overfishing and rebuilding of overfished stocks), take into account the importance of fishery resources to fishing communities in order to (A) provide for the sustained participation of such communities, and (B) to the extent practicable, minimize adverse economic impacts on such communities. The proposed alternatives are consistent with this standard.

National Standard 9 requires that conservation and management measures to minimize bycatch and minimize the mortality of bycatch. NMFS is required to "promote and support monitoring programs to improve estimates of total fishing-related mortality and bycatch, as well as those to improve information necessary to determine the extent to which it is practicable to reduce bycatch and bycatch mortality. The proposed action to implement a monitoring program to monitor the integrity of closed areas that were established to protect overfished species is consistent with this standard.

National Standard 10 Conservation and Management measures shall, to the extent practicable, promote the safety of human life at sea. Issue 1, Alternatives 3 and 4 will have the greatest safety benefits because the VMS system will provide for a Distress signal that may reduce response time in an emergency.
Under Issue 1, Alternatives 5, observers would be NMFS-certified and would therefore be considered observers under the Magnuson-Stevens Act and the vessels would be required to meet observer heath and safety provisions at 50 CFR 600.725 and 600.746.

Essential Fish Habitat This action will affect fishing in areas designated as essential fish habitat (EFH) by Amendment 11 to the FMP. The proposed action is to implement a monitor program to monitor the integrity of closed areas that were established to protect overfished species. The potential effects of the proposed actions are not expected to have either no adverse effect on EFH, or to have a positive effect resulting from reduced fishing effort in critical areas. No EFH consultation is warrented for this action.

5.3 Endangered Species Act

NMFS issued Biological Opinions (B.O.) under the ESA on August 10, 1990, November 26, 1991, August 28, 1992, September 27, 1993, May 14, 1996, and December 15, 1999 pertaining to the effects of the groundfish fishery on chinook salmon (Puget Sound, Snake River spring/summer, Snake River fall, upper Columbia River spring, lower Columbia River, upper Willamette River, Sacramento River winter, Central Valley spring, California coastal), coho salmon (Central California coastal, southern Oregon/northern

California coastal), chum salmon (Hood Canal summer, Columbia River), sockeye salmon (Snake River, Ozette Lake), and steelhead (upper, middle and lower Columbia River, Snake River Basin, upper Willamette River, central California coast, California Central Valley, south-central California, northern California, southern California). During the 2000 Pacific whiting season, the whiting fisheries exceeded the 11,000 fish chinook bycatch amount specified in the Pacific whiting fishery B.O. (December 19, 1999) incidental take statement, by approximately 500 fish. In the 2001 whiting season, however, the whiting fishery's chinook bycatch was about 7,000 fish, which approximates the long-term average. After reviewing data from, and management of, the 2000 and 2001 whiting fisheries (including industry bycatch minimization measures), the status of the affected listed chinook, environmental baseline information, and the incidental take statement from the 1999 whiting B.O., NMFS determined that a re-initiation of the 1999 whiting BO was not required. NMFS has concluded that implementation of the FMP for the Pacific Coast groundfish fishery is not expected to jeopardize the continued existence of any endangered or threatened species under the jurisdiction of NMFS, or result in the destruction or adverse modification of critical habitat. This proposed rule implements a data collection program and is within the scope of these consultations. Because the impacts of this action fall within the scope of the impacts considered in these B.O.s, additional consultations on these species are not required for this action.

5.4 Marine Mammal Protection Act

Under the MMPA, marine mammals whose abundance falls below the optimum sustainable population level (usually regarded as 60% of carrying capacity or maximum population size) can be listed as "depleted". Populations listed as threatened or endangered under the ESA are automatically depleted under the terms of the MMPA. Currently the Stellar sea lion population in the WOC is listed as threatened under the ESA and the fur seal population is listed as depleted under the MMPA. Incidental takes of these species in the Pacific Coast fisheries are well under the annual PBR. None of the proposed management alternatives are likely to affect the incidental mortality levels of species protected under the MMPA.

The WOC groundfish fisheries are considered category III fisheries where the annual mortality and serious injury of a stock by the fishery is less than or equal to 1 percent of the PBR level. Implementation of Alternatives 3,4, or 5 are expected to benefit MMPA species because it will allow observer data and data from other sources to be joined to better understand the extent of potential fishing related impacts on various marine mammal species.

5.5 Coastal Zone Management Act

The proposed alternatives would be implemented in a manner that is consistent to the maximum extent practicable with theenforceable policies of the approved coastal zone management programs of Washington, Oregon, and California. This determination has been submitted to the responsible state agencies for review under section 307(c)(1) of the Coastal Zone Management Act (CZMA) . The relationship of the groundfish FMP with the CZMA is discussed in Section 11.7.3 of the groundfish FMP. The groundfish FMP has been found to be consistent with the Washington, Oregon, and California coastal zone management programs. The recommended action is consistent and within the scope of the actions contemplated under the framework FMP.

Under the CZMA, each state develops its own coastal zone management program which is then submitted for federal approval. This has resulted in programs which vary widely from one state to the next. The EA for Amendment 14 to groundfish FMP contains a summary of the fishery relevant consistency criteria used in federal consistency determinations by each state.

5.6 Paperwork Reduction Act

This action contains a collection-of-information subject to the PRA. These materials all represent a new collection of information that are subject to the Paperwork Reduction Act (PRA).

<u>Declaration reports</u> Under Issue 1, Alternatives 2,3, 4 and 5 vessels registered to limited entry permits; any vessel using trawl gear, including exempted gear used to take pink shrimp, spot and ridgeback prawns, California halibut and sea cucumber; and any tribal vessel using trawl gear, will be required to submit a declaration report to NMFS before the vessel is used to fish in any rockfish conservation area, including the cowcod closure. This report would allow NMFS to identify vessels that were legally fishing within a

restricted conservation areas. Declaration reports will include: the vessel name and/or identification number, and gear declaration. At 4 minutes per response for each declaration report the expected time burden on the public from all 723 respondents would be 578 hours annually.

Installation/activation reports Under Issue 1, Alternatives 3 and 4, vessel owners and operators would be required to follow a prescribed installation protocol and provide certain information about the installation of their VMS transceiver unit to NMFS. An installation checklist would be issued by NMFS and the VMS installer would certify the information about the installation by signing a certification form and returning it to NMFS. At 4 hours per response for installation of the VMS transceiver unit and 5 minutes per response to send the installation/activation report the expected time burden on the public from all 424 respondents would be1,696 hours for installation of the VMS transceiver units and 34 hours annually for sending the installation/activation report .

Hourly position reports Under Issue 1, Alternatives 3 and 4, hourly positions are automatically transmited to NMFS via satellite once the VMS transceiver unit is installed and activated. Vessels that are required to have VMS must operate the mobile transceiver unit continuously 24 hours a day throughout the calendar year, except when the vessel leaves the EEZ for an extened period. The number of annual transmissions depends on the VMS transceiver that the vessel owner purchases and the number of fishing days per year in the managed area. With many of the systems, there is a sleep function, when the vessel is in port, position transmissions are automatically reduced. At 5 seconds per response for each hourly transmission the expected time burden on the public from all 424 respondents would be 5,159 hours annually.

Exemption reports Under Issue 1, Alternatives 3 and 4, an exemption report could be sent by the vessel owner or operator because they wanted their vessel to be excused from the requirement to operate the mobile transceiver unit continuously 24 hours a day throughout the calendar year. Such exemptions would only be allowed for vessels that operate outside of the EEZ for more than 7 consecutive days or for vessels that are continuously out of the water for more than 7 consecutive days. A vessel may be exempted from the requirement to operate the mobile transceiver unit continuously 24 hours a day throughout the calendar year if a valid exemption report, is received by NMFS, Office for Law Enforcement (OLE) and the vessel is in compliance with all conditions and requirements of the exemption. At 4 minutes per response for each exemption report the expected time burden on the public from 145 respondents would be 19 hours annually.

5.7 Executive Order 12866

This action is not significant under E.O. 12866. This action will not have a cumulative effect on the economy of $100 million or more nor will it result in a major increase in costs to consumers, industries, government agencies, or geographical regions. No significant adverse impacts are anticipated on competition, employment, investments, productivity, innovation, or competitiveness of U.S.-based enterprises.

5.8 Executive Order 13175

Executive Order 13175 is intended to ensure regular and meaningful consultation and collaboration with tribal officials in the development of Federal policies that have tribal implications, to strengthen the United States government-to-government relationships with Indian tribes, and to reduce the imposition of unfunded mandates upon Indian tribes.

The Secretary of Commerce recognizes the sovereign status and co-manager role of Indian tribes over shared Federal and tribal fishery resources. At Section 302(b)(5), the Magnuson-Stevens Act reserves a seat on the Council for a representative of an Indian tribe with Federally recognized fishing rights from California, Oregon, Washington, or Idaho.

The U.S. government formally recognizes that the four Washington Coastal Tribes (Makah, Quileute, Hoh, and Quinault) have treaty rights to fish for groundfish. In general terms, the quantification of those rights is 50 percent of the harvestable surplus of groundfish available in the tribes' usual and accustomed (U and A) fishing areas (described at 50 CFR 660.324). Each of the treaty tribes has the discretion to administer their fisheries and to establish their own policies to achieve program objectives. The proposed regulations have been developed in consultation with the affected tribe(s) and, insofar as possible, with tribal consensus.

5.9 Migratory Bird Treaty Act and Executive Order 13186

The Migratory Bird Treaty Act of 1918 was designed to end the commercial trade of migratory birds and their feathers that, by the early years of the 20th century, had diminished populations of many native bird species. The Act states that it is unlawful to take, kill, or possess migratory birds and their parts (including eggs, nests, and feathers) and is a shared agreement between the United States, Canada, Japan, Mexico, and Russia to protect a common migratory bird resource. The Migratory Bird Treaty Act prohibits the directed take of seabirds, but the incidental take of seabirds does occur. None of the proposed management alternatives, or the Council recommended action are likely to affect the incidental take of seabirds protected by the Migratory Bird Treaty Act.

Executive Order 13186 (Responsibilities of Federal Agencies to Protect Migratory Birds) is intended to ensure that each Federal agency taking actions that have, or are likely to have, a measurable negative effect on migratory bird populations develop andimplement a Memorandum of Understanding (MOU) with the U.S. Fish and Wildlife Service that shall promote the conservation of migratory bird populations. Currently, NMFS is planning to develop and implement a MOU with the U.S. Fish and Wildlife Service. None of the proposed management alternatives are likely to have a measurable effect on migratory bird populations.

5.10 Executive Order 12898 (Environmental Justice) and 13132 (Federalism)

There is no specific guidance on application of EO 12898 to fishery management actions. The EO states that environmental justice should be part of an agency's mission "by identifying and addressing disproportionately high and adverse human health or environmental effects of its programs, policies, and activities on minority or low-income populations."

These recommendations would not have federalism implications subject to E.O. 13132. State representatives on the Council have been fully consulted in the development of this policy recommendation.

6.0 REGULATORY IMPACT REVIEW AND REGULATORY FLEXIBILITY ANALYSIS

The RIR and IRFA analyses have many aspects in common with each other and with EAs. Much of the information required for the RIR and IRFA analysis has been provided above in the EA.. Table 6.0.1 identifies where previous discussions relevant to the EA and IRFA can be found in this document. In addition to the information provided in the EA, above, a basic economic profile of the fishery is provided annually in the Council's SAFE document.

Table 6.0 1 Regulatory Impact Review and Regulatory Flexibility Analysis

RIR Elements of Analysis	Corresponding Sections in EA	IRFA Elements of Analysis	Corresponding Sections in EA
Description of management objectives	1.2 and 1.3	Description of why actions are being considered	1.2 and 1.3
Description of the Fishery	3.3	Statement of the objectives of, and legal basis for actions	1.0
Statement of the Problem	1.2 and 1.3	Description of projected reporting, recordkeeping and other compliance requirements of the proposed action	4.3
Description of each selected alternative	2.2	Identification of all relevant Federal rules	5.0
An economic analysis of the expected effects of each selected alternative relative to status quo	4.3		

6.1 Regulatory Impact Review

The RIR is designed to determine whether the proposed action could be considered a "significant regulatory actions" according to E.O. 12866. E.O. 12866 test requirements used to assess whether or not an action would be a "significant regulatory action", and identifies the expected outcomes of the proposed management alternatives. 1) Have a annual effect on the economy of $100 million or more or adversely affect in a material way the economy, a sector of the economy, productivity, competition, jobs, the environment, public health or safety, or state, local, or tribal governments or communities;2) Create a serious inconsistency or otherwise interfere with action taken or planned by another agency; 3) Materially alter the budgetary impact of entitlement, grants, user fees, or loan programs or the rights and obligations of recipients thereof; or 4) Raise novel legal or policy issues arising out of legal mandates, the President's priorities, or the principles set forth in this executive Order. Based on results of the economic analysis contained in section 4.3, this action is not expected to be significant under E.O. 12866.

Requirements of an IRFA

The Regulatory Flexibility Act (5 U.S.C. 603) states that:
(b) Each initial regulatory flexibility analysis required under this section shall contain--

(1) a description of the reasons why action by the agency is being considered:
(2) a succinct statement of the objectives of, and legal basis for, the proposed rule;
(3) a description of and, where feasible, and estimate of the number of small entities to which the proposed rule will apply;
(4) a description of the projected reporting, recordkeeping and other compliance requirements of the proposed rule, including an estimate of the classes of small entities which will be subject to the requirement and the type of professional skills necessary for preparation of the report or record;
(5) an identification, to the extent practicable, of all relevant Federal rules which may duplicate, overlap, or conflict with the proposed rule.

(c) Each initial regulatory flexibility analysis shall also contain a description of any significant alternatives to the prosed rule which accomplish the stated objectives of applicable statutes and which minimize any significant economic impact of the proposed rule on small entities. Consistent with the stated objectives of applicable statutes, the analysis shall discuss significant alternatives such as--

(1) the establishment of differing compliance or reporting requirements or timetables that take into account the resources available to small entities;
(2) the clarification, consolidation, or simplification of compliance and reporting requirements under the rule for such small entities;
(3) the use of performance rather than design standards; and
(4) an exemption from coverage of the rule, or any part thereof, for such small entities.

6.2 Initial Regulatory Flexibility Analysis

When an agency proposes regulations, the RFA requires the agency to prepare and make available for public comment an Initial Regulatory Flexibility Analysis (IRFA) that describes the impact on small businesses, non-profit enterprises, local governments, and other small entities. The IRFA is to aid the agency in considering all reasonable regulatory alternatives that would minimize the economic impact on affected small entities (attachment 1). To ensure a broad consideration of impacts on small entities, NMFS has prepared this IRFA without first making the threshold determination whether this proposed action could be certified as not having a significant economic impact on a substantial number of small entities. NMFS, must determine such certification to be appropriate if established by information received in the public comment period.

1) A description of the reasons why the action by the agency is being considered.
For 2003, the Council sought a management strategy that would allow fishing to continue in areas and with gear that can harvest healthy stocks with little incidental catch of low abundance species. Recent stock assessments for bocaccio, yelloweye, canary and darkblotched rockfish, indicate that these species are in an overfished status (<25% of the virgin biomass). Therefore, measures must be taken to protect these stocks and rebuild them to sustainable biomass levels. The Council recommended that NMFS define additional management areas for the groundfish fishery that are based on bottom depth ranges where these overfished species are commonly found. For 2003, large-scale depth-related areas, referred to as groundfish conservation areas, will be used to restrict commercial and recreational fishing across much of the continental shelf. Deep-water fisheries on the slope and nearshore fisheries will be permitted, but only in areas seaward or shoreward of the depth-based conservation areas.
The boundaries of the groundfish conservation areas are complex, involving hundreds of points of latitude and longitude to delineate nearshore and offshore fathom curves. The areas are vast, extending along the entire West Coast from Canada to Mexico, and the weather and sea conditions are frequently harsh. Some fishing such as midwater trawling for pelagic species and shrimp trawling providing finfish excluders are

used, will be allowed to occur in the conservation areas. In addition, vessels intending to fish seaward of the westernmost boundary of a conservation area will be allowed to transit through the area providing the gear is properly stowed. Ensuring the integrity of conservation areas using traditional enforcement methods is especially difficult when the closed areas are large-scale and the lines defining the areas are irregular. Furthermore, when some gear types and target fishing are allowed in all or a portion of the conservation area while other fishing activities are prohibited it is difficult and costly to effectively enforce restrictions using traditional methods.

> **NMFS Guidance on RFA**
>
> NMFS has provided guidance as to how the regulatory flexibility analysis relates to other analyses and other applicable law. (source: "Operational Guidelines, Fishery Management Plan Process" National Marine Fisheries Service, Silver Spring MD, March 1, 1995, Appendix I.2.d.)
>
> "The RFA requires that the agency identify and consider alternatives that minimize the impacts of a regulation on small entities, but it does not require that the agency select the alternative with the least net cost. Section 606 of the RFA clearly states that the requirements of a regulatory flexibility analysis do not alter standards otherwise applicable by law. Executive Order 12866 requires that agencies provide an assessment of the potential costs and benefits of a "significant" action, including an explanation of the manner in which the regulatory action is consistent with a statutory mandate and, to the extent permitted by law, promotes the President's priorities and avoids undue interference with State, local, and tribal governments in the exercise of their governmental function (section 6(a)(3)(B)(ii)). However, the Executive Order also requires agencies to adhere to the requirements of the RFA and other applicable law (section 6(a)(3)). In short, when either the regulatory flexibility analysis or the RIR conflict with a statutory mandate (e.g., the Magnuson Act), the resulting decision must conform to the statute."

To allow for a more liberal depth-based management regime, as proposed by the Council for 2003, it was necessary to take action to establish a monitoring program to ensure the integrity of these large irregularly shaped depth-based conservation areas. NMFS has prepared regulations, at 50 CFR Part 660 subpart G, that require vessels registered to a Pacific Coast groundfish fishery limited entry permits to carry and use mobile Vessel Monitoring System (VMS) transceiver units while fishing in the EEZ off the coasts of Washington, Oregon and California. This regulation will enhance monitoring of compliance with large-scale depth-based restrictions for fishing across much of the continental shelf. The regulations at 50 CFR 660 subpart G also require the operator of any vessel registered to a limited entry permit, and any other commercial or tribal vessel using trawl gear; including exempted gear used to take pink shrimp, spot and ridgeback prawns, California halibut and sea cucumber, to identify their intent to fish within restricted areas. These regulations further the conservation goals and objectives of the Pacific Coast Groundfish FMP by allowing fishing to continue in areas and with gears that can harvest healthy stocks with little incidental catch of low abundance species.

2) <u>A succinct statement of the objectives of, and legal basis for, the proposed rule</u>.

The U.S. groundfish fisheries in the EEZ off the Washington, Oregon, and California coasts are managed pursuant to the Magnuson- Stevens Act and the Pacific Coast Groundfish FMP. The FMP was developed by the Council. Regulations implementing the FMP appear at 50 CFR part 660 subpart G.

3) <u>A description of and, where feasible, and estimate of the number of small entities to which the proposed rule will apply</u>;

Any vessel registered to a limited entry permit that operates in the EEZ off the states of Washington, Oregon or California must carry a NMFS OLE-approved mobile transceiver unit. Declarataion report requirements apply to vessels registered to limited entry permits with trawl endorsements; any vessel using trawl gear, including exempted gear used to take pink shrimp, spot and ridgeback prawns, California halibut and sea cucumber**;** and any tribal vessel using trawl gear, before the vessel is used to fish in any trawl RCA or the CCA in a manner that is consistent with the requirements of the conservation areas (I.E pelagic trawl during when permitted for pelagic species such as yellowtail and widow rockfish or Pacific whiting; or pink shrimp gear with the required finfish excluder during the pink shrimp season). In addition, declaration reports will be required from vessels registered to limited entry permits with longline and pot endorsements, before the vessel can be used to fish in any Non-trawl RCA or the CCA, in a manner that is consistent with the requirements of those conservation areas (e.g. during the Dungeness crab or lobster fisheries).

The requirement to declare trips is applicable to 723, comprised of 424 limited entry vessels, 294 open access vessels, and 5 tribal vessels. The requirement to install and operate a VMS transceiver applies to 424 limited entry vessels, comprised of 257 trawl, 140 longline, 11 pot and 16 combined gear vessels. Except for the limited entry processing vessels in the at-sea whiting sector, all vessels affected by this action are assumed to have gross annual receipts of under $3.5 million and are defined as small entities under Section 601 of the Regulatory Flexability Act.

Most vessels affected by this action have gross annual receipts of under $3.5 million and are defined as small entities under Section 601 of the Regulatory Flexibility Act, however, there are approximately 10 vessels defined as large entities operating in the limited trawl fishery. There could be some disproportionate economic impacts on small entities versus large entities for the group of limited trawl vessels that are less than 40 feet in length and have relatively low gross annual receipts. Depending upon the cost of the VMS, some of these smaller vessels would be forced to pay a relatively larger share of their annual expendentures for purchase of the VMS compared to the larger vessels. However, all vessels would increase their gross receipts by being able to fish in more productive areas, having the effect of increasing profitability and mitigating the cost of the VMS.

4) A description of the projected reporting, recordkeeping and other compliance requirements of the proposed rule, including an estimate of the classes of small entities which will be subject to the requirement and the type of professional skills necessary for preparation of the report or record.

Any vessel registered to a limited entry permit that operates in the EEZ off the states of Washington, Oregon or California must carry a NMFS OLE-approved mobile transceiver unit. Vessels required to carry VMS transceiver units will provide installation/activation reports, hourly position reports, and exemption reports. The following reports are required for a VMS system to be effectively implemented:

Installation/activation reports would require vessel owners and operators to follow a prescribed installation protocol and provide certain information about the installation to NMFS. An installation checklist would be issued by NMFS and the VMS installer would certify the information about the installation by signing a certification form and returning it to NMFS. Given that the VMS hardware and satellite communications services are provided by third parties, as approved by NMFS, there is a need for NMFS to collect information regarding the individual vessel's installation in order to ensure that automated position reports will be received. No special training or skills are necessary to prepare this report.

Hourly position reports are automatically transmitted by the VMS unit to NMFS via satellite once the VMS transceiver unit is installed and activated. Vessels that are required to have VMS must operate the mobile transceiver unit continuously 24 hours a day throughout the calendar year, except when the vessel leaves the EEZ for an extended period. The number of annual transmissions depends on the VMS transceiver that the vessel owner purchases and the number of fishing days per year in the managed area. With many of the systems, there is a sleep function, when the vessel is in port, position transmissions are automatically reduced. This allows for port stays without significant power drain or power shutdown. When the vessel goes to sea, the unit restarts and normal position transmissions automatically resume. Because the unit in continuously operable, NMFS may query the unit at any time to obtain a position report.

Exemption reports are optional, and would be sent by the vessel owner or operator because they wanted their vessel to be excused from the requirement to operate the mobile transceiver unit continuously 24 hours a day throughout the calendar year. Such exemptions would only be allowed for vessels that will be operating outside of the EEZ for more than 7 consecutive days or for vessels that will be continuously out of the water for more than 7 consecutive days. A vessel may be exempted from the requirement to operate the mobile transceiver unit continuously 24 hours a day throughout the calendar year if a valid exemption report, is received by NMFS, Office for Law Enforcement (OLE) and the vessel is in compliance with all conditions and requirements of the exemption. An exemption report would be valid until a second report was sent to cancel the exemption.

Declaration reports Vessels registered to limited entry permits with trawl endorsements; any vessel using trawl gear, including exempted gear used to take pink shrimp, spot and ridgeback prawns, California halibut and sea cucumber; and any tribal vessel using trawl gear, will be required to send a declaration report before the vessel is used to fish in any trawl RCA or the CCA in a manner that is consistent with the requirements of the conservation areas (I.E pelagic trawl during when permitted for pelagic species such as yellowtail and widow rockfish or Pacific whiting; or pink shrimp gear with the required finfish excluder during the pink shrimp season). In addition, declaration reports will be required from vessels registered to limited entry permits with longline and pot endorsements, before the vessel can be used to fish in any Non-trawl RCA or the CCA, in a manner that is consistent with the requirements of those conservation areas (e.g. during the Dungeness crab or lobster fisheries). Each declaration report will be valid until cancelled or revised by the vessel operator. After a declaration report has been sent, the vessel cannot engage in any activity with gear that is inconsistent with that which can be used in the conservation area unless another declaration report is sent to cancel or change the previous declaration.

Declaration and exemption reports will be submitted by using an Interactive Voice Response (IVR) system . The IVR system, which is accessed by dialing a toll-free number, prompts the caller my asking a series of questions and allowing the caller to use the touch-tone telephone to respond. An IVR system allows vessels to quickly and easily submit their report 24 hours a and will reduce the paperwork burden on both the fisherman and the NMFS, as it makes it easier to collate the information submitted in the reports and monitor fishing activity. No special training or skills are necessary to prepare these reports.

5) An identification, to the extent practicable, of all relevant Federal rules which may duplicate, overlap, or conflict with the proposed rule.

No duplicative requirements that have been identified.

6) A summary of economic impacts. The vessels that would be most directly affected by the VMS requirement are the limited entry trawl, longline and pot vessels, and the exempted trawl vessels from the two open access classes. In section 4.3 of this document, 247 limited entry trawl vessels were estimated to earn an average of $180,000 exvessel revenue under the Council's 2003 depth-based management regime, as compared with the average $154,000 if the fishery were managed without the depth-based closures, this is a difference of $26,000 per vessel. Similarly, 197 limited entry longline and pot vessels were estimated to earn an average $96,000 in exvessel revenue under the Council's depth-based management regime, as compared with an average of $82,000 if the fishery were managed without depth-based management, a difference of $14,000 per vessel. The difference in average revenues for the two classes of open access groundfish vessels is less, but still significant: $7,000 for the 516 vessels with less than 5% of revenue from groundfish, and $3,000 for the 771 vessels with more than 5% of revenue from groundfish.

While exvessel revenues appear higher on average for vessels likely to be required to use VMS under the depth-based management regime, it should be noted that non-VMS fishing costs may also be higher, offsetting some of the apparent gain. Unfortunately vessel cost data necessary to estimate this effect are not currently available. It is also important to keep in mind that using average revenues masks the variability of ex-vessel revenues in each vessel class. While on average, additional revenues appear greater than VMS-related costs, for some individual vessels in each class this will not be the case.

The average per vessel costs of adopting VMS under Monitoring System Alternative 3 range from $2,163 to $5,623 in the first year, and from $548 to $1,698 each subsequent year. Similarly under Monitoring System Alternative 4, VMS-related costs range from $3,878 to $7,607 in the first year, and from $1,063 to $2,342 each subsequent year. Comparing these per vessel average cost estimates with the average revenue gains derived above indicates that on average, and depending on how other non-VMS costs are affected, most vessels could potentially be better off with depth-based management, including VMS related costs, than under the likely alternative management regime. The obvious exception would be Open Access vessels with more than 5% of revenue from groundfish. Under most of the alternatives, the first year VMS-related costs would apparently outweigh the expected average benefit for these vessels (although once

VMS is installed, in subsequent years, the annual operating, maintenance and replacement costs would generally be less than average additional revenues).

7) A description of any alternatives to the proposed rule which accomplish the stated objectives of applicable statutes and which minimizes and significant economic impacts of the proposed rule on small entities.

The defined objective of for this proposed rulemaking is to ensure the integrity of groundfish conservation areas. To accomplish this three different approaches for a monitoring system were analyzed: a declaration system, a VMS monitoring program, and fishery Observers. In addition, the sectors of the groundfish fleet that would be required to have a VMS or observers and the distribution of costs between NMFS and the fishing industry for a monitoring system were analyzed. After considering the alternatives, the Council and NMFS determined that a VMS monitoring program was the alternative that best accomplished the defined objectives.

Two approaches to VMS were considered: a Basic VMS system and an Upgraded VMS system. The primary difference between the two alternative action was that the upgraded system uses two-way communications between the vessel and shore such that full or compressed data messages can be transmitted and received by the vessel, while the basic system only transmits positions to a shore station. It was determined that basic system was the minimum system that accomplished the stated objectives.

Most of the affected entities qualify as small businesses. As the rule was developed the burden on fishery participant was considered and changes were made to the reporting requirements ,so only the minimum data needed to monitor compliance with regulations are being required.

The VMS units that have been type-approved for this fishery range in costs and service features. This allows the vessel owner the flexibility in choosing the model that best fits the needs of their vessel. Vessel that have already purchased VMS transceiver units for other fisheries or personal purposes have been given consideration. Vessels will be allowed to retain existing VMS transceivers providing they are on the list of type-approved models and have been upgraded to the level required for the fishery.

The Submission of declaration reports were initially proposed as per trip report. Following consultation with fishery participants, it was determined that the needs of NMFS OLE and the USCG could be met with less frequently made declaration reports. Therefore, it was determined that a declaration report identifying the type of gear being used by a vessel would remain valid until cancelled or revised by the vessel operator. This results in a significant reduction in the number of reports.

Following consultation with fishery participants, it was determined that some vessels may prefer to reduce the costs of reporting when leaving the EEZ off the coasts of Washington, Oregon, and California. Because a substantial number of permitted vessels also fish in waters off Alaska and in areas outside the EEZ, and because vessels are commonly pulled out of the water for extended periods, a VMS hourly report exemption option was added, which included an exemption report.

7.0 List of Preparers

This document was prepared by the Northwest Regional Office of the NMFS. Contributors from the NMFS: Becky Renko, lead and primary author; Yvonne derReynier, Carrie Nordeen, Jamie Goen. Ed Waters of the Pacific Fishery Management Council provided the analysis of the expected economic effects of the fishery participants. Steven Springer of the National Marine Fisheries Service Office for Law Enforcement provided provide technical information on VMS system and costs. Will Daspit, of the Pacific States Marine Fish Commission who provided PacFin data used in the analysis.

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9.0 Acronyms and Glossary of Terms

ABC (Acceptable biological catch) The allowable catch for a species or species group, based on its estimated abundance. The ABC is used to set the upper limit of the annual total allowable catch and is calculated by applying the estimated or proxy harvest rate that produces maximum sustainable yield to the estimated exploitable stock biomass.

B0 Unfished biomass; the estimated size of a fish stock at equilibrium in the absence of fishing.

B25% 25% of unfished biomass. This is the Council's threshold for declaring a stock overfished or the Minimum Stock Size Threshold.

B40% 40% of unfished biomass. This is the Council's threshold for declaring a stock rebuilt or the size of the stock estimated to produce MSY. This is also referred to as BMSY.

Biological opinion (BO) A scientific assessment issued by the National Marine Fisheries Service, as required by the Endangered Species Act for listed species.

Biomass The total weight of a group (or stock) of fish. The term biomass means total biomass (age one and above) unless stated otherwise.

Bycatch Fish which are harvested in a fishery, but which are returned to the sea rather than being sold, kept for personal use, or donated to a charitable organization. Bycatch + landed catch = total catch or total estimated fishing-related mortality.

California Bight The region of concave coastline off Southern California between the headland at Point Conception and the U.S./Mexican border, and encompassing various islands, shallow banks, basins and troughs extending from the coast roughly 200 km offshore.

CCA (Cowcod Conservation Area) Two areas located in the Southern California Bight southwest of Santa Monica to the California-Mexico border that encompass roughly 4,300 nm2 of habitat where the highest densities of cowcod occur. These areas are closed to bottom fishing in order to rebuild the cowcod stock to BMSY.

CDFG California Department of Fish and Game

Cetaceans Marine mammals of the order *Cetacea*. Includes whales, dolphins and porpoises.

CFR (Code of Federal Regulations). A codification of the regulations published in the *Federal Register* by the executive departments and agencies of the federal government. The CFR is divided into 50 titles that represent broad areas subject to federal regulation. Title 50 contains wildlife and fisheries regulations.

Coastal pelagic species. Coastal pelagic species are schooling fish, not associated with the ocean bottom, that migrate in coastal waters. They are usually planktivorous (plankton-eating) and the main forage of higher level predators such as tuna, salmon, most groundfish, and man. Examples are herring, squid, anchovy, sardine, and mackerel.

Commercial fishing. Fishing in which the fish harvested, either whole or in part, are intended to enter commerce through sale, barter, or trade.

Cumulative limit. The total allowable amount of a species or species group, by weight, that a vessel may take and retain, possess, or land during a period of time. Fishers may take as many landings of a species or species complex as they like as long as they do not exceed the cumulative limit that applies to the vessel or permit during the designated period.

CZMA (Coastal Zone Management Act) An act of federal law with the main objective to encourage and assist states in developing coastal zone management programs, to coordinate state activities, and to safeguard regional and national interests in the coastal zone.

Demersal Living in close relation with the sea floor.

Density dependence The degree to which recruitment changes as spawning biomass changes.

DTS Dover sole/thornyhead/trawl-caught sablefish complex

EEZ (Exclusive economic zone). A zone under national jurisdiction (up to 200-nautical miles wide) declared in line with the provisions of the 1982 United Nations Convention of the Law of the Sea, within which the coastal State has the right to explore and exploit, and the responsibility to conserve and manage, the living and non-living resources.

EFH (Essential fish habitat). Those waters and substrate necessary to fish for spawning, breeding, feeding or growth to maturity.

Environmental assessment As part of the National Environmental Policy Act (NEPA) process, an EA is a concise public document that provides evidence and analysis for determining whether to prepare an Environmental Impact Statement (EIS) or a Finding of No Significant Impact.

Environmental impact statement As part of the National Environmental Policy Act (NEPA) process, an EIS is an analysis of the expected impacts resulting from the implementation of a fisheries management or development plan (or some other proposed action) on the environment. EISs are required for all fishery management plans as well as significant amendments to existing plans. The purpose of an EIS is to ensure that the fishery management plan gives appropriate consideration to environmental values in order to prevent harm to the environment.

E.O. 12866 A Federal executive order that, among other things, requires agencies to assess the economic costs and benefits of all regulatory proposals and complete a Regulatory Impact Analysis (RIA) that describes the costs and benefits of the proposed rule and alternative approaches, and justifies the chosen approach. See RIR.

E.O. Executive Order

ESA (Endangered Species Act) An act of federal law that provides for the conservation of endangered and threatened species of fish, wildlife, and plants. When preparing fishery management plans, councils are required to consult with the National Marine Fisheries Service and the U.S. Fish and Wildlife Service to determine whether the fishing under a fishery management plan is likely to jeopardize the continued existence of an ESA-listed species, or to result in harm to its critical habitat.

Exploitable biomass The biomass that is available to a unit of fishing effort. Defined as the sum of the population biomass at age (calculated as the mean within the fishing year) multiplied by the age-specific availability to the fishery. Exploitable biomass is equivalent to the catch biomass divided by the instantaneous fishing mortality rate.

Federal Register The *Federal Register* is the official daily publication for Rules, Proposed Rules, and Notices of Federal agencies and organizations, as well as Executive Orders and other Presidential documents. Fisheries regulations are not considered final until they are published in the *Federal Register*.

Fish stock A population of a species of fish from which catches are taken in a fishery. Use of the term "fish stock" usually implies that the particular population is more or less isolated from other stocks of the same species, and hence self-sustaining.

Fishing community A community which is substantially dependent on or substantially engaged in the harvest or processing of fishery resources to meet social and economic needs. Includes fishing vessel owners, fishing families, operators, crew, recreational fishers, fish processors, gear suppliers, and others in the community who depend on fishing.

Fishing year January 1 through December 31.

Fixed gear Fishing gear that is stationary after it is deployed (unlike trawl or troll gear which is moving when it is actively fishing). Within the context of the limited entry fleet, "fixed gear" means longline and fishpot (trap) gear. Within the context of the entire groundfish fishery, fixed gear includes longline, fishpot, and any other gear that is anchored at least at one end.

FM (Fathom) Six feet.

FMP (Fishery management plan) A plan, and its amendments, that contains measures for conserving and managing specific fisheries and fish stocks.

(***GPS) Global Positioning Systems*** GPS provides specially coded satellite signals that can be processed in a GPS receiver, enabling the receiver to compute position, velocity and time.

(GAP) Groundfish Advisory Subpanel The Council established the GAP to obtain the input of the people most affected by, or interested in, the management of the groundfish fishery. This advisory body is made up of representatives with recreational, trawl, fixed gear, open access, tribal, environmental, and processor interests. Their advice is solicited when preparing fishery management plans, reviewing plans before sending them to the Secretary, and reviewing the effectiveness of plans once they are in operation.

GMT (Groundfish Management Team) Groundfish management plans are prepared by the Council's GMT, which consists of scientists and managers with specific technical knowledge of the groundfish fishery

HMS (Highly migratory species) In the Council context, highly migratory species in the Pacific Ocean include species managed under the HMS Fishery Management Plan: tunas, sharks, billfish/swordfish, and dorado or dolphinfish.

Incidental catch or incidental species Groundfish species caught when fishing for the primary purpose of catching a different species.

IPHC (International Pacific Halibut Commission) A Commission responsible for studying halibut stocks and the halibut fishery. The IPHC makes proposals to the U.S. and Canada concerning the regulation of the halibut fishery.

IRFA (Initial regulatory flexibility analysis) An analysis required by the Regulatory Flexibility Act.

Limited entry fishery A fishery for which a fixed number of permits have been issued in order to limit participation.

Magnuson-Stevens Fishery Conservation and Management Act (Magnuson-Stevens Act) established the 200 nm fishery conservation zone (EEZ), the regional fishery management council system, and the process and mandates for regulating marine fisheries in the EEZ.

Marine Recreational Fisheries Statistical Survey (MRFSS) A national survey conducted by National Marine Fisheries Service to estimate the impact of recreational fishing on marine resources.

MMPA (Marine Mammal Protection Act) The MMPA prohibits the harvest or harassment of marine mammals, although permits for incidental take of marine mammals while commercial fishing may be issued subject to regulation.

MSY (Maximum sustainable yield) An estimate of the largest average annual catch or yield that can be continuously taken over a long period from a stock under prevailing ecological and environmental conditions.

Mt (Metric ton) 2,204.62 pounds.

National Environmental Policy Act (NEPA) Passed by Congress in 1969, NEPA requires Federal agencies to consider the environment when making decisions regarding their programs. Section 102(2)(C) requires Federal agencies to prepare an Environmental Impact Statement (EIS) before taking major Federal actions that may significantly affect the quality of the human environment.

National Marine Fisheries Service (NMFS) A division of the U.S. Department of Commerce, National Ocean and Atmospheric Administration (NOAA). NMFS is responsible for conservation and management of offshore fisheries (and inland salmon). The NMFS Regional Director is a voting member of the Council.

NAO NOAA Administrative Order

Neritic Inhabiting coastal waters primarily over the continental shelf, generally over bottom depths equal to or less than 183 meters (100 fm) deep.

Oceanic Inhabiting the open sea, ranging beyond the continental and insular shelves, beyond the neritic zone.

ODFW Oregon Department of Fish and Wildlife

Office of law Enforcement (OLE) The the National Marine Fishery Service, Office of Enforcement, Northwest Division

OMB Office of Management and Budget

Open-access fishery The segment of the groundfish fishery or any other fishery for which entry is not controlled by a limited entry permitting program.

Overfished The term generally describes any stock or stock complex determined to be below its overfished/rebuilding threshold. The default proxy is generally 25% of its estimated unfished biomass; however, other scientifically valid values are also authorized.

Overfishing Fishing at a rate or level that jeopardizes the capacity of a stock or stock complex to produce MSY on a continuing basis. More specifically, overfishing is defined as exceeding a maximum allowable fishing mortality rate (or the MFMT). For any groundfish stock or stock complex, the maximum allowable mortality rate will be set at a level not to exceed the corresponding MSY rate (FMSY) or its proxy (e.g., F35%).

Optimum yield (OY) The amount of fish that will provide the greatest overall benefit to the Nation, particularly with respect to food production and recreational opportunities, and taking into account the protection of marine ecosystems. The OY is developed on the basis of the Maximum Sustained Yield from the fishery, taking into account relevant economic, social, and ecological factors. In the case of overfished fisheries, the OY provides for rebuilding to a level that is consistent with producing the Maximum Sustained Yield for the fishery and is typically a prescribed harvest level less than the ABC.

PacFIN Pacific Coast Fisheries Information Network. A database managed by the Pacific States Marine Fisheries Commission that provides commercial fishery information for Washington, Oregon, and California.

Pelagic Inhabiting the water column as opposed to being associated with the sea floor; generally occurring anywhere from the surface to 1000 meters (547 fm)..

Potential biological removal (PBR) The maximum number of animals, not including natural mortalities, that may be removed from a marine mammal stock while allowing that stock to reach or maintain its optimum sustainable population.

PRA Paperwork Reduction Act

Processing The preparation or packaging of fish to render it suitable for human consumption, retail sale, industrial uses, or long-term storage, including but not limited to cooking, canning, smoking, salting, drying, filleting, freezing, or rendering into meal or oil, but not heading and gutting unless additional preparation is done.

RCA Rockfish Conservation Area

Rebuilding Implementing management measures that increase a fish stock to its target size.

RecFin Recreational Fishery Information Network. A database managed by the Pacific States Marine Fisheries Commission that provides recreational fishery information for Washington, Oregon, and California.

Regulatory Flexibility Analysis or Regulatory Impact Review (RIR) Anytime an agency publishes a notice of proposed rule making, an RFA is required. It describes the action, why it is necessary, the objectives and legal basis for the action, a description of who will be impacted by the action, and a description of the projected reporting, record-keeping, and other compliance requirements of the proposed rule. The types of entities subject to the rule, and the professional skills required to prepare the report or record, must also be described.

Stock Assessment and Fishery Evaluation (SAFE) a document prepared by the Council that provides a summary of the most recent biological condition of species in the fishery management unit, and the social and economic condition of the recreational and commercial fishing industries, including the fish processing sector.

Target fishing Fishing for the primary purpose of catching a particular species or species group.

U and A Usual and accustomed

USCG U.S. Coast Guard

USFWS U.S. Fish and Wildlife Service

VMS Vessel monitoring system

WDFW Washington Department of Fish and Wildlife

WOC Washington, Oregon, California

YRCA Yelloweye Rockfish Conservation Area

Appendix A

VMS standards
(March 31, 1994: 59 FR 151180)

DRAFT

DEPARTMENT OF COMMERCE

National Oceanic and Atmospheric Administration

50 CFR Part 660

[I.D.051403C]

RIN 0648–AQ68

Fisheries off West Coast States and in the Western Pacific; Pacific Coast Groundfish Fishery; Amendment 17

AGENCY: National Marine Fisheries Service (NMFS), National Oceanic and Atmospheric Administration (NOAA), Commerce.

ACTION: Notice of availability of an amendment to a fishery management plan; request for comments.

SUMMARY: NMFS announces that the Pacific Fishery Management Council (Council) has submitted Amendment 17 to the Pacific Coast Groundfish Fishery Management Plan (FMP) for Secretarial review. Amendment 17 would revise the Council's annual groundfish management process so that it would become a biennial process with a NMFS public notice and comment period prior to implementation of the biennial specifications and management measures. Amendment 17 is intended to ensure that the specifications and management measures process comports with a Court ruling to make the Council's development process for specifications and management measures more efficient, and to streamline the NMFS regulatory process for implementing the specifications and management measures.

DATES: Comments on Amendment 17 must be received on or before July 21, 2003.

ADDRESSES: Comments on Amendment 17 or supporting documents should be sent to D. Robert Lohn, Administrator, Northwest Region, NMFS, Sand Point Way NE., BIN C15700, Seattle, WA 98115–0070; or to Rodney McInnis, Acting Administrator, Southwest Region, NMFS, 501 West Ocean Boulevard, Suite 4200, Long Beach, CA 90802–4213.

Copies of Amendment 17 and the Environmental Assessment/ Regulatory Impact Review (EA/RIR) are available from Donald McIsaac, Executive Director, Pacific Fishery Management Council, 2130 SW Fifth Ave., Suite 224, Portland, OR 97201.

FOR FURTHER INFORMATION CONTACT: Yvonne deReynier (Northwest Region, NMFS), phone: 206–526–6140; fax: 206–526–6736 and; e-mail: *yvonne.dereynier@noaa.gov.*

SUPPLEMENTARY INFORMATION:

Electronic Access

This **Federal Register** document is also accessible via the Internet at the Web site of the Office of the **Federal Register**'s Web site at: *http://www/access/gpo.gov/su_docs/aces140.html.*

The Magnuson-Stevens Fishery Conservation and Management Act (Magnuson-Stevens Act) requires each regional fishery management council to submit fishery management plans or plan amendments to NMFS for review and approval, disapproval, or partial approval. The Magnuson-Stevens Act also requires NMFS, immediately upon receiving a fishery management plan or amendment, to publish notification in the **Federal Register** that the fishery management plan or plan amendment is available for public review and comment. At the end of the comment period, NMFS considers the public comments received during the comment period described above in determining whether to approve, partially approve, or disapprove the fishery management plan or plan amendment.

Amendment 17 is administrative in nature and is intended to revise Council and NMFS processes associated with the specifications and management measures. This annual process establishes harvest "specifications," which are harvest levels or limits such as acceptable biological catches, optimum yields, or allocations for different user groups. Management measures, such as trip limits, closed times and areas, and gear restrictions are also set in the annual regulatory process. Since 1990, in order to use the most recent scientific information possible, the Council has annually developed its recommendations for specifications and management measures in a two-meeting process (usually its September and November meetings) followed by a NMFS final action published in the **Federal Register** and made available for public comment after the effective date of the action. In 2001, NMFS was challenged on this process in *Natural Resources Defense Council, Inc.* v. *Evans*, 168 F.Supp. 2d 1149 (N.D. Cal. 2001) and the Court ordered NMFS to provide prior public notice and allow public comment on the annual specifications. Amendment 17 would amend the FMP's framework for developing annual specifications and management measures to include time for NMFS to publish a proposed rule for the specifications and management measures, followed by a final rule.

In addition to needing to revise the notice and comment procedure associated with the specifications and management measures, the Council wished to take a new look at efficiency in the annual management process. Groundfish management workload levels have grown in recent years, particularly those associated with setting annual harvest levels for both depleted and healthy stocks. Because of the increasing workload associated with developing specifications and management measures, the Council and NMFS have had less time for addressing many other important groundfish fishery management issues. NMFS has recently asked all of the fishery management councils to consider how they might streamline their processes for developing regulatory recommendations. Amendment 17 responds to this request by setting the specifications and management measures process for biennial, rather than annual, development and implementation.

Public comments on Amendment 17 must be received by July 21, 2003, to be considered by NMFS in the decision whether to approve, disapprove, or partially approve Amendment 17. A proposed rule to implement Amendment 17 has been submitted for Secretarial review and approval. NMFS expects to publish and request public comment on proposed regulations to implement Amendment 17 in the near future.

Authority: 16 U.S.C. 1801 *et seq.*

Dated: May 16, 2003.

Bruce C. Morehead,

Acting Director, Office of Sustainable Fisheries, National Marine Fisheries Service.

[FR Doc. 03–12885 Filed 5–21–03; 8:45 am]

BILLING CODE 3510–22–S

DEPARTMENT OF COMMERCE

National Oceanic and Atmospheric Administration (NOAA)

50 CFR Part 660

[Docket No. 030430106–3106–01; I.D. 040103C]

RIN 0648–AQ58

Fisheries Off West Coast States and in the Western Pacific; Pacific Coast Groundfish Fishery; Vessel Monitoring Systems

AGENCY: National Marine Fisheries Service (NMFS), National Oceanic and Atmospheric Administration (NOAA), Commerce.

ACTION: Proposed rule; request for comments.

SUMMARY: NMFS is proposing a rule that would require vessels registered to Pacific Coast groundfish fishery limited entry permits to carry and use mobile vessel monitoring system (VMS) transceiver units while fishing in the exclusive economic zone (EEZ) off the coasts of Washington, Oregon, and California. This action is necessary to monitor compliance with large-scale depth-based restrictions for fishing across much of the continental shelf.

This proposed rule also requires the operators of any vessel registered to a limited entry permit and any other commercial or tribal vessel using trawl gear, including exempted gear used to take pink shrimp, spot and ridgeback prawns, California halibut and sea cucumber, to declare their intent to fish within a conservation area specific to their gear type, in a manner that is consistent with the conservation area requirements. This action is intended to further the conservation goals and objectives of the Pacific Coast Groundfish Fishery Management Plan(FMP) by allowing fishing to continue in areas and with gears that can harvest healthy stocks with little incidental catch of low abundance species.

DATES: Comments must be received by July 21, 2003.

ADDRESSES: Send comments to, D. Robert Lohn, Administrator, Northwest Region, NOAA Fisheries, 7600 Sand Point Way, NE, Seattle, WA 98112, Attn: Becky Renko. Comments also may be sent via facsimile (fax) to 206–526–6736. Comments will not be accepted if submitted via e-mail or Internet.

Copies of the environmental assessment/regulatory impact review/initial regulatory flexibility analysis (EA/RIR/IRFA) prepared for this action may be obtained from the Pacific Fishery Management Council (Council) by writing to the Council at 7700 NE Ambassador Place, Portland, OR 97220, phone: 503–820–2280, or may be obtained from William L. Robinson, Northwest Region, NMFS, 7600 Sand Point Way N.E., BIN C15700, Bldg. 1, Seattle, WA 98115–0070. Send comments on collection-of-information requirements to the NMFS address above and to the Office of Information and Regulatory Affairs (OIRA), Office of Management and Budget (OMB), Washington DC 20503 (Attn: NOAA Desk Officer).

FOR FURTHER INFORMATION CONTACT: Becky Renko or Yvonne deReynier (Northwest Region, NMFS) 206–526–6140.

SUPPLEMENTARY INFORMATION: This rule is accessible via the Internet at the Office of the Federal Register's Web site at *http://www.access.gpo.gpv/su-docs/aces/aces140.htm*. Background information and documents are available at the NMFS Northwest Region Web site at *http://www.nwr.noaa.gov/1sustfsh/gdfsh01.htm* and at the Council's Web site at *http://www.pcouncil.org*.

Specific Request for Comments

NMFS is specifically seeking comment on: the requirements to send declaration reports prior to leaving port; prohibition of vessels registered to limited entry permits with trawl endorsements from activities other than continuous transit through the Trawl Rockfish Conservation Area; and the requirement for continuous VMS position reports, particularly as it applies to small vessels that are regularly removed from the water.

Background

In general, a variety of methods are used to routinely monitor fishing fleets to ensure that vessel operators comply with fishery regulations. Traditional techniques used to monitor marine fisheries have been relatively limited and include monitoring from air and surface craft, through on-board observer programs, and by analyzing catch records and vessel logbooks. The efficiency of these traditional monitoring techniques can be enhanced by the addition of VMS and the use of declaration reports.

VMS is a tool that allows vessel activity to be monitored in relation to geographically defined management areas. VMS transceiver units installed aboard vessels automatically determine the vessel's position and transmit that position to a processing center via a communication satellite. At the processing center, the information is validated and analyzed before being disseminated for various purposes, which may include fisheries management, surveillance and enforcement. VMS transceivers automatically determine the vessel's position using Global Positioning System (GPS) satellites. Generally, the vessel's position is determined once per hour, but the position determinations may be more or less frequent depending on the fishery. VMS transceivers are designed to be tamper resistant. In most cases, the vessel owner is not aware of exactly when the unit is transmitting and is unable to alter the signal or the time of transmission. On September 23, 1993 (58 FR 49285)and March 31, 1994 (59 FR 15181) NMFS published VMS standards for transceiver units and service providers used for Federal fisheries management.

Information collected under a VMS program is subject to the confidentiality provisions of Section 402 of the Magnuson-Stevens Fishery Conservation and Management Act (Magnuson-Stevens Act), 6 U.S.C. 1881 a(b), and implementing regulations at 50 CFR part 600, Subpart E. These authorities specify in detail who may access and use the information and for what purposes.

Amendment 13 to the Pacific Coast groundfish FMP recognized the value of VMS systems in enforcing closed areas established to reduce bycatch levels. Amendment 13 also identified VMS as a technological tool that could be used to improve bycatch management by providing location data that can be used in conjunction with observer data collections.

Time and area closures have long been used in the Pacific Coast groundfish fishery to restrict fishing activity in order to keep harvests within sector allocations and at sustainable levels and to prohibit the catch of certain species. Until September 2002, geographically-defined areas tended to be in nearshore areas or defined by simple latitude and longitude lines. On September 13, 2002, NMFS took emergency action to implement the first depth-based management measures (67 FR 57973). This emergency rule restricted trawling north of 40°10′ N. lat., in the months of September-December 2002, to depths where darkblotched rockfish, an overfished species, was not expected to be encountered. These measures were taken to keep the total catch of darkblotched rockfish below the 2002 Optimum Yield level. The Darkblotched Rockfish Conservation Area was a depth-based management area based on bottom depth ranges where darkblotched rockfish commonly occur (100–250 fm). This large, irregularly-shaped geographical area was defined by a series of latitudinal and longitudinal coordinates which generally follow depth (fathom) contours. This area differed from previously closed areas because it extends far offshore making air and surface craft enforcement difficult.

For 2003, the Council sought a management strategy that would allow fishing to continue in areas and with gear that can harvest healthy stocks with little incidental catch of low abundance species such as bocaccio, yelloweye, canary and darkblotched rockfish. Measures must be taken to protect these stocks and rebuild them to sustainable biomass levels. Therefore, the Council recommended that NMFS define additional management areas for the groundfish fishery that are based on bottom depth ranges where these low abundance species are commonly found. For 2003, large-scale depth-related closed areas, referred to as rockfish conservation areas or RCAs, are being used to restrict both commercial and recreational fishing across much of the Continental Shelf. Different RCAs are established for different gear types, as not all gear types encounter each overfished species at the same rate or in similar areas. For example, groundfish bottom trawling is banned in some RCAs (known as trawl RCAs); use of non-trawl gear -- such as limited entry and open access longline, pot or trap is banned in other RCAs (known as non-trawl RCAs).

Within the RCAs, fishing likely to result in the catch of substantial amounts of overfished species is banned, while other fishing is allowed. In addition, transit of the RCAs by fishing vessels headed for open areas seaward of the RCAs is allowed.

The depth-based management strategy associated with the RCAs is designed to allow fishing for healthy stocks to continue, while protecting overfished species. However, it presents new enforcement challenges, and requires new tools such as VMS to supplement existing enforcement mechanisms. NMFS and cooperating enforcement agencies (such as the U.S. Coast Guard and state marine law enforcement agencies) will continue to use traditional enforcement methods such as aerial surveillance and marine patrols that have proved effective in the past. Adding requirements for VMS and declaration reports will allow the enforcement agencies to continuously monitor vessels fishing in, and transiting through, the RCAs.

At its September 2002 meeting, the Council indicated that the information provided by a VMS program will be beneficial to managing the groundfish fishery, specifically, in maintaining the integrity of new, depth-based management measures. At this same meeting, the Council requested that NMFS further analyze a VMS program and develop implementing regulations.

At its November 2002 meeting, following public comment and Council discussion, the Council recommended that NMFS move forward with a proposed rule to implement a VMS program for the Pacific Coast groundfish fishery in 2003. During the initial phase of this program the Council recommended starting with requiring vessels registered to limited entry permits fishing in the EEZ off the Washington, Oregon, and California coasts to have VMS transceiver units. This is intended to be a pilot program that begins with the sector that is allocated the majority of the groundfish resources. In order to implement a VMS program effectively, the Council also recommended requiring the operator of any vessel registered to a limited entry permit; and any commercial or tribal vessel using trawl gear, including, exempted gear used to take pink shrimp, spot and ridgeback prawns, California halibut and sea cucumber, to declare their intent to fish within a conservation area specific to their gear type, in a manner that is consistent with the conservation area requirements.

Although the Council recommended that NMFS fully fund a VMS monitoring program, it is not possible at this time because neither state nor Federal funding is available for purchasing, installing, or maintaining VMS transceiver units, nor is funding available for data transmission. Because of the critical need to monitor the integrity of conservation areas that protect overfished stocks, while allowing for the harvest of healthy stocks, NMFS believes it is necessary to proceed with this rulemaking. To move this rulemaking forward at this time it is necessary to require fishery participants to bear the cost of purchasing, installing, and maintaining VMS transceiver units, VMS data transmissions, and reporting costs associated with declaration requirements. If state or Federal funding becomes available, fishery participants may be reimbursed for all or a portion of their VMS expenses.

Declaration Reports

Before the vessel is used to fish in any trawl RCA or the Cowcod Conservation Areas (CCA) in a manner that is consistent with the requirements of the conservation areas, a declaration report will be required from (1) any vessel registered to a limited entry permit with a trawl endorsement; (2) any vessel using trawl gear, including exempted gear used to take pink shrimp, spot and ridgeback prawns, California halibut and sea cucumber; and (3) any tribal vessel using trawl gear. In addition, declaration reports will be required from vessels registered to limited entry permits with longline and pot endorsements, before these vessels can be used to fish in any Non-trawl RCA or the CCA. The declaration report must be submitted before the vessel leaves port on the trip to fish in an RCA or CCA. Each declaration report will be valid until cancelled or revised by the vessel operator. The declaration report must state the type of fishing in which the vessel will engage. If the type of fishing changes, a new declaration report must be submitted.

During the period that a vessel has a valid declaration report on file with NMFS, it cannot fish with a gear other than a gear type that is within the gear category (50 CFR 660.303 (b)(5)) declared by the vessel. In addition, on any trip on which a vessel fishes in an RCA or CCA, the vessel cannot participate in any fishing that is inconsistent with the restrictions that apply within the RCA or CCA.

Declaration reports will be submitted to NMFS by using the VMS system or another approved method, such as email, facsimile or telephone, as identified by NMFS. Vessel operators making declaration reports will receive a confirmation notice or number that verifies that the reporting requirements were satisfied.

Declaration Requirements Example #1: If a vessel registered to a limited entry permit with a trawl endorsement leaves port on a trip to harvest Pacific whiting during the primary season, and the vessel is not used in another commercial fishery in the EEZ off the coasts of Washington, Oregon, or California during the year, a declaration report will be required before the vessel leaves port on its trip to harvest Pacific whiting with midwater trawl gear in the Trawl RCA. This is the only declaration report required for this vessel.

Declaration Requirements Example #2: If a vessel registered to a limited entry permit with a trawl endorsement is used to harvest pink shrimp inside the Trawl RCA from April to June; Pacific whiting inside the Trawl RCA from June to September; flatfish from areas not inside the Trawl RCA from September to December; and crab both inside the Trawl RCA and from areas not inside the Trawl RCA in December; the following declarations will be required: in April a declaration will be required to identify the gear as pink shrimp, spot and ridgeback prawn trawl gear; in June a declaration will be required to identify the gear as limited entry midwater trawl gear; in September a declaration will be sent to cancel the declaration to fish in a conservation area; in December a declaration will be sent identifying the gear type as crab or lobster gear. Each declaration report would be sent before the vessel leaves port on the first trip under that declaration.

VMS

Under this proposed rule, any vessel registered to a limited entry permit for the Pacific Coast groundfish fishery will be required to have an operating NMFS type-approved VMS transceiver unit on board while fishing in the EEZ off the states of Washington, Oregon and California. Type-approved VMS transceiver units may include but are not limited to, the following features: automatically generated position reports from transceivers with a fully integrated, tamper proof GPS, two-way communications for sending and receiving messages, global or near global coverage, delays between position transmission and receipt at processing center that averages 5 minutes, ability to add sensors and data input devices, sleep modes that detect lack of vessel movement (in port) and stop sending position reports (greatly reducing power consumption) until the vessel begins moving again, and visual or audible alarms for malfunctions.

Currently, the cost of a NMFS type-approved VMS transceiver unit, suitable for the Pacific Coast groundfish fishery, ranges from approximately $2,000 to $6,000. The charges for the transmission of VMS position data from these units ranges from $1.00 to $5.00 per day. NMFS is in the process of revising VMS standards for type-approved models and testing new, less expensive, VMS transceiver technologies for agency approval. NMFS intends to complete this approval process and provide the public with a list of type-approved transceiver units before NMFS implements a final rule requiring the use of VMS transceivers in the fishery. The cost for some of the VMS units that are being tested for type-approval are expected to be less expensive than the prices quoted above.

A list of VMS transceivers that have been type-approved by NMFS will be mailed to the permit owner's address of record. NMFS will also distribute installation and activation instructions for the affected vessel owners. The installation of the VMS transceiver is expected to take less than 4 hours and will be the responsibility of the vessel owners. Prior to fishing, the vessel owner will be required to fax an activation report to NMFS to verify that the unit was installed correctly and has been activated. This regulatory amendment will require that the vessel owner or operator of a vessel registered to a limited entry groundfish permit use a NMFS type-approved VMS transceiver at all times when participating in any and all fisheries in the U.S. West Coast EEZ. A vessel owner required to continuously operate a VMS transceiver, may choose to send an exemption report to discontinue transmissions during a period when the vessel will be continuously out of the water for more than 7 consecutive days, or if the vessel is operating seaward of the EEZ off Washington, Oregon, or California for more than 7 consecutive days.

The 2003 Annual Specifications and Management Measures

The 2003 Annual Specifications and Management Measures implemented gear restrictions that affect this rulemaking. When the annual specifications and management measures became effective on March 1, 2003 (68 FR 11182), it became unlawful to take and retain, possess, or land groundfish taken with limited entry groundfish trawl and open access exempted trawl gear in the Trawl RCA. The only exceptions are for exempted trawl gear that is used to harvest pink shrimp coastwide and prawns north of 4°10′ N. lat.; and for limited entry midwater trawl gear used to harvest yellowtail rockfish, widow rockfish or Pacific whiting during the primary whiting season. Similarly, recreational fishing for groundfish was prohibited within the Yelloweye RCA and directed fishing with non-trawl gear (open access or limited entry) was prohibited within the Non-trawl RCA. As it was in 2002, recreational and commercial fishing for groundfish continues to be prohibited within the CCA, except that recreational and commercial fishing for rockfish and lingcod is permitted in waters inside 20 fathoms (36.9 m).

Trawl vessels may transit through the Trawl RCA, with or without groundfish on board, provided all groundfish trawl gear is stowed either: (1) below deck; or (2) if the gear cannot readily be moved, in a secured and covered manner, detached from all towing lines, so that it is rendered unusable for fishing; or (3) remaining on deck uncovered if the trawl doors are hung from their stanchions and the net is disconnected from the doors. If a vessel fishes in an RCA, it may not participate in any fishing on that same trip that is inconsistent with the restrictions that apply within the RCA. In addition, a vessel is prohibited from having more than one type of trawl gear on board if it is trawling within an RCA and may only have trawl gear authorized for use within an RCA on board.

Classification

NMFS prepared an IRFA that describes the economic impact this proposed rule, if adopted, would have on small entities. The IRFA is available from NMFS (see **ADDRESSES**). A summary of the IRFA follows:

A description of the action, why it is being considered, and the legal basis for this action are contained in the SUMMARY and at the beginning of this section of this proposed rule. This proposed rule does not duplicate, overlap, or conflict with other Federal rules.

A range of five alternative actions were considered and analyzed. The alternative monitoring systems included: (1) the status quo, (2) a declaration system, (3) a basic VMS program with 1–way communications (the proposed action), (4) an upgraded VMS program with 2–way communications, and (5) the expanded use of fishery observers. Vessel plotters were recommended as a monitoring system by the industry. After consideration, it was determined that vessel plotters, which were designed as a navigational aid, would not be an adequate enforcement monitoring tool for depth-based management.

Under the status quo (Alternative 1) for 2003, large-scale depth-related closed areas, referred to as rockfish conservation Areas or RCAs, are being used to restrict both commercial and recreational fishing across much of the Continental Shelf. The depth-based management strategy associated with the RCAs is designed to allow fishing for healthy stocks to continue, while protecting overfished species. However, this management system presents new enforcement challenges, and requires new tools to supplement existing enforcement mechanisms. These measures would remain in place under all alternatives, with increased access allowed to restricted areas as conditioned by the different alternatives.

Declaration reports (Alternative 2) alone were not considered to be as effective as VMS in monitoring vessels location in relation to restricted areas. Much of the information collected by observers (Alternative 5) goes beyond the identified need and was by far the most expensive alternative.

A VMS program is an effective tool for monitoring vessel location. The two approaches to VMS were: a basic VMS system (Alternative 3–proposed action) and an upgraded VMS system (Alternative 4). The primary difference between the two alternatives was that the upgraded system uses two-way communications between the vessel and shore such that full or compressed data messages can be transmitted and received by the vessel, while the basic system only transmits positions to a shore station. It was determined that the basic system was the minimum system that would maintain the integrity of the closed areas. However, this action will not preclude vessels from installing an upgraded VMS system.

A VMS program that identified the sectors of the groundfish fleet that would be required to have a VMS or observer monitoring system was considered. The alternative coverage levels ranged from limited entry vessels actively fishing off the West Coast to all limited entry, open access, and recreational charter vessels regardless of where fishing occurs. During the initial phase of this program the Council recommended starting with vessels registered to limited entry permits fishing in the EEZ off the Washington, Oregon, and California coasts to be required to have VMS transceiver units. This is intended to be a pilot program that begins with the sector that is allocated the majority of the groundfish resources. In addition, alternative approaches for funding the purchasing, installation, and maintenance of VMS transceiver units, as well as the responsibilities for transmission of reports and data were considered and included the following alternatives: Vessel pays all costs, vessel pays only for the transceiver, NMFS pays for initial transceiver, and NMFS pays all costs.

Although the Council recommended that NMFS fully fund a VMS monitoring program, it is not possible at this time because neither state nor Federal funding is available for purchasing, installing, or maintaining VMS transceiver units, nor is funding available for data transmission. Because of the critical need to monitor the integrity of conservation areas that protect overfished stocks, while allowing for the harvest of healthy stocks, NMFS believes it is necessary to proceed with this rulemaking.

Approximately 424 vessels that are registered to limited entry permits that operate in the EEZ off the states of Washington, Oregon or California would be required to carry and operate a NMFS type-approved VMS transceiver unit. All but 10 of the affected entities qualify as small businesses. Vessels required to carry VMS transceiver units will provide installation/activation reports, hourly position reports, and exemption reports. As this proposed rule was developed, the burden on fishery participants was considered and changes were made to ensure that only the minimum data needed to monitor compliance with regulations are being required.

In addition to VMS requirements, declaration report requirements would apply to vessels registered to limited entry permits with trawl endorsements (262 vessels); other vessels using trawl gear, including exempted gear used to take pink shrimp, spot and ridgeback prawns, California halibut and sea cucumber (299 vessels); and tribal vessels using trawl gear, before these vessel are used to fish in any trawl RCA or the CCA. In addition, declaration reports would be required from vessels registered to limited entry permits with longline and pot endorsements (167), before the vessel could be used to fish in any non-trawl RCA or the CCA.

The Council's VMS Committee initially considered declaration reports as ''per trip'' reports. Following consultation with fishery participants, it was determined that the needs of NMFS and the USCG could be met with less frequently made declaration reports. Therefore, it was determined that a declaration report identifying the type of gear being used by a vessel would remain valid until cancelled or revised by the vessel operator. This results in a significant reduction in the number of reports. Following consultation with fishery participants, it was determined that some vessels may prefer to reduce the costs of reporting when leaving the EEZ off the coasts of Washington, Oregon, and California. A substantial number of permitted vessels also fish in waters off Alaska and in areas seaward of the EEZ. In addition, vessels are commonly pulled out of the water for extended periods. To reduce the reporting burden on vessels outside the EEZ, an optional exemption report was proposed to allow vessels to reduce or discontinue VMS hourly position reports when they are out of the EEZ for more than 7 consecutive days.

The proposed measure (alternative 3), which would require limited entry vessels to purchase and operate a VMS in the EEZ off of Washington, Oregon, and California, is expected to increase the profitability of individual vessels that participate in the VMS program. To determine profitability, the Council compared the costs of purchasing and operating a VMS unit to the increase in revenue that would be obtained from expanded fishing opportunities under the depth management program. Since revenue data for individual vessels were not readily available, the Council used average annual revenue per vessel as a proxy. In the absence of vessel operating cost data, the Council considered only the cost of purchasing and maintaining a VMS unit and assumed other costs to be constant.

The VMS units that have been type-approved for this fishery range in costs and service features. This allows the vessel owner the flexibility in choosing the model that best fits the needs of his or her vessel. NMFS would pay for all costs associated with polling (when the processing center queries the transceiver, outside of regular transmission, for a position report). The costs of installation are minimal because the transceivers can be installed by the vessel operator. Vessels that already have VMS transceiver units installed for other fisheries or personal purposes could use their current unit, providing it is a model that has been type-approved for the Pacific Coast groundfish fishery and the software has been upgraded to meet the defined requirements.

The Council estimated that, under the proposed VMS measure, costs of purchasing and installing the unit would be between $800 and $3800 per individual vessel, and between $548 and $1698 per year to operate and maintain the unit. Revenues from expanded fishing were estimated to increase $26,000 per year for limited entry trawl vessels and $14,000 per year for limited entry longline and pot vessels, far exceeding the exceeding the estimated start-up and maintenance costs of the VMS.

While ex-vessel revenues appear higher on average for vessels likely to be required to use VMS under the depth-based management regime, it should be noted that fishing costs may also be higher, offsetting some of the apparent gain. Unfortunately, vessel cost data necessary to estimate this effect are currently not available. It is also important to keep in mind that using average revenues masks the variability of ex-vessel revenues in each vessel class. While on average, additional revenues appear greater than VMS-related costs, for some individual vessels in each class this will not be the case.

Alternative 4, which would implement a two-way VMS, would produce higher costs per vessel (year 1 at $3,878-$7,607; subsequent years at $1,063-$2,342) and would yield less profit, ceteris paribus, than the proposed VMS alternative. Alternative 5, which would implement observer coverage, would be very costly at $300 per day, or $36,000 per year assuming 10 fishing days per month, and would most likely produce economic losses for the majority of limited entry vessels.

Alternative 2, which would allow expanded fishing by use of declaration only, would be more profitable to limited entry vessels than the proposed VMS measure, since they would earn the same revenue at a minimal cost. However, the Council believes that mandatory VMS will allow for better enforcement of fishing regulations and provide a more accurate database of fishing activity to better meet the conservation goals of the Pacific Groundfish FMP.

The proposed measure to require all trawl vessels to declare their intentions to fish is expected to have only a minimal impact on individual trawlers since the cost of a declaration is minimal.

Most vessels affected by this action have gross annual receipts of under $3.5 million and are defined as small entities under Section 601 of the Regulatory Flexibility Act, however, there are approximately 10 vessels defined as large entities operating in the limited trawl fishery. There could be some disproportionate economic impacts on small entities versus large entities for the group of limited entry vessels that are less than 40 ft (12.192 m) in length and have relatively low gross annual receipts. These include 90 limited entry vessels, comprised of 5 trawl vessels and 85 longline and pot vessels. Depending upon the cost of the VMS, some of these smaller vessels would be forced to pay a relatively larger share of their annual expenditures for purchase of the VMS compared to the larger vessels. All vessels that fish in conservation areas would increase their gross receipts by being able to fish in more productive areas, having the effect of increasing profitability and mitigating the cost of the VMS. This mitigation would be less for smaller vessels, due to their smaller catches and, therefore, income from groundfish.

This proposed rule contains collection-of-information requirements subject to review and approval by OMB under the Paperwork Reduction Act (PRA). These requirements have been submitted to OMB for approval. Public reporting burden for these collections is estimated to average as follows: 4 minutes for a declaration report; 4 hours for installation of a VMS transceiver unit; 4 hours for annual maintenance of a VMS transceiver unit; 5 minutes for an installation/activation report; 5 seconds for each automated hourly position report; and 4 minutes for an exemption report. These estimates include the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection information.

Public comment is sought regarding whether this proposed collection of information is necessary for the proper performance of the functions of the agency, including whether the information shall have practical utility; the accuracy of the burden estimate; ways to enhance the quality, utility, and clarity of the information to be collected; and ways to minimize the burden of the collection of information, including through the use of automated collection techniques or other forms of information technology. Send comments on these or any other aspects of the collection of information to NMFS (see **ADDRESSES**) and to OMB at the Office of Information and Regulatory Affairs, OMB, Washington, DC 20503 (Attn: NOAA Desk Officer).

Notwithstanding any other provision of the law, no person is required to respond to, nor shall any person be subject to a penalty for failure to comply with, a collection of information subject to the requirements of the PRA, unless the collection of information displays a currently valid OMB Control Number.

NMFS issued Biological Opinions (BOs) under the Endangered Species Act on August 10, 1990, November 26, 1991, August 28, 1992, September 27, 1993, May 14, 1996, and December 15, 1999, pertaining to the effects of the groundfish fishery on chinook salmon (Puget Sound, Snake River spring/summer, Snake River fall, upper Columbia River spring, lower Columbia River, upper Willamette River, Sacramento River winter, Central Valley, California coastal), coho salmon (Central California coastal, southern Oregon/northern California coastal, Oregon coastal), chum salmon (Hood Canal, Columbia River), sockeye salmon (Snake River, Odette Lake), and steelhead (upper, middle and lower Columbia River, Snake River Basin, upper Willamette River, central California coast, California Central Valley, south-central California, northern California, and southern California). During the 2000 Pacific whiting season, the whiting fisheries exceeded the chinook bycatch amount specified in the Pacific whiting fishery's Biological Opinion's (whiting BO) (December 19, 1999) incidental catch statement estimate of 11,000 fish, by approximately 500 fish. In the 2001 whiting season, however, the whiting fishery's chinook bycatch was about 7,000 fish, which approximates the long-term average. After reviewing data from, and management of, the 2000 and 2001 whiting fisheries (including industry bycatch minimization measures), the status of the affected listed chinook, environmental baseline information, and the incidental catch statement from the 1999 whiting BO, NMFS determined in a letter dated April 25, 2002, that a re-initiation of the 1999 whiting BO was not required. NMFS has concluded that implementation of the FMP for the Pacific Coast groundfish fishery is not expected to jeopardize the continued existence of any endangered or threatened species under the jurisdiction of NMFS, or result in the destruction or adverse modification of critical habitat. This action is within the scope of these consultations.

This proposed rule has been determined to be not significant for purposes of Executive Order 12866.

Dated: May 15, 2003.

Rebecca Lent,

Deputy Assistant Administrator for Regulatory Programs, National Marine Fisheries Service.

For the reasons set out in the preamble, 50 CFR part 660 is proposed to be amended as follows:

PART 660—FISHERIES OFF THE WEST COAST STATES AND IN THE WESTERN PACIFIC

1. The authority citation for part 660 continues to read as follows:

Authority: 16 U.S.C. 1801 *et seq.*

Subpart G—West Coast Groundfish Fisheries

2. In § 660.302, add '' Address of record'', ''Groundfish Conservation Area or GCA'', ''Mobile transceiver unit'', ''Office for Law Enforcement'', and ''Vessel monitoring system or VMS'', in alphabetical order to read as follows:

§ 660.302 Definitions.

Address of record means the business address of a person, partnership, or corporation used by NMFS to provide notice of actions.

* * * * *

Groundfish Conservation Area or GCA means a geographic area defined by coordinates expressed in degrees latitude and longitude, created and enforced for the purpose of contributing to the rebuilding of overfished West Coast groundfish species. Specific GCAs are referred to or defined at § 660.304(c).

* * * * *

Mobile transceiver unit means a device installed on board a vessel that is used for monitoring a vessel and for transmitting the vessel's position as required by this subpart.

Office for Law Enforcement (OLE) refers to the National Marine Fisheries Service, Office for Law Enforcement, Northwest Division.

* * * * *

Vessel monitoring system or VMS means a vessel monitoring system or mobile transceiver unit as set forth in § 660.359 and approved by NMFS for use on vessels that take (directly or incidentally) species managed under the Pacific Coast Groundfish FMP, as required by this subpart.

3. Section 660.303 is revised to read as follows:

§ 660.303 Reporting and recordkeeping.

(a) This subpart recognizes that catch and effort data necessary for implementing the PCGFMP are collected by the States of Washington, Oregon, and California under existing state data collection requirements. Telephone surveys of the domestic industry may be conducted by NMFS to determine amounts of whiting that may be available for reallocation under 50 CFR 660.323(a)(4)(vi). No Federal reports are required of fishers or processors, so long as the data collection and reporting systems operated by state agencies continue to provide NMFS with statistical information adequate for management.

(b) Any person who is required to do so by the applicable state law must make and/or file, retain, or make available any and all reports of groundfish landings containing all data, and in the exact manner, required by the applicable state law.

(c) Any person landing groundfish must retain on board the vessel from which groundfish is landed, and provide to an authorized officer upon request, copies of any and all reports of groundfish landings containing all data, and in the exact manner, required by the applicable state law throughout the cumulative limit period during which a landing occurred and for 15 days thereafter.

(d) *Reporting requirements for vessels fishing in conservation areas*—(1) *Declaration reports for trawl vessels intending to fish in a conservation area.* The operator of any vessel registered to a limited entry permit with a trawl endorsement; any vessel using trawl gear, including exempted gear used to take pink shrimp, spot and ridgeback prawns, California halibut and sea cucumber; or any tribal vessel using trawl gear must provide NMFS with a declaration report, as specified at paragraph 660.303(d)(5), of this section to identify the intent to fish within the CCA, as defined at § 660.304, or any trawl RCA, as defined in the groundfish annual management measures that are published in the **Federal Register**.

(2) *Declaration reports for non-trawl vessels intending to fish in a conservation area.* The operator of any vessel registered to a limited entry permit with a longline or pot endorsement must provide NMFS OLE with a declaration report, as specified at paragraph (d)(5) of this section, to identify the intent to fish within the CCA, as defined at § 660.304, or any non-trawl RCA, as defined in the groundfish annual management measures that are published in the **Federal Register**.

(3) *When a declaration report for fishing in a conservation area is required*, as specified in paragraphs (d)(1) and (d)(2) of this section, it must be submitted before the vessel leaves port:

(i) On a trip in which the vessel will be used to fish in a conservation area for the first time during the calendar year;

(ii) On a trip in which the vessel will be used to fish in a conservation area with a gear type that is different from the gear declaration provided on a valid declaration report as defined at paragraph 660.303 (d)(6) of this section; or

(iii) On a trip in which the vessel will be used to fish in a conservation area for the first time after a declaration report to cancel fishing in a conservation area was received by NMFS.

(4) *Declaration report to cancel fishing in a conservation area.* The operator of any vessel that provided NMFS with a declaration report for fishing in a conservation area, as required at paragraphs (d)(1) or (d)(2) of this section, must submit a declaration report to NMFS OLE to cancel the current declaration report before the vessel leaves port on a trip in which the vessel is used to fish with a gear that is not in the same gear category set out in paragraph 660.303 (d)(5)(i) declared by the vessel in the current declaration.

(5) *Declaration reports will include*: the vessel name and/or identification number, and gear declaration (as defined in paragraph 660.303(d)(5)(i)). Upon receipt of a declaration report, NMFS will provide a confirmation code or receipt. Retention of the confirmation code or receipt to verify that the declaration requirement was met is the responsibility of the vessel owner or operator.

(i) One of the following gear types must be declared:

(A) Limited entry fixed gear,

(B) Limited entry midwater trawl,

(C) Limited entry bottom trawl,

(D) Trawl gear including exempted gear used to take pink shrimp, spot and ridgeback prawns, California halibut south of Pt. Arena, CA, and sea cucumber.

(E) Tribal trawl,

(F) Other gear including: gear used to take spot and ridgeback prawns, crab or lobster, Pacific Halibut, Salmon, California halibut, California sheephead, species managed under the Highly Migratory Species Fishery Management Plan, species managed under the Coastal Pelagic Species Fishery Management Plan, and any species in the gillnet complex as managed by the State of California.

(G) Non-trawl gear used to take groundfish.

(ii) Declaration reports must be submitted through the VMS or another method that is approved by NMFS OLE and announced in the **Federal Register**. Other methods may include email, facsimile, or telephone. NMFS OLE will provide, through appropriate media, instructions to the public on submitting declaration reports. Instructions and other information needed to make declarations may be mailed to the limited entry permit owner's address of record. NMFS will bear no responsibility if a notification is sent to the address of record and is not received because the permit owner's actual address has changed without notification to NMFS, as required at § 660.335 (a)(2). Owners of vessels that are not registered to limited entry permits and owners of vessels registered to limited entry permits that did not receive instructions by mail are responsible for contacting NMFS OLE during business hours at least 3 days before the declaration is required to obtain information needed to make declaration reports. NMFS OLE must be contacted during business hours (Monday through Friday between 0800 and 1700 Pacific Time).

(6) *A declaration report will be valid until* a declaration report to revise the existing gear declaration or a declaration report to cancel fishing in a conservation area is received by NMFS OLE. During the period that a vessel has a valid declaration report on file with NMFS, it cannot fish with a gear other than a gear type that is within the gear category (50 CFR 660.303 (d)(5)) declared by the vessel. After a declaration report to cancel fishing in the RCA is received, that vessel must not fish in a conservation area until another declaration report for fishing by that vessel in a conservation area is received by NMFS.

4. Section 660.304 is revised to read as follows:

§ 660.304 Management areas, including conservation areas, and commonly used geographic coordinates.

(a) *Management areas*

(1) *Vancouver.* (i) The northeastern boundary is that part of a line connecting the light on Tatoosh Island, WA, with the light on Bonilla Point on Vancouver Island, British Columbia (at 48°35′75″ N. lat., 124°43′00'' W. long.) south of the International Boundary

between the U.S. and Canada (at 48° 29′37.19'' N. lat., 124°43′33.19'' W. long.), and north of the point where that line intersects with the boundary of the U.S. territorial sea.

(ii) The northern and northwestern boundary is a line connecting the following coordinates in the order listed, which is the provisional international boundary of the EEZ as shown on NOAA/NOS Charts #18480 and #18007:

Point	N. lat.	W. long.
1	48°29′37.19″	124°43′33.19″
2	48°30′11″	124°47′13″
3	48°30′22″	124°50′21″
4	48°30′14″	124°54′52″
5	48°29′57″	124°59′14″
6	48°29′44″	125°00′06″
7	48°28′09″	125°05′47″
8	48°27′10″	125°08′25″
9	48°26′47″	125°09′12″
10	48°20′16″	125°22′48″
11	48°18′22″	125°29′58″
12	48°11′05″	125°53′48″
13	47°49′15″	126°40′57″
14	47°36′47″	127°11′58″
15	47°22′00″	127°41′23″
16	46°42′05″	128°51′56″
17	46°31′47″	129°07′39″

(iii) The southern limit is 47°30′ N. lat.

(2) *Columbia.* (i) The northern limit is 47°30′ N. lat.

(ii) The southern limit is 43°00′ N. lat.

(3) *Eureka.* (i) The northern limit is 43°00′ N. lat.

(ii) The southern limit is 40°30′ N. lat.

(4) *Monterey.* (i) The northern limit is 40°30′ N. lat.

(ii) The southern limit is 36°00′ N. lat.

(5) *Conception.* (i) The northern limit is 36°00′ N. lat.

(ii) The southern limit is the U.S.-Mexico International Boundary, which is a line connecting the following coordinates in the order listed:

Point	N. lat.	W. long.
1	32°35′22″	117° 27′49″
2	32°37′37″	117°49′31″
3	31°07′58″	118°36′18″
4	30°32′31″	121°51′58″

(b) *Commonly used geographic coordinates.*

(1) Cape Falcon, OR—45°46′ N. lat.

(2) Cape Lookout, OR——45°20′15'' N. lat.

(3) Cape Blanco, OR—42°50′ N. lat.

(4) Cape Mendocino, CA—40°30′ N. lat.

(5) North/South management line—40°10′ N. lat.

(6) Point Arena, CA—38°57′30'' N. lat.

(7) Point Conception, CA—34°27′ N. lat.

(c) *Groundfish Conservation Areas (GCAs).* In § 660.302, a GCA is defined as ''a geographic area defined by coordinates expressed in latitude and longitude, created and enforced for the purpose of contributing to the rebuilding of overfished West Coast groundfish species.'' Specific GCAs may be defined here in this paragraph, or in the **Federal Register**, within the harvest specifications and management measures process. While some GCAs may be designed with the intent that their shape be determined by ocean bottom depth contours, their shapes are defined in regulation by latitude/longitude coordinates and are enforced by those coordinates. Fishing activity that is prohibited or permitted within a particular GCA is detailed in **Federal Register** documents associated with the harvest specifications and management measures process.

(1) *Rockfish Conservation Areas (RCAs).* RCAs are defined in the **Federal Register** through the harvest specifications and management measures process. RCAs may apply to a single gear type or to a group of gear types, such as ''trawl RCAs'' or ''non-trawl RCAs''.

(2) *Cowcod Conservation Areas (CCAs).* (i) The Western CCA is an area south of Point Conception that is bound by straight lines connecting all of the following points in the order listed:

33°50′ N. lat., 119°30′ W. long.;
33°50′ N. lat., 118°50′ W. long.;
32°20′ N. lat., 118°50′ W. long.;
32°20′ N. lat., 119°37′ W. long.;
33°00′ N. lat., 119°37′ W. long.;
33°00′ N. lat., 119°53′ W. long.;
33°33′ N. lat., 119°53′ W. long.;
33°33′ N. lat., 119°30′ W. long.;
and connecting back to 33°50′ N. lat., 119°30′ W. long.

(2) The Eastern CCA is a smaller area west of San Diego that is bound by straight lines connecting all of the following points in the order listed:

32°42′ N. lat., 118°02 W. long.;
32°42′ N. lat., 117°50 W. long.;
32°36′42'' N. lat., 117°50 W. long.;
32°30′ N. lat., 117°53′30'' W. long.;
32°30′ N. lat., 118°02 W. long.;
and connecting back to 32°42′ N. lat., 118°02′ W. long.

(d) *Yelloweye Rockfish Conservation Area (YRCA).* The YRCA is a C-shaped area off the northern Washington coast that is bound by straight lines connecting all of the following points in the order listed:

48°18′ N. lat., 125°18′ W. long.;
48°18′ N. lat., 124°59′ W. long.;
48°11′ N. lat., 124°59′ W. long.;
48°11′ N. lat., 125°11′ W. long.;
48°04′ N. lat., 125°11′ W. long.;
48°04′ N. lat., 124°59′ W. long.;
48°00′ N. lat., 124°59′ W. long.;
48°00′ N. lat., 125°18′ W. long.;
and connecting back to 48°18′ N. lat., 125°18′ W. long.

(e) *International boundaries.* (1) Any person fishing subject to this subpart is bound by the international boundaries described in this section, notwithstanding any dispute or negotiation between the United States and any neighboring country regarding their respective jurisdictions, until such time as new boundaries are established or recognized by the United States.

(2) The inner boundary of the fishery management area is a line coterminous with the seaward boundaries of the States of Washington, Oregon, and California (the ''3–mile limit'').

(3) The outer boundary of the fishery management area is a line drawn in such a manner that each point on it is 200 nm from the baseline from which the territorial sea is measured, or is a provisional or permanent international boundary between the United States and Canada or Mexico.

* * * * *

5. In § 660.306, new paragraphs (z), (aa) and (bb) are added to read as follows:

§ 660.306 Prohibitions.

* * * * *

(z) *Vessel monitoring systems.* (1) Use any vessel registered to a limited entry permit to operate in the EEZ off the States of Washington, Oregon or California unless that vessel carries a NMFS OLE type-approved mobile transceiver unit and complies with the requirements described at § 660.359.

(2) Fail to install, activate, repair or replace a mobile transceiver unit prior to leaving port as specified at § 660.359.

(3) Fail to operate and maintain a mobile transceiver unit on board the vessel at all times as specified at § 660.359.

(4) Tamper with, damage, destroy, alter, or in any way distort, render useless, inoperative, ineffective, or inaccurate the VMS, mobile transceiver unit, or VMS signal required to be installed on or transmitted by a vessel as specified at § 660.359.

(5) Fail to contact NMFS OLE or follow NMFS OLE instructions when automatic position reporting has been interrupted as specified at § 660.359.

(aa) *Fishing in conservation areas.* (1) Fish with any trawl gear, including exempted gear used to take pink shrimp, spot and ridgeback prawns, California halibut south of Pt. Arena, CA, and sea cucumber; or with trawl gear from a tribal vessel or with any gear from a vessel registered to a groundfish limited entry permit in a conservation area unless the vessel owner or operator has a valid declaration confirmation code or receipt for fishing in conservation area as specified at § 660.303(d)(5).

(bb) Operate any vessel registered to a limited entry permit with a trawl endorsement in a Trawl Rockfish Conservation Area (as defined at 660.302), except for purposes of continuous transiting, provided that all groundfish trawl gear is stowed in accordance with 660.322(b)(8) or as authorized in the annual groundfish management measures published in the **Federal Register**.

6. In § 660.322, new paragraph (b)(7) is added to read as follows:

§ 660.322 Gear restrictions.

(b) * * *

(7) Trawl vessels may transit through the trawl RCA, with or without groundfish on board, provided all groundfish trawl gear is stowed either:

(i) Below deck; or

(ii) If the gear cannot readily be moved, in a secured and covered manner, detached from all towing lines, so that it is rendered unusable for fishing; or

(iii) Remaining on deck uncovered if the trawl doors are hung from their stanchions and the net is disconnected from the doors.

7. Section 660.359 is added to subpart G to read as follows:

§ 660.359 Vessel Monitoring System (VMS) requirements.

(a) *What is a VMS?* A VMS consists of a NMFS OLE type-approved mobile transceiver unit that automatically determines the vessel's position and transmits it to a NMFS OLE type-approved communications service provider. The communications service provider receives the transmission and relays it to NMFS OLE.

(b) *Who is required to have VMS?* A vessel registered for use with a Pacific Coast groundfish limited entry permit that fishes in the EEZ off the States of Washington, Oregon or California is required to install a NMFS OLE type-approved mobile transceiver unit and to arrange for an NMFS OLE type-approved communications service provider to receive and relay transmissions to NMFS OLE, prior to fishing in the EEZ.

(c) *How are mobile transceiver units and communications service providers approved by NMFS OLE?* (1) NMFS OLE will publish type-approval specifications for VMS components in the **Federal Register** or notify the public through other appropriate media.

(2) Mobile transceiver unit manufacturers or communication service providers will submit products or services to NMFS OLE for evaluation based on the published specifications.

(3) NMFS OLE may publish a list of NMFS OLE type-approved mobile transceiver units and communication service providers for the Pacific Coast groundfish fishery in the **Federal Register** or notify the public through other appropriate media. As necessary, NMFS OLE may publish amendments to the list of type-approved mobile transceiver units and communication service providers in the **Federal Register** or through other appropriate media. A list of VMS transceivers that have been type-approved by NMFS OLE may be mailed to the permit owner's address of record. NMFS will bear no responsibility if a notification is sent to the address of record and is not received because the applicant's actual address has changed without notification to NMFS, as required at § 660.335 (a)(2).

(d) *What are the vessel owner's responsibilities?* If you are a vessel owner that must participate in the VMS program, you or the vessel operator must:

(1) Obtain a NMFS OLE type-approved mobile transceiver unit and have it installed on board your vessel in accordance with the instructions provided by NMFS OLE. You may get a copy of the VMS installation and operation instructions from the NMFS OLE Northwest, VMS Program Manager upon Request at 7600 Sand Point Way NE, Seattle, WA 98115–6349, phone: (206)526–6133.

(2) Activate the mobile transceiver unit, submit an activation report, and receive confirmation from NMFS OLE that the VMS transmissions are being received before participating in a fishery requiring the VMS. Instructions for submitting an activation report may be obtained from the NMFS OLE, Northwest VMS Program Manager upon request at 7600 Sand Point Way NE, Seattle, WA 98115–6349, phone: (206)526–6133. An activation report must again be submitted to NMFS OLE following reinstallation of a mobile transceiver unit or change in service provider before the vessel may participate in a fishery requiring the VMS.

(i) *Activation reports*. If you are a vessel owner who must use VMS and you are activating a VMS transceiver unit for the first time or reactivating a VMS transceiver unit following a reinstallation of a mobile transceiver unit or change in service provider, you must fax NMFS OLE an activation report that includes: Vessel name; vessel owner's name, address and telephone number, vessel operator's name, address and telephone number, USCG vessel documentation number/state registration number; if applicable, the groundfish permit number the vessel is registered to; VMS transceiver unit manufacturer; VMS communications service provider; VMS transceiver identification; and a statement signed and dated by the vessel owner confirming compliance with the installation procedures provided by NMFS OLE.

(ii) [Reserved]

(3) Operate the mobile transceiver unit continuously 24 hours a day throughout the calendar year, unless such vessel is exempted under paragraph(d)(4)of this section.

(4) *VMS exemptions*. A vessel that is required to operate the mobile transceiver unit continuously 24 hours a day throughout the calendar year may be exempted from this requirement if a valid exemption report, as described at paragraph (d)(4)(iii) of this section, is received by NMFS OLE and the vessel is in compliance with all conditions and requirements of the VMS exemption identified in this section.

(i) *Haul out exemption*. When it is anticipated that a vessel will be continuously out of the water for more than 7 consecutive days and a valid exemption report has been received by NMFS OLE, electrical power to the VMS mobile transceiver unit may be removed and transmissions may be discontinued. Under this exemption VMS transmissions can be discontinued from the time the vessel is removed from the water until the time that the vessel is placed back in the water.

(ii) *Outside areas exemption*. When the vessel will be operating seaward of the EEZ off Washington, Oregon, or California for more than 7 consecutive days and a valid exemption report has been received by NMFS OLE, the VMS mobile transceiver unit transmissions may be reduced or discontinued from the time the vessel leaves the EEZ off the coasts of Washington, Oregon or California until the time that the vessel re-enters the EEZ off the coasts of Washington, Oregon or California. Under this exemption, the vessel owner or operator can request that NMFS OLE reduce or discontinue the VMS transmissions after receipt of an exemption report, if the vessel is equipped with a VMS transceiver unit that NMFS OLE has approved for this exemption.

(iii) Exemption reports must be submitted through the VMS or another method that is approved by NMFS OLE and announced in the **Federal Register**. Other methods may include email, facsimile, or telephone. NMFS OLE will

Exhibit B.9.c
Public Comment
June 2003

Subject: Fwd: VMS
From: "PFMC Comments" <pfmc.comments@noaa.gov>
Date: Mon, 12 May 2003 15:19:51 -0700
To: John.DeVore@noaa.gov
CC: Mike.Burner@noaa.gov

Pacific Fishery Management Council
7700 NE Ambassador Place, Suite 200
Portland, Oregon 97220-1384
Phone: 503-820-2280
Fax: 503-820-2299
On the web at: http://www.pcouncil.org

Subject: VMS
From: "Sharon Demmert" <demmsha@aptalaska.net>
Date: Fri, 9 May 2003 19:44:21 -0800
To: <pfmc.comments@noaa.gov>

Hello my name is Larry Demmert,I own Several West Coast Sablefish endorsed permits. I believe that the VMS system needs to have a non fishing mode,and we need to be able to use it in different ways,such as sleeping or changing areas or setting gear in 2 or more areas.Many areas that are deeper than 100 fathoms are surrounded by shallower waters, to ask a crew to jog to be in the deeper water instead of drifting and sleeping is too much. There will be a greater chance of injury due to fatigue and excessive costs of fuel consumption and engine wear and tear. Also , what if I want to run from the Nitnat Valley to the Juan De Fuca, do I have to run 12 hours extra by following the depth contours, when in just a few hours on a straight line I would be there? What about when I quit fishing to deliver, is there a time allotment to be there by ?

Larry Demmert

PFMC Comments <pfmc.comments@noaa.gov>
Pacific Fishery Management Council

GROUNDFISH STOCK ASSESSMENT AND REVIEW PROCESS DURING 2005-2006

Introduction

The purpose of this document is to help the Council family and others understand the groundfish stock assessment review process (STAR). Parties involved are the National Marine Fisheries Service (NMFS); state agencies; the Council and its advisors, including the Scientific and Statistical Committee (SSC), Groundfish Management Team (GMT), Groundfish Advisory Subpanel (GAP), Council staff; and interested persons. The STAR process is a key element in an overall process designed to make timely use of new fishery and survey data, to analyze and understand these data as completely as possible, to provide opportunity for public comment, and to assure that the results are as accurate and error-free as possible. The STAR process is designed to assist in balancing these somewhat conflicting goals of timeliness, completeness and openness. (Insert references to NMFS technical guidance for implementing precautionary approach and reference to the NRC report on stock assessments).

STAR Goals and Objectives

The goals and objectives for the groundfish assessment and review process[†] are:

a) Ensure that groundfish stock assessments provide the kinds and quality of information required by all members of the Council family.

b) Satisfy the Magnuson-Stevens Sustainable Fisheries Act (SFA) and other legal requirements.

c) Provide a well-defined, Council oriented process that helps make groundfish stock assessments the "best available" scientific information and facilitates use of the information by the Council. In this context, "well-defined" means with a detailed calendar, explicit responsibilities for all participants, and specified outcomes and reports.

d) Emphasize external, independent review of groundfish stock assessment work.

e) Increase understanding and acceptance of groundfish stock assessment and review work by all members of the Council family.

f) Identify research needed to improve assessments, reviews and fishery management in the future.

g) Use assessment and review resources effectively and efficiently.

Shared Responsibilities

All parties have a stake in assuring adequate technical review of stock assessments. NMFS must determine that the best scientific advice has been used when it approves fishery management recommendations made by the Council. The Council uses advice from the SSC to determine whether the information on which it will base its recommendation is the “best available” scientific advice. Fishery managers and scientists providing technical documents to the Council for use in management need to assure that the work is technically correct. Program reviews, in-depth external reviews, and peer-reviewed scientific publications are used by federal and state agencies to provide quality assurance for the basic scientific methods used to produce stock assessments. However, the time-frame for this sort of review is not suited to the routine examination of assessments that are, generally, the primary basis for a harvest recommendation.

[†] In this document, the term "stock assessment" includes activities, analyses, and management recommendations, beginning with data collection and continuing through to the development of management recommendations by the Groundfish Management Team and information presented to the Council as a basis for management decisions.

The review of current stock assessments requires a routine, dedicated effort that simultaneously meets the needs of NMFS, the Council, and others. Leadership, in the context of the stock assessment review process for groundfish, means consulting with all interested parties to plan, prepare terms of reference, and develop a calendar of events and a list of deliverables. Coordination means organizing and carrying out review meetings, distributing documents in a timely fashion, and making sure that assessments and reviews are completed according to plan. Leadership and coordination both involve costs, both monetary and time, which have not been calculated, but are likely substantial.

The Council and NMFS share primary responsibility to a successful STAR process. The Council will sponsor the process and involve its standing advisory committees, especially the Scientific and Statistical Committee. NMFS will provide a coordinator to oversee and facilitate the process. Together they will consult with all interested parties to plan, prepare terms of reference, and develop a calendar of events and a list of deliverables. NMFS and the Council will share fiscal and logistical responsibilities.

The STAR process is sponsored by the Council because the Federal Advisory Committee Act (FACA) limits the ability of NMFS to establish advisory committees. FACA specifies a procedure for convening advisory committees that provide consensus recommendations to the federal government. The intent of FACA was to limit the number of advisory committees; ensure that advisory committees fairly represent affected parties; and insure that advisory committee meetings, discussions, and reports are carried out and prepared in full public view. Under FACA, advisory committees must be chartered by the Department of Commerce through a rather cumbersome process. However, the SFA exempts the Council from FACA *per se*, but requires public notice and open meetings similar to those under FACA.

NMFS Responsibilities

NMFS will work with the Council, other agencies, groups or interested persons that carry out assessment work to organize STAT Teams and STAR Panels, and make sure that work is carried out in a timely fashion according to the calendar and terms of reference. NMFS will provide a senior scientist to coordinate these tasks with assistance from Council staff. NMFS will convene a pre-assessment meeting for STAT Teams, GAP representatives, and interested parties to discuss upcoming stock assessments, external reviews, and data.

The Stock Assessment coordinator, in consultation with the SSC, will select STAR Panel chairs, and will coordinate the selection of external reviewers following criteria for reviewer qualifications, nomination, and selection. The public is welcome to nominate qualified reviewers. Following any modifications to the stock assessments resulting from STAR panel reviews and prior to distribution of the stock assessment documents and STAR panel reports to GMT, the coordinator will review the stock assessments and panel reports for consistency with the terms of reference, especially completeness. Inconsistencies will be identified and the authors requested to made appropriate revisions in time to meet the deadline for distributing documents for the GMT meeting at which ABC and OY recommendations are developed.

Individuals (employed by NMFS, state agencies, or other entities) that conduct assessments or technical work in connection with groundfish stock assessments are responsible for ensuring their work is technically sound and complete. The Council's review process is the principal means for review of complete stock assessments, although additional in-depth technical review of methods and data is desirable. Stock assessments conducted by NMFS, state agencies, or other entities must be completed and reviewed in full accordance with the terms of reference (Appendix Band C), at times specified in the calendar (Appendix A).

GMT Responsibilities

The GMT is responsible for identifying and evaluating potential management actions based on the best available scientific information. In particular, the GMT makes ABC recommendations to the Council based on estimated stock status, uncertainty about stock status, and socioeconomic and ecological factors. The GMT will use stock assessments, STAR Panel reports, and other information in making their ABC recommendations. The GMT's preliminary ABC recommendation will be developed at a meeting that includes representatives from the SSC, STAT Teams, STAR Panels, and GAP. A representative(s) of the GMT will serve as a liaison to each STAR Panel, but will not serve as a member of the Panel. The GMT will not seek revision or additional review of the stock assessments after they have been reviewed by the STAR Panel. The GMT chair will communicate any unresolved issues to the SSC for consideration. Successful separation of scientific (i.e.; STAT Team and STAR Panels) from management (i.e.; GMT) work depends on stock assessment documents and STAR reviews being completed by the time the GMT meets to discuss preliminary ABC and OY levels. However, the GMT can request additional model projections, based on reviewed model scenarios, in order to develop a full evaluation of potential management actions.

GAP Responsibilities

The chair of the GAP will appoint a representative to track each stock assessment and attend the STAR Panel meeting where the assessment of his / her species is reviewed. The GAP representative will participate in review discussions as an advisor to the STAR Panel, in the same capacity as the GMT advisor.

The GAP representative, along with STAR, STAT, and SSC representatives, will attend the GMT meeting at which ABC recommendations are made. The GAP representative will also attend subsequent GMT, Council, and other necessary meetings where the assessment of his / her species is discussed.

The GAP representative will provide appropriate data and advice to the STAR Panel and GMT and will report to the GAP on STAR Panel and GMT meeting proceedings.

SSC Responsibilities

The Scientific and Statistical Committee (SSC) will participate in the stock assessment review process and provide the GMT and Council with technical advice related to the stock assessments and the review process. The SSC will assign one member from its Groundfish Subcommittee to each STAR Panel. This member is expected to attend the assigned STAR Panel meeting, the GMT meeting at which ABC recommendations are made, and the Council meetings when groundfish stock assessment agenda items are discussed (see calendar in Appendix A).The SSC representative on the STAR Panel will present the STAR Panel report at GMT, SSC and Council meetings. The SSC representative will communicate SSC comments or questions to the GMT and STAR Panel chair. The SSC will review any additional analytical work on any of the stock assessments required or carried out by the GMT after the stock assessments have been reviewed by the STAR Panels. In addition, the SSC will review and advise the GMT and Council on projected ABCs and OYs.

The SSC, during their normally scheduled meetings, will serve as arbitrator to resolve disagreements between the STAT Team, STAR Panel, or GMT. The STAT Team and the STAR Panel may disagree on technical issues regarding an assessment. In this case, a complete stock assessment must include a point-by-point response by the STAT Team to each of the STAR Panel recommendations. Estimates and projections representing all sides of the disagreement need to be presented, reviewed, and commented on by the SSC.

Council Staff Responsibilities

Council Staff will prepare meeting notices and distribute stock assessment documents, stock summaries, meeting minutes, and other appropriate documents. Council Staff will help NMFS and the state agencies in coordinating stock assessment meetings and events. Staff will also publish or maintain file copies of reports from each STAR Panel (containing items specified in the STAR Panel’s term of reference), the outline for groundfish stock assessment documents, comments from external reviewers, SSC, GMT, and GAP, letters from the public, and any other relevant information. At a minimum, the stock assessments (STAT Team reports, STAR Panel reports, and stock summaries) should be published and distributed in the Council’s annual SAFE document.

Stock Assessment Priorities

Stock assessments for West Coast groundfish are conducted periodically to assess the abundance, trends and appropriate harvest levels for these species. Assessments use statistical population models to analyze and integrate a combination of survey, fishery and biological data. Annually, the Council establishes a prioritized list of species that it desires to have assessed. The principles used to set priorities and assign assessments to STAR panels are:

1. Assessments will be scheduled to take advantage of new data, especially survey data, and will generally be conducted once every three years due to limited fiscal and personnel resources.

2. Assessments may be conducted more frequently than once every three years if:
   a. Biological situation requires more frequent tracking to prevent overfishing and to track OY
   b. new data, including fishery dependent and anecdotal data indicating unforseen increases or decreases in stock size, are brought to the attention of the Council;
   c. the Council believes that the results of a stock assessment are sufficiently in dispute to warrant a re-assessment the following year; or
   d. a fishery for a species, stock, or stock complex has rapidly developed and that species, stock, or stock complex has not been assessed recently.

3. Generally, no more than 2 assessments will be reviewed by a STAR Panel when these assessments involve new types of data or assessment methods.

4. An update or report that falls short of a full assessment may be prepared for a species, stock, or stock complex to provide information helpful to the Council in making management decisions.

5. Any stock assessment submitted by the public should be submitted through normal Council channels and reviewed at STAR Panel meetings.

6. The assessment list should be discussed at the Council's June meeting and finalized at its September meeting to allow sufficient time for assembly of relevant assessment data and for arrangement of a STAR.

Terms of Reference for STAR Panels and Their Meetings

The principal responsibility of the STAR Panel is to carry out these terms of reference according to the calendar for groundfish assessments. Most groundfish stocks are assessed infrequently (every three years) and each assessment and review should result in useful advice to the Council. The STAR Panel's work includes:

1. reviewing draft stock assessment documents and any other pertinent information (e.g.; previous assessments and STAR Panel reports, if available);
2. working with STAT Teams to ensure assessments are reviewed as needed;
3. documenting meeting discussions; and
4. reviewing summaries of stock status (prepared by STAT Teams) for inclusion in the SAFE document.

STAR Panels normally include a chair, at least one "external" member (i.e.; outside the Council family and not involved in management or assessment of West Coast groundfish), and one SSC member. The total number of STAR members should be at least "n+2" where n is the number of stock assessments and "2" counts the chair and external reviewer. In addition to Panel members, STAR meetings will include GMT and GAP advisory representatives with responsibilities laid out in their terms of reference.

STAR Panels normally meet for one week.

The number of assessments reviewed per Panel should not exceed two.

The STAR Panel is responsible for determining if a stock assessment document is sufficiently complete according to Appendix B: Outline for Groundfish Stock Assessments. It is the Panel's responsibility to identify assessments that cannot be reviewed or completed for any reason. The Panel's decision that an assessment is complete should be made by consensus. If a Panel cannot reach agreement, then the nature of the disagreement must be described in the Panel's report.

For some species the available data will not be sufficient to calculate estimates of Fmsy (or proxy), Bmsy (or proxy), ending biomass or unfished biomass etc. Results of assessments of these species typically will not meet requirements of the Full Assessment Terms of Reference and each STAR Panel should consider what information can be drawn robustly from the available data. The panel should review the reliability and appropriateness of any methods used to draw conclusions about the population state and exploitation potential and either recommend or reject the analysis on the basis of its merit to introduce into the management process.

~~The STAR Panel's terms of reference concern technical aspects of stock assessment work. The STAR Panel should strive for a risk neutral approach in its reports and deliberations. The full range of uncertainty should be reflected in completed stock assessments and the reports prepared by STAR Panels. The STAR Panel should identify scenarios that are unlikely or have a flawed technical basis.~~

The STAR Panel's terms of reference concern technical aspects of stock assessment work, so the panel should strive for a risk neutral approach in its reports and deliberations. Assessment results based on model scenarios that have a flawed technical basis or are implausible on other grounds should be identified by the panel and excluded from the set on which management advise is developed. It is recognized that some of these unacceptable results may need to be reported in the STAT document in order to better define the scope of the accepted model results. The STAR panel should comment on the degree to which the accepted model scenarios describe and quantify the major sources of uncertainty, and on the degree to which the probabilities associated with these scenarios are technically sound. The STAR panel may also provide qualitative comments on the probability of various model results, especially if the panel does not believe that the probability distributions calculated by the STAT capture all major sources of uncertainty, but the STAR panel is not expected to endorse a single model result.

Recommendations and requests to the STAT Team for additional or revised analyses must be clear, explicit and in writing. A written summary of discussion on significant technical points and a lists of all STAR Panel recommendations and requests to the STAT Team are required in the STAR Panel's report. This should be completed (at least in draft form) prior to the end of the meeting. It is the chair and Panel's responsibility to carry out any follow-up review work that is required.

Additional analyses required in the stock assessment should be completed during the STAR Panel meeting. If follow-up work by the STAT Team is required after the review meeting, then it is the Panel's responsibility to track STAT Team progress. In particular, the chair is responsible for communicating with all Panel members (by phone, e-mail, or any convenient means) to determine if the revised stock assessment and documents are complete and ready to be used by managers in the Council family. If stock assessments and reviews are not complete at the end of the STAR Panel meeting, then the work must be completed prior to the GMT meeting where the assessments and preliminary ABC levels are discussed.

The STAR Panel, STAT Team, and all interested parties are legitimate meeting participants that must be accommodated in discussions. It is the STAR Panel chair's responsibility to manage discussions and public comment so that work can be completed.

STAT Teams and STAR Panels may disagree on technical issues. If the STAR Panel and STAT Team disagree, the STAR Panel must document the areas of disagreement in its report. The STAR Panel may request additional analysis based on alternative approaches. Estimates and projections representing all sides of the disagreement need to be presented in the assessment document, reviewed, and commented on by the SSC. It is expected that the STAT Team will make a good faith effort to complete these analyses.

The SSC representative on the STAR Panel is expected to attend GMT and Council meetings where stock assessments and harvest projections are discussed to explain the reviews and provide other technical information and advice.

The chair is responsible for providing Council staff with a camera ready and suitable electronic version of the Panel's report for inclusion in the annual SAFE report.

Suggested Template for STAR Panel Report

1. Minutes of the STAR Panel meeting containing
   a. Name and affiliation of STAR Panel members; and
   b. List of analyses requested by the STAR Panel.
2. Comments on the technical merits and/or deficiencies in the assessment and recommendations for remedies.
3. Explanation of areas of disagreement regarding STAR Panel recommendations:
   a. among STAR Panel members (majority and minority reports), and
   b. between the STAR Panel and STAT Team
4. Unresolved problems and major uncertainties, e.g.; any special issues that complicate scientific assessment, questions about the best model scenario.
5. Prioritized recommendations for future research and data collection

Terms of Reference for Groundfish STAT Teams

The STAT Team will carry out its work according to these terms of reference and the calendar for groundfish stock assessments.

Each STAT Team will appoint a representative who will attend the pre-assessment planning meeting, if one is held. STAT Teams are encouraged to also organize independent meetings with industry and interested parties to discuss issues, questions, and data.

Each STAT Team will appoint a representative to coordinate work with the STAR Panel and attend the STAR Panel meeting.

Each STAT Team will appoint a representative who will attend the GMT meeting and Council meeting where preliminary acceptable biological catch (ABC) and optimum yield (OY) levels are discussed. In addition, a representative of the STAT Team should attend the GMT and Council meeting where final ABC and OY levels are discussed, if requested or necessary. At these meetings, the STAT Team member shall be available to answer questions about the STAT Team report.

The STAT Team is responsible for preparing three versions of the stock assessment document: 1) a "draft" for discussion at the stock assessment review meeting; 2) a revised "complete draft" for distribution to the GMT, SSC, GAP, and Council for discussions about preliminary ABC and OY levels; 3) a "final" version published in the SAFE report. Other than authorized changes, only editorial and other minor changes should be made between the "complete draft" and "final" versions. The STAT Team will distribute "draft" assessment documents to the STAR Panel, Council, and GMT and GAP representatives at least two weeks prior to the STAR Panel meeting.

The STAT Team is responsible for bringing computerized data and working assessment models to the review meeting in a form that can be analyzed on site. STAT Teams should take the initiative in building and selecting candidate models. If possible, the STAT Team should have several complete models and be prepared to justify model recommendations.

The STAT Team is responsible for producing the complete draft by the end of the STAR Panel meeting. In the event that the complete draft is not completed, the Team is responsible for completing the work as soon as possible and to the satisfaction of the STAR Panel at least one week before the GMT meeting.

The STAT Team and the STAR Panel may disagree on technical issues regarding an assessment, but a complete stock assessment must include a point-by-point response by the STAT Team to each of the STAR Panel recommendations. Estimates and projections representing all sides of the disagreement need to be presented, reviewed, and commented on by the SSC.

For stocks which are newly projected by the STAT Team to fall below overfishing thresholds, the STAT Teams need to estimate the baseline rebuilding parameters as described in Appendix B. In addition to providing the baseline calculations, authors are encouraged to present alternative approaches (where appropriate), along with clear justification for why the alternatives may be an improvement over the baseline approach.

Electronic versions of final assessment documents, parameter files, data files, and key output files will be sent to the Stock Assessment Coordinator for inclusion in a stock assessment archive.

Appendix A: 2005-2006 Stock Assessment Review Calendar

June 16-20	PFMC Meeting (Portland) Approval of TOR
Sep 15-19	**STAR Panel meeting for lingcod and cabezon (Seattle)**
Oct 14-17	GMT meeting (Seattle)
Nov 3-7	PFMC Meeting (San Diego) - assessment results to be used for 2005-06 ABC and OYs presented to PFMC

Appendix B: Outline for Groundfish Stock Assessment Documents

This is an outline of items that should be included in stock assessment reports for groundfish managed by the Pacific Fishery Management Council. The outline is a working document meant to provide assessment authors with flexible guidelines about how to organize and communicate their work. All items listed in the outline may not be appropriate or available for each assessment. In the interest of clarity and uniformity of presentation, stock assessment authors and reviewers are encouraged (but not required) to use the same organization and section names as in the outline. It is important that time trends of catch, abundance, harvest rates, recruitment and other key quantities be presented in tabular form to facilitate full understanding and followup work.

1. <u>Title page and list of preparers</u> – the names and affiliations of the stock assessment team (STAT) either alphabetically or as first and secondary authors

2. <u>Executive Summary</u> (see attached template). This also serves as the STAT summary included in the SAFE.

3. <u>Introduction</u>

a. Scientific name, distribution, stock structure, management units
b. Important features of life history that affect management (e.g.; migration, sexual dimorphism, bathymetric demography)
c. Important features of current fishery and relevant history of fishery
d. Management history (e.g. changes in mesh sizes, trip limits, optimum yields)
e. Management performance – a table or tables comparing acceptable biological catches, optimum yields, landings, and catch (i.e., landings plus discard) for each area and year

4. <u>Assessment</u>

a. Data
   - i. Landings by year and fishery, discards (generally specified as a percentage of total catch in weight and in units of mt), catch-at-age, weight-at-age, survey and CPUE data, data used to estimate biological parameters (e.g.; growth rates, maturity schedules, and natural mortality) with coefficients of variances (CVs) or variances if available. Include complete tables and figures if practical.
   - ii. Treatment of discards (specified as a percentage of total catch in weight and in units of mt).
   - iii. Sample size information for length and age composition data by area, year, gear, market category, etc.

b. History of modeling approaches used for this stock – changes between current and previous assessment models

c. Model description
   - i. Complete description of any new modeling approaches.
   - ii. Assessment program with last revision date (i.e.; date executable program file was compiled).
   - iii. List and description of all likelihood components in the model.
   - iv. Constraints on parameters, selectivity assumptions, natural mortality, assumed level of age reader agreement or assumed ageing error (if applicable), and other assumed parameters.
   - v. Description of stock-recruitment constraint or components.
   - vi. Critical assumptions and consequences of assumption failures.
   - vii. Convergence criteria.

d. Model selection and evaluation
   - i. Evidence of search for balance between realistic (but possibly over-parameterized) and simpler (but not realistic) models –
   - ii. Use hierarchical approach where possible (e.g.; asymptotic vs. domed selectivities, constant vs. time varying selectivities).
   - iii. Do parameter estimates make sense, are they credible?
   - iv. Residual analysis (e.g.; residual plots, time series plots of observed and predicted values, or other approach).

v. Convergence status and convergence criteria for "base-run(s)" –
vi. Randomization run results or other evidence of search for global best estimates.

e. Base-run(s) results
   i. Table listing all parameters in the stock assessment model used for base runs, their purpose (e.g.; recruitment parameter, selectivity parameter) and whether or not the parameter was actually estimated in the stock assessment model.
   ii. Time-series of total and spawning biomass, recruitment and fishing mortality or exploitation rate estimates (table and figures).
   iii. Selectivity estimates (if not included elsewhere).
   iv. Stock-recruitment relationship.

f. Uncertainty and sensitivity analyses.
   i. The best approach for describing uncertainty and range of probable biomass estimates in groundfish assessments may depend on the situation. Approaches used previously are:
      (1) Sensitivity analyses (tables or figures) that show ending biomass levels or likelihood component values obtained while systematically varying emphasis factors for each type of data in the model.
      (2) Likelihood profiles for parameters or biomass levels may also be used.
      (3) CVs for biomass estimated by bootstrap, implicit autodifferentiation, or the delta method;
      (4) Subjective appraisal of magnitude and sources of uncertainty;
      (5) Comparison of alternate models;
      (6) Comparison of alternate assumptions about recent recruitment.
   ii. If a range of model runs (e.g.; based on CV's or alternate assumptions about model structure or recruitment) is used to depict uncertainty, then it is important that some qualitative or quantitative information about relative probability be included. If no statements about relative probability can be made, then it is important to state that all scenarios (or all scenarios between the bounds depicted by the runs) are equally likely.
   iii. if possible, ranges depicting uncertainty should include at least three runs: (a) one judged most probable; (b) at least one that depicts the range of uncertainty in the direction of lower current biomass levels; and (c) one that depicts the range of uncertainty in the direction of higher current biomass levels. The entire range of uncertainty should be carried through stock projections and decision table analyses.
   iv. retrospective analysis (retrospective bias in base model or models for each area).
   v. historic analysis (plot of actual estimates from current and previous assessments for each area).
   vi. Simulation results (if available).

5. Rebuilding parameters –

a. determine B_o as the product of spawners per recruit (SPR) in unfished state multiplied by the average recruitment expected while the stock is unfished. This typically is estimated as the average recruitment during early years of fishery. According to the 1999 SAFE report (PFMC 1999, p. 24)[††], the values for spawners are preferably measured as total population egg production, but female spawning biomass is a common proxy.
b. $B_{msy} = 0.4\ B_o$;
c. mean generation time; and
d. forward projection using a Monte Carlo re-sampling of recruitments expected to occur as the stock rebuilds. These future recruitments typically are taken from the recent time series of estimated recruitments or recruits per spawner.

[††]Pacific Fishery Management Council. 1999. Status of the Pacific Coast Groundfish Fishery Through 1998 and Recommended Biological Catches for 2000: Stock Assessment and Fishery Evaluation. (Document prepared for the Council and its advisory entities.) Pacific Fishery Management Council, 2130 SW Fifth Avenue, Suite, 224, Portland, Oregon 97201.

6. Target fishing mortality rates (if changes are proposed).

7. Harvest projections and decision tables –
    i. Harvest projections and decision tables should cover the plausible range of uncertainty about current biomass and the full range of candidate fishing mortality targets used for the stock or requested by the GMT. Ideally, the alternatives described in the decision table will be drawn from a probability distribution which describes the pattern of uncertainty regarding the status of the stock and the consequences of alternative future management actions. Where alternatives are not formally associated with a probability distribution, the document needs to present sufficient information to guide assignment of approximate probabilities to each alternative;
    ii. Information presented should include biomass and yield projections for at least three years into the future, beginning with the first year for which management action could be based upon the assessment.

8. Management recommendations.

9. Research needs (prioritized).

10. Acknowledgments-include STAR Panel members and affiliations as well as names and affiliations of persons who contributed data, advice or information but were not part of the assessment team.

11. Literature cited.

12. Complete parameter files and results for base runs.

Appendix C: Template for Executive Summary Prepared by STAT Teams

Stock: species/area

Catches: trends and current levels-include table for last ten years and graph with long term data

Data and assessment: date of last assessment, type of assessment model, data available, new information, and information lacking

Unresolved problems and major uncertainties: any special issues that complicate scientific assessment, questions about the best model scenario, etc.

Reference points: management targets and definition of overfishing

Stock biomass: trends and current levels relative to virgin or historic levels, description of uncertainty-include table for last 10 years and graph with long term estimates

Recruitment: trends and current levels relative to virgin or historic levels-include table for last 10 years and graph with long term estimates

Exploitation status: exploitation rates (i.e., total catch divided by exploitable biomass) – include table for last 10 years and graph with long term estimates.

Management performance: ABC and OY estimates, overfishing levels, actual catch and discard

Forecasts: normally three-year forecasts of catch and biomass

Decision table: (if available)

Recommendations: research and data collection needs

Sources of additional information: cite STAR Panel report, assessment documents, and other sources

Appendix D: History of STAR process

In 1995 and earlier years, stock assessments were examined at a very early stage during ad-hoc stock assessment review meetings (one per year). SSC and GMT members often participated in these ad-hoc meetings and provided additional review of completed stock assessments during regular Council meetings. There were no terms of reference or meeting reports from the ad-hoc meetings. NMFS provided leadership and coordination by setting up meetings. Each agency or Council paid their own travel costs. Council staff distributed meeting announcements and some background documents. The Council paid for publication of assessments as appendices to the annual Stock Assessment and Fishery Evaluation (SAFE) document.

A key event occurred in July 1995 when NMFS convened an independent, external review of West Coast groundfish assessments.[1] The report concluded that: 1) uncertainties associated with assessment advice were understated; 2) technical review of groundfish assessments should be more structured and involve more outside peers; and 3) the distinction between scientific advice and management decisions was blurred. Work to develop a process to review groundfish stock assessments was aimed at resolving these problems.

For 1996, the groundfish stock assessment review process was expanded to include: 1) terms of reference for the review meeting; 2) an outline for the contents of stock assessments; 3) external anonymous reviews of previous assessments; and 4) a review meeting report.[2] Plans were developed during March and April Council meetings and NMFS convened a week long review meeting in Newport, Oregon where preliminary groundfish stock assessments were discussed. The expanded process itself was reviewed by the Council family at an evaluation meeting at the end of the year. Leadership and planning responsibilities were shared by the SSC Groundfish Subcommittee, NMFS, GMT, GAP, and persons who participated in planning discussions during the March and April Council meetings. There was no formal coordination except for the review meeting terms of reference, organization of the review meeting by NMFS, and as provided by Council staff for publication of documents. Costs were shared as in previous years.

The review process for 1997 was further expanded based on a planning meeting in December 1996.[3] It was agreed that agencies (including NMFS and state agencies) conducting stock assessments were responsible for making sure assessments were technically sound and adequately reviewed. A Council-oriented review process was developed that included agencies, the GMT, GAP, and other interested members of the Council family. The process was jointly funded by the Council and NMFS, with NMFS hosting the Stock Assessment Review (STAR) Panel meetings and paying the travel expenses of the external reviewers, and the Council paying for travel expenses of the GAP representative and non-federal GMT and SSC members.

The process for 1997 included: 1) goals and objectives; 2) three STAR Panels, including external membership; 3) terms of reference for STAR Panels; 4) terms of reference for Stock Assessment (STAT) Teams; 5) a refined outline for stock assessments; 6) external anonymous reviews; 7) a clearer distinction between science and management; and 8) a calendar of events with clear deliverables, dates and well defined responsibilities. For the first time, STAR Panels and STAT Teams were asked to provide "decision table" analyses of the effects of uncertain management actions and to provide information required by the GMT in choosing harvest strategies. In addition, STAR Panels were asked to prepare "Stock Summaries" that described the essential elements of stock assessment results in a concise, simple format.

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[1]Anon. 1995. West coast groundfish assessments review, August 4, 1995. Pacific Fishery Management Council. Portland, OR.

[2] Brodziak, J., R. Conser, L. Jacobson, T. Jagielo, and G. Sylvia. 1996. Groundfish stock assessment review meeting - June 3-7, 1996 in Newport, Oregon. *In*: Status of the Pacific coast groundfish fishery through 1996 and recommended acceptable biological catches for 1997. Pacific Fisheries Management Council. Portland, OR.

[3]Meeting Report, Proposals and Plans for Groundfish Stock Assessment and Reviews During 1997 (May 8, 1997). Pacific Fishery Management Council, 2130 SW Fifth Avenue, Suite 224, Portland, OR 97201.

At the end of 1997, participants met to discuss events and make recommendations for 1998.[4] Participants concluded that objectives were, to varying degrees, achieved during 1997. A notable shortfall was in "increasing acceptance and understanding by all members of the Council family." The most significant issues seemed to be the nature of the STAR Panels' responsibilities, communicating uncertainty to decision makers, workload, and inexperience in conducting the review process.

In retrospect, there was no formal coordination and leadership except for the terms of reference and the calendar. As in previous years, Council staff coordinated distribution of meeting announcements and distribution of documents. Costs increased substantially due to travel for external experts, increased number of review meetings (three instead of one), and distribution of larger and additional reports. NMFS paid travel and other costs for external members of STAR Panels. Other costs were distributed as in 1996. It was not possible for the Council to copy and distribute all of the stock assessments because of limited funds.

In 1998, the stock assessment process was similar to that in 1997, including the 8 elements listed above. In November, a joint session of the SSC, GMT, and GAP was held to review events in 1998 and make recommendations for 1999. Several topics were discussed, including policy issues related to the 1998 terms of reference and operational issues related to how the terms of reference were implemented in 1998. This meeting produced a list of recommended changes for 1999, including:

- increasing the SSC's involvement in the process;
- clarify/modify the participant roles;
- limit the number of assessments, especially the difficulty caused by the late addition of assessments (e.g., sablefish and shortspine thornyhead in 1998);
- increase the involvement of external participants;
- timeliness in completing and submitting assessments; and
- duration of STAR Panel meetings, and the time required to adequately reviewing assessments.

Accordingly, the terms of reference were amended to include a cut-off date of November by which anyone proposing to present an assessment for review in the following year must notify the stock assessment coordinator. This change will ensure there is adequate time for formation and planning of STAR Panel meetings. The terms of reference were also changed to clarify the SSC's role in the process as "editor" and "arbiter;" the SSC will hear reports from all STAR Panels at its September meeting and will be involved in any unresolved issues between the STAT Teams, STAR Panels, or the GMT. Other issues were raised that had no quick solutions, such as how to incorporate socioeconomic information into the process, and how to present the decision tables to GMT and Council members.

Other than the changes noted above, the 1999 STAR process was similar to 1997 and 1998. As in previous years, a joint meeting of the SSC, GAP, and GMT was convened to review and evaluate the stock assessment process and to recommend modifications for 2000. There were relatively few concerns about the process in 1999, and they centered mainly around the difficulty of recruiting sufficient (external and internal) reviewers. Participants did not recommend departing from the current terms of reference regarding STAR panel composition, although they seemed to regard it more as a goal than a strict requirement. A notable continuing concern was the timeliness of STAT team reports prior to the STAR panel meetings.

Requirements for stock rebuilding analyses and monitoring of rebuilding progress and their relationship to the STAR process were also discussed. The group agreed that the terms of reference should be modified to require additional values (e.g., B_{msy}) be tabulated and included in STAT Team report related to an overfished species. There was general agreement that the STAR process should be used to review assessments of overfished species, which are

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[4]Jacobson, L.D. (ed.). 1997. Comments, issues and suggestions arising from the groundfish stock assessment and review process during 1997. Report to the Pacific Fishery Management Council (Revised Supplemental Attachment B.9.b, November 1997).

still likely to be on a 3-year cycle. However, the STAR process is not the appropriate process for the "monitoring" reports (required every 2 years), when they are out of phase with the assessment cycle.

Additionally, it was agreed that certain additional values should be consistently tabulated in the STAT team report in order to build a long-term computerized database of key parameters. The group noted that this would not impose additional work for the STAT team, but would simply require these values to be reported consistently.

The 2000 STAR process was reviewed during a joint meeting of the GAP, GMT, and SSC at the November 2000 meeting. There were relatively few recommendations for improvement to the terms of reference for 2001, although concerns about the long-term future for the STAR process were raised. It was agreed that the future of the STAR process would be evaluated during 2001, but the STAR process in 2001 would proceed similarly to past years. For the 2001 STAR process, participants at the review meeting recommended that greater efforts be made to produce and distribute documents in a timely manner and to assure their completeness and consistency with the terms of reference. In addition, the SSC agreed that its groundfish subcommittee would meet in concert with the GMT during the August 2001 meeting to identify issues, if any, with the assessments or STAR panel reviews that may require additional consideration by the SSC.

At the March 2001 PFMC meeting, the SSC provided recommendations for integrating rebuilding analyses and reviews into the STAR process for 2001.

Appendix E: Terms of Reference for Expedited Stock Assessment Updates

While the ordinary STAR process is designed to provide a general framework for obtaining a comprehensive, independent review of a stock assessment, in other situations a less rigorous review of assessment results is desirable. This is especially true in situations where a “model” has already been critically examined and the objective is to simply update the model by incorporating the most recent data. In this context a model refers not only to the population dynamics model *per se*, but to the particular data sources that are used as inputs to the model, the statistical framework for fitting the data, and the analytical treatment of model outputs used in providing management advice, including reference points, the allowable biological catch (ABC) and optimum yield (OY). When this type of situation occurs, it is an inefficient use of scarce personnel resources to assemble a 6 person panel for a whole week to evaluate an accepted modeling framework. These terms of reference establish a procedure that can accommodate an abbreviated form of review for stock assessment models that fall into this latter category. However, it is recognized that what in theory may seem to be a simple update, may in practice result in a situation that is impossible to resolve in an abbreviated process. In these cases, it may not be possible to update the assessment – rather the assessment may need to be revised in the next full assessment review cycle.

Qualification

The Scientific and Statistical Committee (SSC) will determine when a stock assessment qualifies for an expedited update under these terms of reference. To qualify, a stock assessment must carry forward its fundamental structure from a model that was previously reviewed and endorsed by a full STAR panel. In practice this means similarity in: (a) the particular sources of data used, (b) the analytical methods used to summarize data prior to input to the model, (c) the software used in programming the assessment, (d) the assumptions and structure of the population dynamics model underlying the stock assessment, (e) the statistical framework for fitting the model to the data and determining goodness of fit, (f) the weighting of the various data components, and (g) the analytical treatment of model outputs in determining management reference points, including F_{msy}, B_{msy}, and B_0. It is the SSC’s intention to employ an expedited stock assessment update in situations where no significant change in these 7 factors has occurred, other than extending time series of data elements within particular data components used by the model, e.g., adding information from a recently completed survey with an update of landings. In practice there will always be valid reasons for altering a model, as defined in this broad context, although, in the interests of stability, such changes should be resisted when possible. Instead, significant alterations should be addressed in the next subsequent full assessment and review. In principle, an expedited update is reserved for stock assessments that maintain fidelity to an accepted modeling framework, but the SSC does not wish to prescribe in advance what particular changes may or may not be implemented. Such a determination will need to be made on a case by case basis.

Composition of the Review Panel

The groundfish subcommittee of the SSC will conduct the review of an expedited stock assessment update. A review panel chairman will be designated by the chairman of the groundfish subcommittee from among its membership and it will be the panel chairman’s responsibility to insure the review is completed properly and that a written report of the proceedings is produced. Other members of the subcommittee will participate in the review to the extent possible, i.e., input from all members will not be required to finalize a report. At a minimum, one member of the SSC’s groundfish subcommittee will be needed to conduct a review (i.e., the panel chairman). In addition, the groundfish management team (GMT) and the groundfish advisory panel (GAP) will designate one person each to participate in the review, although the GMT and GAP panelists will serve in an advisory capacity only.

Review Format

Typically, a physical meeting will not be required to complete an expedited review of an updated stock assessment. Rather, materials can be distributed electronically. STAT and panel representatives will largely be expected to interact by email and telephone. A conference call will be held to facilitate public participation in the review.

The review process will be as follows. Initially, the STAT team that is preparing the stock assessment update will distribute to the review panelists a document that summarizes the team’s findings. In addition, Council staff will provide panelists with a copy of the last stock assessment reviewed under the full STAR process, as well as the previous STAR panel report. Each panelist will carefully review the materials provided. A conference call will be arranged by the panel chairman, which will provide an opportunity to discuss and clarify issues arising during the review, as well as provide for public participation. Notice of the conference call and a list of public listening stations will be published in the *Federal Register* (generally, 23 days in advance of the conference call) and a Meeting Notice will be distributed (generally, 14 days in advance). A dialogue will ensue among the panelists and the STAT team over a period of time that generally should not exceed one week. Upon completion of the interactive phase of the review, the panel chairman may, if necessary, convene a second conference call to reach a consensus among panel members and will draft a report of the panel's findings regarding the updated assessment. The whole process should be scheduled to occur within a two week period and the STAT team and panelists should be prepared to complete their work within that time frame. It will be the chairman's responsibility to insure that the review is completed in a timely manner.

STAT Team Deliverables

It is the STAT team's responsibility to provide a description of the updated stock assessment to the panel at the beginning of the review. To streamline the process, the team can reference whatever material it chooses, which was presented in the previous stock assessment (e.g., a description of methods, data sources, stock structure, etc.). However, it is essential that any new information being incorporated into the assessment be presented in enough detail, so that the review panel can determine whether the update satisfactorily meets the Council's requirement to use the best available scientific information. Of particular importance will be a retrospective analysis showing the performance of the model with and without the updated data streams. Likewise, a decision table that highlights the consequences of mis-management under alternative states of nature would be useful to the Council in adopting annual specifications. Similarly, if any minor changes to the "model" structure are adopted, above and beyond updating specific data streams, a sensitivity analysis to those changes may be required.

In addition to documenting changes in the performance of the model, the STAT team will be required to present key assessment outputs in tabular form. Specifically, the STAT team's final update document should include the following:

- Title page and list of preparers
- Executive Summary (see Appendix C)
- Introduction
- Documentation of updated data sources
- Short description of overall model structure
- Base-run results (largely tabular and graphical)
- Uncertainty analysis, including retrospective analysis, decision table, etc.
- 10 year harvest projections under the default harvest policy

Review Panel Report

The expedited stock assessment review panel will issue a report that will include the following items:

- Name and affiliation of panelists
- Comments on the technical merits and/or deficiencies of the update
- Explanation of areas of disagreement among panelists and between the panel and STAT team
- Recommendation regarding the adequacy of the updated assessment for use in management

IN THE UNITED STATES DISTRICT COURT
FOR THE DISTRICT OF COLUMBIA

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U.S. DISTRICT COURT
DISTRICT OF COLUMBIA
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NANCY M. MAYER-WHITTINGTON
CLERK

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PFMC

AMERICAN OCEANS CAMPAIGN, *et al.*,

Plaintiffs,

v.

DONALD L. EVANS, Secretary of Commerce, *et al.*,

Defendants.

Civ. No: 1:99CV00982 (GK)

JOINT STIPULATION AND [PROPOSED] ORDER TO AMEND DECEMBER 17, 2001, JOINT STIPULATION AND ORDER AS TO THE PACIFIC GROUNDFISH FISHERY MANAGEMENT PLAN

WHEREAS, plaintiffs in this case challenged the federal defendants' approval (in whole or in part) of certain fishery management plan amendments concerning essential fish habitat (EFH) in the following fishery management regions: Caribbean, Gulf of Mexico, New England, North Pacific, and Pacific (hereinafter "the EFH Amendments");

WHEREAS, plaintiffs alleged that federal defendants' approval of the EFH Amendments violated the Magnuson-Stevens Fishery Conservation and Management Act (Magnuson-Stevens Act) and federal defendants' own regulations, because federal defendants had (1) failed to analyze adequately the potential adverse effects of fishing gear on EFH; (2) failed to analyze adequately whether there were any practicable steps to minimize any such adverse effects of fishing on EFH; and (3) failed to take all practicable steps to minimize any such adverse effects of fishing on EFH;

WHEREAS, plaintiffs also alleged that federal defendants' approval of the EFH Amendments violated the National Environmental Policy Act (NEPA), because federal defendants had failed to analyze adequately the potential direct and indirect environmental impacts of fishing on EFH and to develop and analyze adequately a range of alternatives for minimizing any such adverse effects of fishing on EFH;

WHEREAS, the Texas Shrimp Association and Wilma Anderson (defendant-intervenors) intervened to defend the partial approval of the Gulf of Mexico EFH Amendment;

WHEREAS, in a Memorandum Opinion and Order filed on September 14, 2000, the Court denied defendant-intervenors' motion to dismiss plaintiffs' Magnuson-Stevens Act claim as to the Gulf of Mexico EFH Amendment, and granted federal defendants' and defendant-intervenors' summary judgment motions as to plaintiffs' Magnuson-Stevens Act claims;

WHEREAS, in its September 14, 2000, Memorandum Opinion and Order, the Court granted plaintiffs' summary judgment motion as to the NEPA claims relating to the EFH Amendments at issue in this case;

WHEREAS, in its September 14, 2000, Memorandum Opinion and Order, the Court remanded the EFH Amendments at issue in this case to the federal defendants to comply with NEPA; and

WHEREAS, in its September 14, 2000, Memorandum Opinion and Order, the Court enjoined federal defendants "from enforcing the EFH Amendments until such time as they perform a new, thorough, and legally adequate EA [(environmental assessment)] or EIS [(environmental impact statement)] for each EFH Amendment";

WHEREAS, the parties submitted a Joint Stipulation and [Proposed] Order on December 5, 2001, on a number of issues, including the preparation of the EISs for all of the fisheries that were challenged in this lawsuit; the schedule for the preparation and issuance of the EISs and Records of Decision (RODs); and NMFS's decisionmaking based on the EISs and RODs.

WHEREAS, the Court approved of the Joint Stipulation and entered it as an Order on December 17, 2001;

WHEREAS, pursuant to the December 17, 2001, Joint Stipulation and Order, NMFS is preparing an EIS concerning EFH for the Pacific Coast Groundfish Fishery Management Plan (FMP), that will include analyses of the environmental impacts of fishing on EFH — including direct and indirect effects (as defined in the EFH regulations at 50 C.F.R. § 600.810 (2002)) — and analyses of the environmental impacts of alternatives for implementing the requirement of the Magnuson-Stevens Act, 16 U.S.C. § 1853(a)(7), that the FMP "minimize to the extent practicable adverse effects on [EFH] caused by fishing";

WHEREAS, NMFS has determined that it needs additional time to prepare and issue the EIS concerning EFH for the Pacific Coast Groundfish FMP; and

WHEREAS, plaintiffs have agreed that NMFS may have additional time to prepare and issue the EIS concerning EFH for the Pacific Coast Groundfish FMP;

NOW THEREFORE, the undersigned Parties have conferred and hereby agree to amend Paragraphs 6, 9, and 11 of the December 17, 2001, Joint Stipulation and Order, only insofar as those paragraphs affect the EIS concerning EFH for the Pacific Coast Groundfish FMP, as follows:

1. NMFS will prepare the EIS concerning EFH for the Pacific Coast Groundfish FMP, in accordance with the following revised schedule:

Draft EIS published for public comment:	February 11, 2005
Draft EIS public comment period:	February 11-May 11, 2005
Issuance of Final EIS:	December 9, 2005
Issuance of ROD:	February 28, 2006

2. The EIS concerning EFH for the Pacific Coast Groundfish FMP will consider a range of reasonable alternatives for minimizing the adverse effects (as defined by the EFH regulations at 50 C.F.R. § 600.810 (2002)) of fishing on EFH, including potential adverse effects. This range of alternatives will include "no action" or status quo alternatives and alternatives setting forth specific fishery management actions that can be taken by NMFS under the Magnuson-Stevens Act. The alternatives may include a suite of fishery management measures, and the same fishery management measures may appear in more than one alternative. The selected alternatives can be executed through either amendments to the Pacific Groundfish FMP or implementing regulations.

3. NMFS will propose to the Council that an alternative specified by plaintiffs be adopted and fully analyzed in the Draft EIS concerning EFH for the Pacific Coast Groundfish FMP. Plaintiffs will provide to NMFS their specified alternative as a specific fishery management action, before the Council meeting at which the alternatives are adopted for analysis in the Draft EIS. The alternative specified by plaintiffs will fall within the range of reasonable alternatives considered in the Draft EIS, as those alternatives relate to the purpose and need of the proposed action. Also, NMFS and the Council may adopt and analyze any other reasonable alternative in the Draft EIS proposed by other stakeholder groups before the Council meeting at which the alternatives are adopted for analysis in the Draft EIS.

4. After the issuance of the ROD, if NMFS determines that an FMP amendment and implementing regulations are necessary, NMFS will approve an FMP amendment and implementing regulations as quickly as practicable, but, in any event, no later than May 6, 2006.

5. NMFS will request that the Council extend the life of the *ad hoc* Groundfish Habitat Technical Committee and that the Council amend the mission of the Committee to

include the technical review of the range of alternatives that are adopted by the Council for analysis in the Draft EIS.

6. All terms in the December 17, 2001, Joint Stipulation and Order not inconsistent with this Joint Stipulation remain in force. Nothing in this Joint Stipulation shall be construed as requiring actions inconsistent with existing law, including the Magnuson-Stevens Act and NEPA.

Respectfully submitted this 20th day of May, 2003.

Sylvia Liu

ERIC BILSKY
SYLVIA LIU
Oceana, Inc.
2501 M Street, N.W.
Division Suite 300
Washington, D.C. 20037
Tel: (202) 833-3900
Fax: (202) 833-2070

Attorneys for Plaintiffs

Anthony P. Hoang / SL by oral permission on 5/20/03

ANTHONY P. HOANG
SAMUEL D. RAUCH, III
United States Department of Justice
Environment and Natural Resources
General Litigation Section
P.O. Box 663
Washington, D.C. 20044-0663
Tel: (202) 305-0241
Fax: (202) 305-0267

Attorneys for Federal Defendants

James P. Walsh / SL by oral permission on 5/20/03

JAMES P. WALSH
RICHARD L. CYS
Davis, Wright, Tremaine, LLP
1155 Connecticut Avenue, N.W., Suite 700
Washington, D.C. 20036
Tel: (415) 276-6556
Fax: (415) 276-6599

Attorneys for Texas Shrimp Association and Wilma Anderson

[PROPOSED] ORDER

APPROVED and ENTERED as an Order of this Court, on this ______ day of

____________, 2003.

HON. GLADYS KESSLER
United States District Judge

The following counsel should be notified of the entry of this Order:

Eric Bilsky
Sylvia Liu
Oceana, Inc.
2501 M Street, N.W.
Suite 300
Washington, D.C. 20037

Richard L. Cys
James P. Walsh
DAVIS WRIGHT TREMAINE, L.L.P.
1155 Connecticut Avenue, N.W.,
Suite 700
Washington, D.C. 20036

Samuel D. Rauch, III
U.S. Department of Justice
Environment and Natural Resources Division
P.O. Box 7369
Washington, D.C. 20044-7369

Anthony P. Hoang
U.S. Department of Justice
Environment and Natural Resources Division
P.O. Box 663
Washington, D.C. 20044-0663

RECEIVED
U.S. DISTRICT COURT
DISTRICT OF COLUMBIA

03 MAY 20 PM 6:48

NANCY MAYER-WHITTINGTON
CLERK

CERTIFICATE OF SERVICE

On May 20, 2003, I served true copies of the Joint Stipulation and [Proposed] Order to Amend December 17, 2001, Joint Stipulation and Order as to the Pacific Groundfish Fishery Management Plan on the following by United States first class mail:

Richard L. Cys
James P. Walsh
Davis, Wright, Tremaine, LLP
1155 Connecticut Avenue, N.W., Suite 700
Washington, D.C. 20036

Samuel D. Rauch, III
U.S. Department of Justice
Environment and Natural Resources Division
P.O. Box 7369
Washington, D.C. 20044-7369

Anthony P. Hoang
U.S. Department of Justice
Environment and Natural Resources Division
P.O. Box 663
Washington, D.C. 20044-0663

Sylvia F. Liu (signature)
Sylvia F. Liu

Preliminary Recommendations of the ad hoc Groundfish Habitat Technical Review Committee

The ad hoc Groundfish Habitat Technical Review Committee met February 19-20, 2003 in Seattle and made the recommendations outlined below. The committee was formed by the Pacific Fishery Management Council to guide a scientific assessment of Pacific Coast Groundfish Essential Fish Habitat.

1. The committee unanimously endorses the bayesian approach to modeling EFH/HAPC and adverse impacts but notes that a reasonable degree of caution is prudent at this point prior to the models being made final. Conclusive recommendations for utilizing the models as the foundation for policy decisions will be made after the committee reviews the final product.

2. The committee believes that the modeling process could proceed with the information that is currently available. However, it would be extremely worthwhile to make improvements to the data during the period of time it will take to fully develop and run the model. Specific suggestions are provided below.

3. The committee recommends that the next meeting occur in time to monitor progress and review preliminary model runs.

Tasks

- Complete risk assessment models (EFH/HAPC designation and adverse impacts).
- Contract for interpretation of literature on fishing gear impacts to develop a "west coast perspective." The interpretation would provide a key input into the risk assessment.
- Groundtruth fishing effort data. Compare observer data and input from fishermen with results of Ecotrust fishing effort model.
- Develop GIS layer of priority non-fishing activities for cumulative effects portion of risk assessment model.
- Develop GIS layer of priority invertebrate distribution by mining survey and other relevant data.
- Overlay benthic habitat GIS with data layer that indicates data quality.
- Complete GIS data layer of baseline regulatory areas that are protective of habitat.
- Build the NOS Habitat Suitability Index into the risk assessment models.
- Complete EFH Appendix database.

Pacific States Marine Fisheries Commission Work Plan for a Project to Determine Fishing Effort in State and Federal Waters off the West Coast

Background

The ad hoc Groundfish Habitat Technical Review Committee (TRC), was created by the Pacific Fishery Management Council (Council) to oversee the scientific assessment process for the Pacific Groundfish Essential Fish Habitat Environmental Impact Statement (EIS). The TRC, at their February 19-20, 2003 meeting, reviewed the results of a fishing effort model that was produced by Ecotrust. The TRC noted concern with the results of the model and recommended that experience-based information from fishermen be compiled for comparison with the Ecotrust product.

Fishing effort data is one of several components necessary to evaluate the status of groundfish habitat. More information on how this data may be utilized, including a description of the GIS database being developed for the EIS and the assessment methodology, is available on the Council's website at http://www.pcouncil.org/habitat/habback.html. The fishing effort information is one of several data layers consolidated in a GIS database and being integrated through a risk assessment model under the guidance of the TRC.

Pacific States Marine Fisheries Commission (PSMFC) has developed a response to gathering information from fishermen that is described in the text below. In addition to gathering information on fishing effort, PSMFC will use the opportunity to review the descriptions of west coast fishing gear being used for this project.

Objectives:
a) Produce a compilation of experienced-based information to indicate fishing effort by gear type for areas off the west coast over time.
b) Review the description of fishing gears utilized on the west coast.

Although the TRC recommendation focused on developing a product for comparison with the Ecotrust data, the project has been designed to develop a discrete set of qualitative data that could potentially be used independently. The results will be subjected to the scrutiny of the Council system (including the TRC and SSC) and may potentially become part of the universe of available fishing effort data that among other things, includes logbooks, observer data, and the Ecotrust model.

Methodology

This project is based on small focus groups comprising representative, expert fishermen from four geographic regions (Washington, Oregon, northern California and southern California). The first meeting, to be held in early June, 2003, will be used as a pilot project to test the methodology.

For each geographic region, the project will occur in five steps. First, the lead fishermen will select participants based on their representative knowledge. Second, the participants will be given NOAA charts to fill in based on the parameters described in the Data section below. Third, the information from the charts will be digitized in a GIS database. Forth, the GIS data will be presented in focus groups with the participating fishermen for refinement and validation. Appropriate changes to the database will be made during the focus group. And fifth, the data will be compared with the Ecotrust data and subjected to TRC review.

Focus groups are used by social scientists to obtain information about complex topics, discover new research questions, explore a range of perceptions regarding a topic, and generate feedback from others in the group (Agar 1995, Bloore et al. 2001). Westat (2002) notes, "The focus group session is, indeed, an interview—not a discussion group, problem-solving session, or decision-making group. ... The hallmark of focus groups is the explicit use of the group interaction to generate data and insights that would be unlikely to emerge otherwise."

Such interviews also optimize the limited time and funding available for this project. It would be impossible, under the given constraints, to fully assess all aspects of west coast fishing effort. It should therefore be clearly noted that this project is not based on either random sampling or a census; rather, it is designed to elicit fishermen's expert, qualitative knowledge about fishing effort in order to compare results with other research findings, as request by the Habitat Technical Review Committee when it recommended the compilation of experience-based information from fishermen.

The maps generated by the fishermen will be digitized and captured as independent GIS datasets. The datasets can then be overlaid with the Ecotrust products and other GIS based sources of fishing effort data for comparison.

<u>Group composition</u>

Each focus group will be led by fishermen who sit on the TRC: Marion Larkin (Washington), Scott McMullen (Oregon), and Tim Athens (California). The fishermen were appointed to the TRC by their respective State fisheries agencies based on their representative knowledge of the fishing industry in their geographic area of expertise. Participants in the focus groups will be chosen by Larkin, McMullen and Athens based on their expertise.

The fishermen will be sent the NOAA nautical charts that are commonly utilized by fishermen to navigate and select fishing spots. They will be asked to describe fishing effort in terms of gear, time, area, and intensity based on their expert knowledge of fleet behavior. The maps will then be returned to TerraLogic GIS, who will enter the information into a GIS database. This database will then be presented at each focus group meeting as a starting point. Refinements and additional information will be captured and entered by TerraLogic GIS in concert with the fishermen at each meeting.

Because of the large project area and diversity of gear types, a project management structure based on "points of responsibility" has been created to divide the project into manageable geographic units, each of which are subject to the same goals and quality control standards. Points of responsibility are as follows:

- The Pacific Fishery Management Council's ad hoc Groundfish Habitat Technical Review Committee (TRC) provided the impetus for the project through its recommendations at their February 19-20, 2003 meeting, and will review the final products.
- Randy Fisher, Executive Director of the Pacific States Marine Fisheries Commission, is providing project oversight and contracts administration.
- Dave Colpo, Pacific States Marine Fisheries Commission, is providing project oversight and contracts administration.
- Review by NWFSC
- Steve Copps, NOAA Fisheries, is providing project oversight.
- Tim Athens, commercial fishermen appointed by the California Department of Fish and Game to the TRC, is responsible for project administration and data collection in California, including selection of appropriate fishermen to provide data.
- Scott McMullen, commercial fishermen appointed by the Oregon Department of Fish and Wildlife to the TRC, is responsible for project administration and data collection in Oregon, including selection of appropriate fishermen to provide data.
- Marion Larkin, commercial fishermen appointed by the Washington Department of Fish and Wildlife to the TRC, responsible for project administration and data collection in Washington, including selection of appropriate fishermen to provide data.
- Allison Bailey, technical consultant to the Pacific States Marine Fisheries Commission, is responsible for ensuring technical compatibility of the end product with GIS.

The following people reviewed the study design:

- Flaxen D.L. Conway, Extension Sea Grant Oregon; Oregon State University, Department of Sociology;
- Guy Fleischer, Northwest Fisheries Science Center;
- Ginny Goblirsch, Oregon Sea Grant;
- Jennifer Gilden, Pacific Fishery Management Council;
- Jamie Goen, NOAA Fisheries, Northwest Region;
- Jennifer Langdon Pollock, Pacific States Marine Fisheries Commission.

Project Tasks and Milestones

Task 1 Marion Larkin, with technical support from Allison Bailey, will administer the project on a **pilot basis** for the areas north of Destruction Island for trawl gear only (large footrope, small footrope, and mid-water). Draft milestones follow:

May 12 - PSMFC to distribute charts;
May 23 - Charts to be returned to TerraLogic;
June 6 - Focus group meeting to refine charts; and,
June 16 - Briefing to SSC and Council.

Task 2 Incorporate lessons learned into project design.

Task 3 Implement project for remaining geographical areas and gear types. Marion Larkin, with technical support from Allison Bailey, will administer project for northern coast (roughly for waters off Washington - specific breakdown to be determined). Scott McMullen, with technical support from Allison Bailey, will administer project for mid-coast (roughly for waters off Oregon - specific breakdown to be determined). Tim Athens, with technical support from Allison Bailey, will administer the project for southern coast (roughly for waters off California - specific breakdown to be determined). Dates for milestones to be determined.

Data

Gear types

- Gear types will be limited to trawl for the pilot project and subsequently expanded in consultation with reviewers.
- Gear types for the EFH EIS are being defined in a document titled *Description of Fishing Gears Used on the Pacific Coast*. It is important that the maps be referenced back to that document.

Intensity of Fishing Effort

- Maps should display the relative intensity of fishing effort by gear type. Because of practical limitations on this project, and the fact that it is not a census of all fishermen, it is unrealistic to expect precise quantified results (i.e. tows per year for a given area). However, a relative index consistently applied is crucial in adherence to the overall goals of the project. Effort should be displayed as:

High	concentrated and intense fishing effort throughout the year
Seasonally High	concentrated and intense effort within specified seasons
Medium	fishing effort occurs regularly throughout the year

Seasonally Medium	fishing effort occurs regularly within specified seasons
Low	occasional to rare fishing effort
None	no known fishing

Time

- Time periods will be limited to the following categories trawl for the pilot project and subsequently expanded in consultation with reviewers. These time periods were developed in discussion with Larkin, McMullen and Athens.

1986 - 2000	no footrope restrictions
2001 - 2002	implementation of footrope restrictions
present day	Area management and rebuilding overfished stocks.

Area

- Areas should be chosen based on fishermen's knowledge of where fishing effort has occurred. It should not be limited to statistical area grids, but rather may coincide with depth contours or bottom types based on real experience and observation.

Technical Specifications (necessary standards to ensure data can be converted to GIS)

- One set of charts per gear type and time period
- Areas need to be completely outlined as a polygon (not limited to isolated points or lines)
- Fishing intensity should be indicated by shading each polygon with a color that corresponds to an intensity as follows:
  - high = red
  - seasonally high = orange
  - medium = yellow
  - seasonally medium = blue
  - low = green

References

Agar, M. and MacDonald, J. 1995. "Focus groups and ethnography." *Human Organization* 54 : 78-86.

Bloor, M. et al. 2001. *Focus Groups in Social Research*. London: Sage Publications.

Frechtling Westat, J. 2002. *The 2002 User Friendly Handbook for Project Evaluation*. National Science Foundation, Directorate for Education and Human Resources, Division of Research, Evaluation and Communication.

Budget

Task 1 (Pilot Project)
Project Administration: $500 (Larkin)
Fishermen: $250 per fisherman x 5 fishermen = $1250
Technical Support, Data Entry, and Logistical Costs: $3,000

sub total = $4750

Task 2
base funded

Task 3
a) Northern Coast
Project Administration: $500 x 1 (Larkin) = $500
Fishermen: $250 per fisherman x 10 fishermen = $2500
Technical Support, Data Entry, and Logistical Costs = $3750

sub total = $6750

b) Mid Coast
Project Administration: $500 x 1 (McMullen) = $500
Fishermen: $250 per fisherman x 20 fishermen = $5000
Technical Support, Data Entry, and Logistical Costs = $3750

sub total = $9250

c) Southern Coast
Project Administration: $500 x 1 (Athens) = $500
Fishermen: $250 per fisherman x 20 fishermen = $5000
Technical Support, Data Entry, and Logistical Costs = $3750

sub total = $9250

Project Total = $30,000

Exhibit B.11
Attachment 5
June 2003

Pacific Coast Groundfish EFH

Analytical Framework

Version 1 (28 May 2003)

Prepared for

Pacific States Marine Fisheries Commission

By

MRAG Americas, Inc.
110 South Hoover Boulevard, Suite 212
Tampa, Florida 33609
www.mragamericas.com

May 2003

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1 INTRODUCTION

NOTE: this is intended to be a "living" document. i.e. it is in draft form and incomplete at this stage. As the analytical framework develops and results are obtained, the report will be updated. It will not be finished until the assessment phase of the EIS project is complete.

1.1 <u>The purpose of this document</u>

NOAA Fisheries is developing an Environmental Impact Statement (EIS) that responds to a court directive and settlement agreement to complete new NEPA analyses for Amendment 11 to the Pacific Coast Groundfish FMP.

The decision making process for this project is designed for policy to flow from assessment. A rigorous assessment of groundfish habitat on the west coast is being developed to define the current condition of habitat and set the stage for policy development. The EIS and the Council process will be the vehicles for developing policy in response to the assessment. This careful division of the scientific assessment from policy is pictured in the draft Decision making Framework for the Pacific Coast Groundfish Essential Fish Habitat Environmental Impact Statement (Figure 1).

FIGURE TO BE INSERTED HERE.

Figure 1 Draft framework for Pacific Coast Groundfish EFH EIS showing data inputs and separation of the assessment and policy components

The assessment process has officially been underway since March, 2002 when a team of NMFS and NOS scientists convened to sketch a strategy and identify data sources and responsible parties. The team identified the comparative risk assessment model described in Effects of Trawling and Dredging on Seafloor Habitat (NRC, 2002) as the conceptual starting point for Pacific coast groundfish. The Council reviewed the decisionmaking framework in April, 2002 and subsequently formed the Pacific Groundfish Habitat Techncial Review Committee (TRC) to guide the assessment process.

The assessment has been proceeding along three major tracks: data consolidation, proof of concept, and full implementation. The results of the data consolidation phase are discussed in

Chapter 2. Proof of concept ended in February 2003 with the endorsement of the preliminary assessment methodology. Full implementation is underway and described in Chapters 3 and 4.

1.2 Habitat requirements for FMPs

According to the statutory requirements (Federal Register 62, December 19, 1997, 66551), fishery management plans (FMPs) should contain:

(i) the habitat requirements for each life history stage for each species in the FMP;
(ii) a description and identification of EFH;
(iii) a description of fishing activities that may adversely affect EFH;
(iv) management options for mitigating adverse effects;
(v) identification of non-fishing effects;
(vi) a description of the cumulative and synergistic impacts of multiple effects;
(vii) a description of measures to promote and enhance EFH, particularly in habitat areas of particular concern;
(viii) a description of effects on EFH of loss of prey species;
(ix) identification of habitat areas of particular concern (HAPC);
(x) recommendations for future research; and
(xi) an allowance for subsequent review of EFH components.

There are several important tasks specified in the EFH guidelines, which are summarized under the following headings:

Information Development

- Produce a summary of all available biological information for each life history stage for each species
- Develop an inventory of available environmental and fisheries data to identify habitat-species data gaps
- Gather information on the current and historic stock size, geographic range of managed species, the habitat requirements and the distribution and characteristics of those habitats, by species life stage.

Designate and Evaluate

- Describe and identify EFH using information on distribution, density, growth, mortality, and production of each life stage and within all habitats occupied, or formerly occupied, by each species in the FMP.
- Assess whether, and to what extent a fishing activity is adversely impacting EFH
- Estimate the nature and extent of the adverse fishing impacts
- Assess the practicability of management measures. Examples of control options include fishing gear restrictions, seasonal/temporal area closures, and harvest restrictions.
- Identify and describe each non-fishing activity's likely impact on EFH

- For each non-fishing activity, describe the mechanisms, activities, and processes that cause adverse effects, and how these may affect habitat function.
- Describe and identify habitat areas of particular concern

Cumulative Effects

- Analyze how fishing and non-fishing activities influence habitat function on EFH, especially on habitat areas of particular concern, on an ecosystem or watershed scale.
- Describe and identify options to avoid, minimize, or compensate for the adverse effects of non-fishing or cumulative effects and promote conservation of EFH, and in particular habitat areas of particular concern
- Identify major prey species for species in the FMP, and describe the location of prey species habitat
- Describe and identify actions that cause a reduction of prey species population, including effects of loss habitat on prey species.

1.3 Structure of the document

Methodologies are described in this document under four main headings:

- Data sources
- Describing and identifying EFH;
- Identifying HAPCs;
- Addressing adverse effects of fishing on EFH; and
- Evaluating the consequences of the alternatives

The results arising from the application of these methods will be presented in later versions of this report and the DEIS in due course.

2 DATA SOURCES

To consolidate the available data and set the stage for a risk assessment that will underpin the EIS process, NOAA Fisheries in cooperation with the Pacific States Marine Fisheries Commission initiated a multi-faceted project as follows:

a) development of a GIS database that will display habitat types in comparison with known groundfish distribution/abundance and fishing effort;
b) conduct of a literature review and development of a database on groundfish habitat associations;
c) conduct of a literature review on fishing gear impacts to habitat; and
d) collection and analysis of information on fishing effort.

Add something on non-fishing impacts here?

2.1 GIS mapping of habitats

The first major requirement in mapping EFH, HAPCs and evaluating fishing impacts is the mapping of habitat itself. This was done using a geographic information system (GIS) created specifically for the EIS project. A GIS is the most effective and efficient way to analyze and present spatial information (see Text Box: A Primer on Geographic Information Systems).

Overall, the West Coast EFH GIS development has had two primary focuses: (1) generating and synthesizing new habitat information that was previously unavailable, and (2) compiling additional data sets that are as comprehensive as possible for the West Coast Exclusive Economic Zone (EEZ).

The integration of GIS datasets from disparate sources is an enormously complex and time consuming task. Merging together data from various sources presents many technical challenges, and requires numerous decisions about seemingly arcane, yet critical, details. For example, the large spatial extent of the West Coast EEZ combined with the need for highly detailed GIS data has caused the creation of GIS data sets that exceed the limitations of certain essential software algorithms. Therefore, alternative processing procedures have been developed to process and compile these data.

Often, procedures that are perceived to be “straightforward” and “seamless”, actually involve multiple intermediate steps and decisions about processing approach. For example, the benthic habitat data layers (described below), were provided in several geographic subsets. Ideally, they would be “stitched” together at their edges using straightforward GIS commands. In practice, however, combining these geographic subsets into one comprehensive GIS layer required additional processing, including: (1) modifying attribute definitions to make them identical, (2) eliminating overlapping areas by determining which subset has priority, (3) filling in small data gaps between subsets, (4) validating coding, (5) updating coding as new information is provided, and (6) projecting data to a common west coast projection. During these procedures, the goal was to remain as consistent as possible with the intent of the source data, while also creating comprehensive data coverage for the area of interest. In addition, wherever possible and practical, automated procedures were used, rather than more time-consuming manual editing procedures.

2.1.1 Physical habitat

2.1.1.1 Benthic Habitat Types

GIS data delineating the bottom-types and physiographic features associated with groundfish habitats were developed by experts in marine geology. Benthic habitat data for Washington and Oregon were developed by the Active Tectonics and Seafloor Mapping Lab, College of Oceanic and Atmospheric Sciences at Oregon State University. Benthic habitat data for California were developed by the Center for Habitat Studies at Moss Landing Marine Laboratories. All lithologic and physiographic features were classified according to a deep-water benthic habitat classification system developed by Greene et. al. (1999). Detailed documentation about the classification system and mapping methods are attached as Appendix X (to be developed).

In general, the benthic habitat is classified according to its physical features in several levels of a hierarchical system. The levels, in order, are: megahabitat, seafloor induration, meso/macrohabitat, and modifier(s). For the west coast, the following types have been delineated:

Level 1: Megahabitat:

- Continental Rise/Apron
- Basin Floor
- Continental Slope
- Ridge
- Continental Shelf

Level 2: Seafloor Induration:

- Hard substrate
- Soft substrate

Level 3: Meso/macrohabitat:

- canyon wall
- canyon floor
- exposure, bedrock
- gully
- gully floor
- ice-formed feature
- landslide

Level 4: Modifier:

bimodal pavement
outwash
unconsolidated sediment

Each unique combination of these four characteristics defines a unique benthic habitat type. For the west coast EFH project, 35 unique benthic habitat types have been delineated (Table 1).

Table 1 Unique benthic habitat types have been delineated in the GIS

Habitat Code	Habitat Type	Mega Habitat	Habitat Induration	Meso/Macro Habitat	Modifier
Ahc	Rocky Apron Canyon Wall	Continental Rise	hard	canyon wall	
Ahe	Rocky Apron	Continental Rise	hard	exposure	
As_u	Sedimentary Apron	Continental Rise	soft		unconsolidated
Asc/f	Sedimentary Apron Canyon Floor	Continental Rise	soft	canyon floor	
Asc_u	Sedimentary Apron Canyon Wall	Continental Rise	soft	canyon	unconsolidated
Asg	Sedimentary Apron Gully	Continental Rise	soft	gully	
Asl	Sedimentary Apron Landslide	Continental Rise	soft	landslide	
Bhe	Rocky Basin	Basin	hard	exposure	
Bs_u	Sedimentary Basin	Basin	soft		unconsolidated
Bsc/f_u	Sedimentary Basin Canyon Floor	Basin	soft	canyon floor	unconsolidated
Bsc_u	Sedimentary Basin Canyon Wall	Basin	soft	canyon wall	unconsolidated
Bsg	Sedimentary Basin Gully	Basin	soft	gully	
Bsg/f_u	Sedimentary Basin Gully Floor	Basin	soft	gully floor	unconsolidated
Fhc	Rocky Slope Canyon Wall	Slope	hard	canyon wall	
Fhc/f	Rocky Slope Canyon Floor	Slope	hard	canyon floor	
Fhe	Rocky Slope	Slope	hard	exposure	
Fhg	Rocky Slope Gully	Slope	hard	gully	
Fhl	Rocky Slope Landslide	Slope	hard	landslide	
Fs_u	Sedimentary Slope	Slope	soft		unconsolidated
Fsc/f_u	Sedimentary Slope Canyon Floor	Slope	soft	canyon floor	unconsolidated
Fsc_u	Sedimentary Slope Canyon Wall	Slope	soft	canyon wall	unconsolidated
Fsg	Sedimentary Slope Gully	Slope	soft	gully	
Fsg/f	Sedimentary Slope Gully Floor	Slope	soft	gully floor	
Fsl	Sedimentary Slope Landslide	Slope	soft	landslide	

Habitat Code	Habitat Type	Mega Habitat	Habitat Induration	Meso/Macro Habitat	Modifier
Rhe	Rocky Ridge	Ridge	hard	exposure	
Rs_u	Sedimentary Ridge	Ridge	soft		unconsolidated
Shc	Rocky Shelf Canyon Wall	Shelf	hard	canyon wall	
She	Rocky Shelf	Shelf	hard	exposure	
Shi_b/p	Rocky Glacial Shelf Deposit	Shelf	hard	ice-formed feature	bimodal pavement
Ss_u	Sedimentary Shelf	Shelf	soft		unconsolidated
Ssc/f_u	Sedimentary Shelf Canyon Floor	Shelf	soft	canyon floor	unconsolidated
Ssc_u	Sedimentary Shelf Canyon Wall	Shelf	soft	canyon wall	unconsolidated
Ssg	Sedimentary Shelf Gully	Shelf	soft	gully	
Ssg/f	Sedimentary Shelf Gully Floor	Shelf	soft	gully floor	
Ssi_o	Sedimentary Glacial Shelf Deposit	Shelf	soft	ice-formed feature	outwash

In addition, for Oregon, the marine geologists delineated areas on the continental slope that were "predicted rock." These predicted rock areas were determined using multibeam bathymetry data having slopes greater than 10 degrees. Areas meeting this criteria "have been found from submersible dives, camera tows, and sidescan sonar data to nearly always contain a high percentage of harder substrates." (Goldfinger et. al., 2002). Predicted rock areas are included with the other rocky habitats in the classification, but retain an additional identifier indicating that it was predicted.

2.1.1.2 Bathymetry

Water depth is another key, physical characteristic which is used to delineate west coast groundfish habitat. Bathymetry data was compiled from various, disparate sources. All sources were individually contoured to 10-meter depth intervals, and compiled to create a GIS coverage delineating polygons of 10-meter depth ranges. The geographic extent of the final bathymetry data was set to the same extent as the benthic habitat data. In addition, the shoreline delineated by the benthic habitat data was used as the shoreline (i.e., 0-meter depth contour) for the bathymetry data, as well.

For California, Moss Landing Marine Lab provided 10-meter depth contours. These contours were derived from a publicly-available 200-meter bathymetry grid from the California Department of Fish and Game, Marine Region GIS Unit. For Oregon, up to 46° latitude, Oregon State University provided 10-meter depth contours. These contours were generated from a 100-meter bathymetry grid developed by combining and resampling multiple in-house data sets. Data sources and processing procedures for these contours are described in Appendix X (to be developed) (Goldfinger et. al. 2002). Bathymetry data for the remaining areas, (Washington and the southern-most portion of the EEZ), were developed from free, publicly-available sources.

For most of Washington, a 20-meter bathymetry grid was acquired from Washington Department of Fish and Wildlife and contoured to 10-meter depths. The remaining data gaps were filled with 10-meter contours developed from the gridded Naval Oceanographic Digital Bathymetric Data Base – Variable Resolution (DBDB-V). A small data gap between Oregon and Washington, approximately 100-200 meters across, was filled by extending the ends of the contour lines to meet the shared boundary.

Because of the disparate nature of the bathymetry sources, the depth zones are discontinuous at the boundaries between data sources. No manual adjustment have been made to the compiled bathymetry data to remove these discontinuities. Due to software processing constraints and the extremely large size of the contour data files for California, these contours were algorithmically smoothed to remove extra vertexes within a maximum distance of 150 meters. By visually assessment, this generalization process had minimal impact on the contour locations.

2.1.1.3 Latitude

Along the west coast, another primary determiner of groundfish habitat is latitude. Boxes delineating 1’ latitudinal zones have been created and are overlayed with bathymetry and benthic habitat data to create a set of unique physical habitat polygons.

2.1.1.4 Data Quality

The benthic habitat maps have been interpreted and compiled from various types of source data, including existing geologic maps, sediment samples, sidescan sonar imagery, seismic reflection data, and multibeam bathymetry. As with any type of mapping, there is some uncertainty involved in mapping benthic habitats. Each data source has its own strengths and weaknesses, as well as a specific spatial resolution. In general, when more than one source of information was available, or the data source was highly detailed, the interpretation will be of higher quality and accuracy.

A ‘data quality’ GIS layer indicates the degree of certainty that the mapped seafloor type represents the ‘real’ seafloor type. For Washington and Oregon benthic habitat maps, the Active Tectonics and Seafloor Mapping Lab at OSU has provided a data quality layer. The data quality layer was created by creating four separate 100-meter grids for each type of data (bathymetry, sidescan sonar, substrate samples, seismic reflection) and ranking the data sources on a scale of 1 to 10. The overall data quality layer is created by summing each of these individual data source quality layers. No data quality layer is currently available for benthic habitat in California.

2.1.2 Biogenic habitat

Biological organisms also play a critical role in determining groundfish habitat use and preference. For example, kelp beds have been shown to be important to many groundfish species, including several rockfish species. GIS data for the floating kelp species, *Macrocystis* spp. and *Nereocystis* sp., are available from state agencies in Washington, Oregon, and California. These data will be compiled into a comprehensive data layer delineating kelp beds along the west coast. Kelp data compilation will be completed after June 30th, once final kelp data are available from Washington State.

A Primer on Geographic Information Systems

At its simplest level, a GIS is a sophisticated computer system capable of holding and displaying databases describing places and activities on the earth's surface to "paint a picture" of complex scenarios. Given that the majority of information pertaining to the marine environment has a spatial component, GIS and related geoprocessing technologies such as the global positioning system (GPS) and remote sensing provide a means to aggregate and analyze the data generated by disparate sources. GIS technology is rapidly replacing the traditional cartographic techniques that have typified most coastal mapping and resource inventory projects, and application to coastal and marine research and management efforts occurs worldwide.

A GIS is not simply a computer system for making maps, although it can create maps at different scales, different sizes, and with different colors and symbols. A GIS does not store a map in any conventional sense, nor does it store a particular image or view of a geographic area. Instead, a GIS stores the data from which the user can draw a desired view to suit a particular purpose. A GIS is also an analytical tool that allows the user to pose very complex questions to the computer, and receive answers in easy-to-interpret map form. The GIS database is a collection of spatial and tabular data depicting the location, extent, and characteristics of geographic features.

A GIS allows users to answer questions that deal with issues of location, condition, trends, patterns, and strategic decision-making, such as Where is it?; What patterns exist?; What has changed since...?;; What if...? It comprises layers of information occupying the same space so that users can rapidly analyze multiple conditions over wide areas. What a GIS cannot do, however, is generate scales of information that do not already exist in the input data. The scale of information that a GIS can analyze and display is fundamentally limited by the scale of the data that are used to create it.

2.2 Fish

2.2.1 NMFS Trawl Survey Data

Data from the National Marine Fisheries Service's west coast trawl surveys have been compiled and converted to GIS format. The surveys were conducted by the Alaska Fisheries Science Center and the Northwest Fisheries Science Center. These surveys census the groundfish occurring within the trawlable areas of continental shelf and slope out to approximately 1300 meters depth. Haul locations are stored both as points indicating the vessel's start position and trawl mid-point, as well as straight lines connecting the vessel's start and end point. The tabular data associated with each haul, such as species code and species weight are stored in related database tables. The information in these related tables can be queried geographically, or tabular queries can be performed and then the results displayed geographically.

These trawl survey data can be used in geographic overlays with other information, such as fishing effort or habitat, to validate model outputs or assess the relationship between various layers.

2.2.2 NOAA Atlas

In the late 1980's, NOAA compiled information about several commercially-valuable groundfish species on the west coast. This information was synthesized into a hand-drawn map atlas format showing the species distribution for various life stages (NOAA, 1990). The source data for these maps included NMFS' RACEBASE, commercial and recreational catch statistics, state or regional agency data, and expert review. The scale of these maps were generally 1:10,000,000. In the 1990's these atlas maps were converted to GIS format. This conversion included clipping the species polygons with a 1:2,000,000 land polygon. The following 13 groundfish species and lifestages are available in GIS format:

Table 2 Groundfish distributions mapped in the NOAA Atlas (1990)

		Life History Stage							
COMMON NAME	**SPECIES NAME**	**adult**	**juvenile**	**mating**	**old juvenile**	**young juvenile**	**spawning**	**release of young**	**range**
arrowtooth flounder	Atheresthes stomias	x	x						
Dover sole	Microstomus pacificus	x	x				x		
English sole	Parophrys vetulus (=Pleuronectes vetulus)	x			x	x	x		
flathead sole	Hippoglossoides elassodon	x	x				x		
lingcod	Ophiodon elongatus	x	x				x		x

		Life History Stage							
COMMON NAME	SPECIES NAME	adult	juvenile	mating	old juvenile	young juvenile	spawning	release of young	range
Pacific cod	Gadus macrocephalus	x			x	x	x		
Pacific hake (prev. Pacific whiting)	Merluccius productus	x				x	x		
Pacific ocean perch	Sebastes alutus	x		x	x			x	
petrale sole	Eopsetta jordani	x			x	x	x		
sablefish	Anoplopoma fimbria	x	x				x		
spiny dogfish	Squalus acanthias	x		x	x	x			
starry flounder	Platichthys stellatus	x			x	x	x		
widow rockfish	Sebastes entomelas	x	x	x				x	

2.2.3 Fish/habitat functional relationships

Using habitat distribution information to identify EFH requires some knowledge of the functional relationships between the species of interest (in this case the Pacific Coast Groundfish FMU) and the habitats they use. This section describes the information available on these relationships.

2.2.3.1 The Updated Life Histories Descriptions Appendix

In 1998 a document was appended to Amendment 11 to the Pacific Coast Groundfish FMP that describes the life histories and EFH designations for each of the 83 individual species that the FMP manages. The appendix was prepared by a team led by Cyreis Schmitt[1] (at the time, affiliated with the Northwest Fisheries Science Center). The primary sources of information for the life history descriptions and habitat associations were published reports and gray literature. GIS maps of species and life stage distributions generated in the format of ArcView were included.

The appendix was intended to be a "living" document that could be changed as new information on particular fish species became available, without using the cumbersome FMP amendment process. The EFH regulations state that the Councils and NMFS should periodically review and revise the EFH components of FMPs at least once every 5 years. In response to this requirement for periodic review, the life history descriptions were recently updated. The draft of the updated appendix was prepared by Bruce McCain with assistance from Stacey Miller and Robin Gintner

[1] The EFH Core Team for West Coast Groundfish: Ed Casillas, Lee Crockett, Yvonne deReynier, Jim Glock, Mark Helvey, Ben Meyer, Cyreis Schmitt, and Mary Yoklavich, and staff: Allison Bailey, Ben Chao, Brad Johnson, and Tami Pepperell

of the NMFS, Northwest Fisheries Science Center. The draft was compiled by conducting literature searches using the *Cambridge Scientific Abstracts Internet Database Service*, and by reviewing recently completed summary documents, for example the California Department of Fish and Game's Nearshore Fishery Management, a draft nearshore fishes synopsis in a section of the Oregon Department of Fish and Wildlife's Nearshore Fisheries Management Plan, and the book *The rockfishes of the Northeast Pacific* by Love et al. published in 2002. Within the updated Appendix, the current 82 FMP groundfish species are sequenced alphabetically according to the common names (Appendix 1). This document also includes nine summary tables and a list of references cited.

The Appendix is therefore an extensive and detailed reference on species/life stage and habitat interactions. However, detailed bathymetry information for all species' life stages is incomplete at present. Furthermore, the information on substrate is somewhat patchy, and the classification of substrates and habitats is inconsistent across species. Some of these problems are unavoidable. For example, although most groundfish species are demersal, some life stages (for example, eggs and larvae) are sometimes pelagic. It is therefore difficult in some instances to associate these life stages with a particular habitat.

The updated Appendix has been presented to the PFMC in draft form so that NMFS can consider appropriate comments prior to its inclusion in the EIS. Specifically, comments are being sought on the types of habitat preferred by various life history stages of the FMP species, and on species-habitat relationships not adequately addressed in this draft.

2.2.3.2 The habitat use database

The Life Histories Appendix provides a valuable compilation of information on the habitat preferences of all the species and life stages in the Pacific Coast Groundfish FMP to the extent known. However, the text format in which the information is presented does not lend itself well to analysis of habitat usage across many habitat types or many species and life stages.

The Pacific Coast Grondfish Habitat Use Relational Database was therefore developed to provide a flexible, logical structure within which information on the uses of habitats by species and life stages could be stored, summarized and analyzed as necessary. The database is designed primarily to capture the important pieces of information on habitat use by species in the Pacific Groundfish FMP as contained in the Updated Life History Descriptions Appendix compiled by NMFS (see Section 2.2.2.1). This Appendix contains information on each of the species in the groundfish FMP that includes range, fishery, habitat, migrations and movements, reproduction, growth and development and trophic interactions. Certain elements of this information need to be captured in a database format so that habitat use data can be analyzed both by species and habitat to provide input into various components of the analysis of EFH, HAPCs and fishing impacts.

The manual of the Habitat Use Database will be included as an appendix.

2.2.3.3 Habitat suitability modeling

Habitat suitability modeling (HSM) is a tool for predicting the quality, or suitability of habitat for a given species based on known affinities with habitat characteristics, such as depth and substrate type. This information is combined with maps of those same habitat characteristics to produce maps of expected distributions of species and life stages. One such technique is termed habitat suitability index (HSI) modeling. A suitability index provides a probability that the habitat is suitable for the species, and hence a probability that the species will occur where that habitat occurs. If the value of the index is high in a particular location, then the chances that the species occurs there are higher than if the value of the index is low. HSI models use regression techniques to analyze data on several environmental parameters and calculate an index of species occurrence. Since this methodology has potential for use in designating EFH and HAPC, we review it briefly here. It is described in more detail in various scientific publications (see for example Christensen et al. 1997, Clark et al. 1999, Coyne and Christensen 1997, Rubec et al. 1998, Rubec et al. 1999, Monaco and Christensen 1997 and Brown et al 2000).

Suitability index (SI) values are generated for important habitat characteristics. For example, one can calculate the likelihood of a species being present given a certain depth, latitude, and substrate type. In situations where trawl or other survey data are available, these can be used to generate SI values based on trends in species abundance with the habitat characteristic under consideration. For example, Figure 2 shows the change in the abundance of juvenile bocaccio with depth. The curved line is a mathematical model used to represent the data points shown on the graph. Table 3 shows how the data are used to calculate the HSI values.

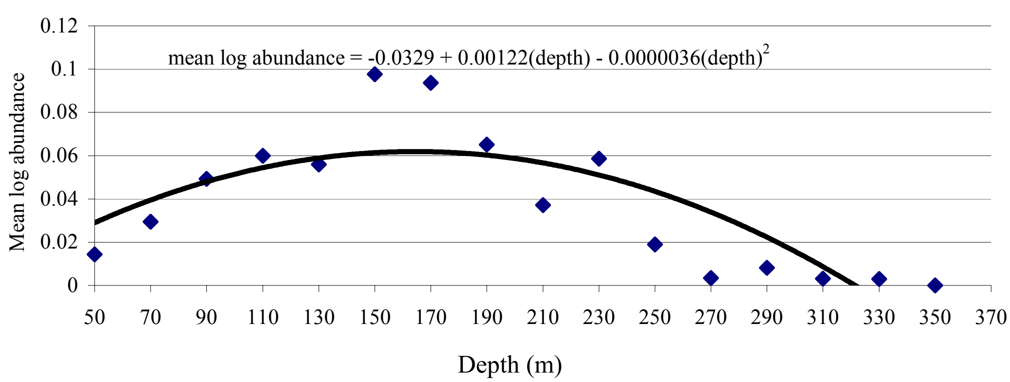

Figure 2 Polynomial regression curve fit with mean log abundance by categorical bathymetric class for juvenile bocaccio (graph provided by NOS).

Table 3 Example data matrix for calculating bathymetry SI values for juvenile bocaccio taken in NMFS trawl samples (Rubec et al., 1999).

Depth Class (m)	Effort (# of samples)	Mean log abundance	Predicted mean log abundance (x)	HSI (x/xmax)*10
50-69	219	.014	.019	3
70-89	361	.029	.035	5
90-109	447	.049	.048	7
110-129	489	.060	.058	8
130-149	398	.056	.065	9
150-169	252	.100	.069	10
170-189	200	.094	.070	10
190-209	213	.065	.069	10
210-229	182	.037	.064	9
230-249	98	.059	.057	8
250-269	92	.019	.047	7
270-289	89	.003	.034	5
290-309	74	.008	.018	3
310-329	98	.003	0	0
330-349	52	0	0	0

In data-poor situations, a literature review of the available information is carried out instead. Each reference provides a score indicating whether a species is present or absent within a given range for an environmental parameter. Presence/absence scores (1=present, 0=absent) are then summed for each range, and scaled by dividing by the maximum score. The resulting SI values range from 0 to 1, with 1 indicating highest suitability. For example, if authors of 5 out of 10 research studies said a certain fish was found between 50 and 100 meters, the SI score would be 0.5

Table 4 illustrates how SI scores are derived for each environmental parameter in the model, using depth as an example.

Table 4 Species occurrence table for presence of a species at different depths

	Depth category (m)				
Author	0-50	51-100	101-300	301-600	801-1000
Literature Reference 1	0	1	1	1	0
Literature Reference 2	0	1	1	0	0
Literature Reference 3	1	1	0	0	0
Literature Reference 4	1	1	0	0	0
Literature Reference 5	1	1	0	0	0
Literature Reference 6	0	1	1	0	0
Literature Reference 7	1	1	1	1	0
Total	4	7	4	2	0
SI Value	0.57	1.00	0.57	0.29	0.00

Species occurrence tables (also called matrices) are developed for each of the habitat characteristics in the model. Once SI values have been calculated for several habitat characteristics, by one or other of the methods described above, the values that relate to the conditions in each GIS map grid reference (i.e. based on maps of each of the habitat characteristics), are averaged and these averages are values are mapped. The resulting maps show the expected distribution of each species and life stage included in the analysis (Figure 3).

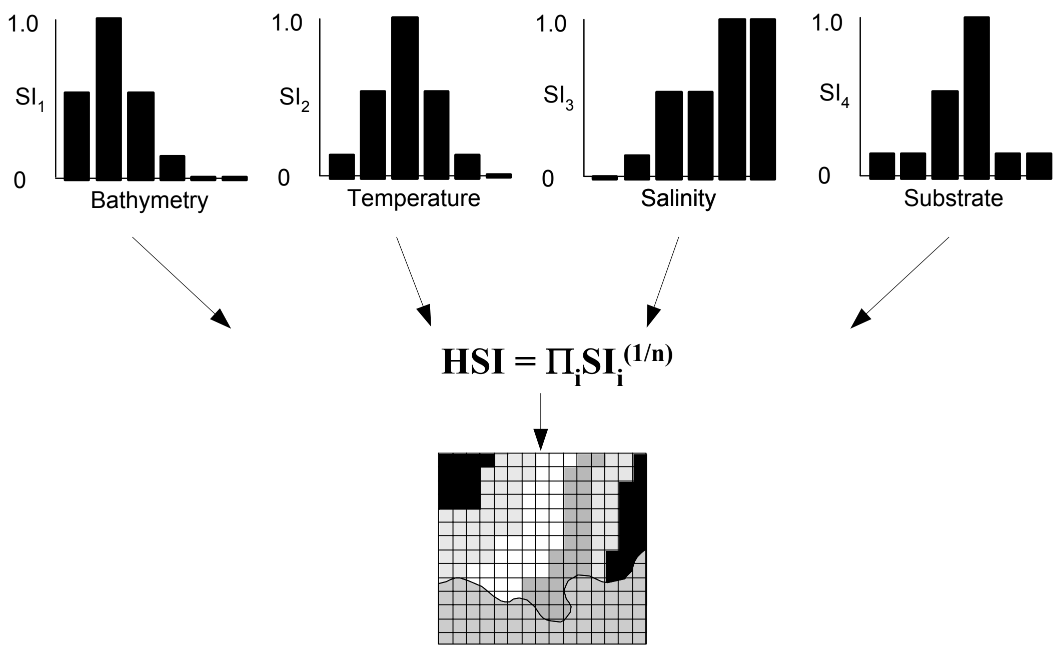

Figure 3 Mapping habitat suitability using SI scores

An important component of the HSI analysis is validation of the SI scores. For example, SI scores can be generated for an area that has survey or trawl data and then the predicted distribution of the species can be compared to the fish actually present, based on trawl and/or commercial fishery data. Alternatively, independent data from another source (e.g. recreational fisheries) can be used. For the model results to be considered valid, there should be a positive relationship between the independent abundance estimate and the SI score.

Initial testing of the HSI model for Pacific Coast Groundfish by independent trawl survey data and recreational catch data, indicates satisfactory model performance[2].

Currently, SI scores have been developed for 18 adult groundfish species from assessments of three central California marine sanctuaries. Depth and bottom substrate type were used as the habitat characteristics to examine habitat quality for benthic species. Mean sea surface temperature and depth were used to model pelagic species distribution. The substrate type consisted of two categories- hard and soft, although there are plans to further classify these to include, sand, mud, cobble, gravel, rock and boulders.

Additional work currently underway:

- using the HSI values to map species distribution across the entire west coast
- validation of the results

A report on the NOS HSI work will be provided as an appendix

2.3 Fisheries

2.3.1 Fishing gears

Summary of Fran's report

The Pacific States Marine Fisheries Commission has prepared a document that describes the fishing gears used on the west coast of the United States (excluding Alaska) and what components of those gears might affect structural habitat features. This gear description is one part of a 'fishing gear impact analysis' that requires an understanding of the gears used, how gear

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[2] Spatial extrapolation of SI scores ideally requires that the following conditions are met:

- independence between the factors that are used to construct the SI scores; and
- sufficient variability in the studies so as to reflect conditions prevailing across the entire fisheries management area.

In addition, if the literature review approach is used, the literature studies should be carefully screened to ensure that differences in results between studies are genuinely related to habitat suitability, and are not confounded by differing methodologies, historical changes in habitat suitability (e.g. through pollution), changes in population size or density (e.g. through fishing pressure), or geographical location. Also, the references should contain no repetitions, for example through literature reviews or other citations of previous research findings

It seems unlikely that all these conditions have been fully met in the HSI approach. However, some model validation has been conducted, with favorable results.

affects habitat, the amount and distribution of fishing effort, and the sensitivity and resiliency of various habitat types.

The fishing gears report describes the types of fishing gear used on the west coast in potential groundfish essential fish habitat and the parts of the gear that might impact structural habitat features.   It includes gear used by fishermen targeting groundfish as well as gear used to target other species.

Many different types of fishing gear are used to capture groundfish in commercial, tribal, and recreational fisheries. Groundfish are caught with trawl nets, gillnets, longline, troll, jig, rod and reel, vertical hook and line, pots (also called traps) and other gear (e.g. spears, throw nets). The groundfish commercial fishery is made up of “limited entry” and “open access” fisheries, with most of the commercial groundfish catch being taken under the limited entry program. There is also a tribal groundfish fishery and a recreational groundfish fishery. Table 5 summarizes the gear used by each of these sectors

Most fishing gear used to target non-groundfish species (such as salmon, shrimp, prawns, scallops, crabs, sea urchins, sea cucumbers, California and Pacific Halibut, herring, market squid, tunas, and other coastal pelagic and highly migratory species) is similar to those used to target groundfish. These gears include trawls, trolls, traps or pots, longlines, hook and line, jig, set net, trammel nets. Other gear that may be used includes seine nets, brush weirs, and mechanical collecting methods used to harvest kelp and sea urchins. These gear is described in section D, below.

Gear types in the PACFIN database are listed in Appendix 2

Table 5 Gear Types Used in the West Coast Groundfish Fisheries [6]

May need to update this with Fran's recent spreadsheets

	Trawl and Other Net	Longline, Pot, Hook and Line	Other
Limited Entry Fishery (commercial)	Bottom Trawl Mid-water trawl Whiting trawl Scottish Seine	Pot Longline	
Open Access Fishery Directed Fishery (commercial)	Set Gillnet Sculpin Trawl	Pot Longline Vertical hook/line Rod/Reel Troll/dinglebar Jig Drifted (fly gear) Stick	
Open Access Fishery Incidental Fishery (commercial)	Exempted trawl (pink shrimp, spot and ridgeback prawn, CA halibut, sea cucumber) setnet driftnet purse seine (round haul net)	Pot (Dungeness crab, CA sheephead, spot prawn) longline rod/reel troll	dive (spear) dive (with hook and line) poke pole
Tribal	as above	as above	as above
Recreational	dip net, throw net (within 3 miles)	Hook and Line methods Pots (within 3 miles) (from shore, private boat, commercial passenger vessel)	dive (spear)

A list of gear types used on the west coast is found in the "Notice of the Continuing Effect of the List of Fisheries" published in the Federal Register Vol 67, No. 12, Thursday January 17, 2002; http://www.nmfs.noaa.gov/prot_res/PR2/ Fisheries_Interactions/list_of_fisheries.html (could not access this URL). This list of commercial fisheries includes salmon net pen aquaculture and Washington and California kelp harvest. These activities are not included in this fishery gear description, but are described under the non-fishing effects section of the EFH environmental impact statement. The list does not include ghost shrimp pumping nor the poke pole fishery which are briefly described in the Commission's fishing gears document.

[6] Adapted from Goen and Hastie, 2002

2.3.2 West Coast Perspective on Fishing Gear Impacts

At its meeting on February 19-20, 2003, the Technical Review Committee reviewed the proposed risk assessment framework and recommended that Pacific States Marine Fisheries Commission contract for development of an index of fishing gear impacts by gear type that will serve as an input into the overall risk assessment. The Committee suggested that, while several literature review and indices exist that may be utilized for this project, there is no clear direction on how that information should be applied to the west coast. As justification for the recommendation, the committee cited the general lack of west coast specific studies and the need to determine specifically how to make inferences from studies that occurred in other parts of the world.

A project is currently underway that is utilizing currently available information to develop a draft index of adverse effects for fishing gears that are utilized on the west coast. For purposes of the analysis, adverse effects of fishing gear are defined consistent with NMFS EFH Final Rule and include "direct or indirect physical, chemical, or biological alterations of the waters or substrate and loss of, or injury to, benthic organisms, prey species and their habitat, and other ecosystem components, if such modifications reduce the quality and/or quantity of EFH" (50 CFR part 600.810). A written report that details and justifies interpretive decisions will accompany the draft index. The index is being developed alongside the risk assessment model and other information that is being applied to the EIS.

In due course, a draft report and effects index will be presented to the Council's committees in order to solicit recommendations. Based on the nature and extent of recommendations gained in committee, improved drafts may be prepared prior to briefing the full Council.

2.3.3 Fishing effort

In order to explore the effects of fishing on specific areas of fish habitat, we need an understanding of the extent and frequency, by gear and geographic location of fishing activity across the area covered by the FMP.

A summary of data sources for fishing effort is shown in Table 6 :

Table 6 Summary of sources of fishing effort data

(to be completed)

Data source	Scale/Units	Comments

Data source	Scale/Units	Comments

2.3.3.1 Commercial fishery

West coast commercial trawling effort has been recorded in logbooks and provided to state fisheries managers since 1987. These logbook entries include the starting point of the trawl, either by latitude/longitude or by logbook block number, the tow duration, the gear used, and the estimated weight of the catch for several species or species groups. The Pacific States Marine Fish Commission (PSMFC) created and maintains a comprehensive database (PACFIN) for commercial fishing data which includes west coast trawl logbook data. Commonly, the commercial trawling data are summarized geographically by the logbook blocks (usually 10-minute blocks).

As part of a larger project[3], Ecotrust, using data provided by PSMFC, has generated GIS data of annual summaries of west coast logbook data for 1987 to 2000. Annual trawl logbook effort is summarized by number of tows or total duration in hours by logbook block. In addition, annual summaries by the following PACFIN gear types are provided: groundfish trawl, midwater trawl, roller trawl, other trawl, pair trawl, flatfish trawl.

Effort data for the non-trawl commercial fishery (hook and line, longline, pot/trap) are also available per vessel (fake id), recorded by port-based fish tickets. Data available from PacFIN includes year and port where catch was landed, type of gear used, vessel length, species landed, prices and revenues, and International North Pacific Fisheries Commission (INPFC) area. Eight of these regions exist, each covering areas of thousands of miles.

Ecotrust has developed a predictive model to further resolve this information to levels consistent with the commercial trawl data (Ecotrust, 2003). Using this predictive model, catch in pounds and revenue in dollars are assigned to a specific 9 km block. The catch and revenue by 9 km block are also summarized by the following gear groups: hook and line, longline, pot and trap, trawl, and other gear. GIS data resulting from this model were provided for two years, 2000 and 1997.

2.3.3.2 Recreational fishery

The recreational fishery sector comprises the commercial passenger fishing vessel (CPFV) fleet (charters), private fishing vessels and other miscellaneous fishing activities. The Marine Recreational Fishery Statistics Surveys (MRFSS) is perhaps the most comprehensive, collecting information on all elements of the recreational fishery. This is a nationwide survey conducted since 1979, with the exception of 1990-2. Information is elicited through telephone surveys and

[3] Groundfish Fleet Restructuring Information and Analysis (GFR) Project (see www.ecotrust.org/gfr).

port interviews, and is collected on mode of fishing (e.g. charter, pier), catch information, distance from shore, and catch reference area. The questionnaire also makes provision for information on gear type use (see http://www.psmfc.org/recfin/). As expected, with a questionnaire of this nature, spatial resolution of the catch reference area is relatively poor. The California Department of Fish and Game collects species information on CPFV fishing and is apparently available at a 10nm by 10nm resolution from 1936 through 1997.

3 MODELING THE STATUS OF FISH HABITAT

3.1 Introduction

The EFH Final Rule provides regulations and guidance on the implementation of the EFH provisions of the M-S Act. It includes information on the types of information that can be used for describing and identifying EFH, designating HAPCs and mitigating fishing impacts on EFH. The guidelines advocate using information in a risk-averse fashion to ensure adequate protection of habitat for all species in the management units.

In this study, we develop a modeling approach for assessing the status of fish habitat and the risks to habitat function posed by fishing activities in the area covered by the Pacific Coast Groundfish FMP. The model is required to provide a scientific method for assessing Pacific coast groundfish habitat and developing management alternatives for designation EFH, HAPCs, and management scenarios that are designed to mitigate specific risks to habitat and ecosystem function.

Bayesian Belief Networks were chosen as a suitable analytical tool (see Sections 3.2 and 3.3) . The models have been designed to take advantage of the GIS data and literature review under development by NOAA Fisheries. It is recognized that this assessment is occurring in a data-poor environment and therefore must be expressed in terms of probabilities rather than hard numbers. In these situations, the models have been structured to express limitations on each component of the assessment in conjunction with a best estimate in answer to fundamental questions of habitat function. Presentations of the methodology were made to the Technical Review Committee (TRC) of the Pacific Fishery Management Council. Proper adjustments to the methodology were made based on input of the TRC.

We implemented the methodology with the goal of, to the extent possible, answering the questions listed below for Pacific coast groundfish. Limitations on answering these questions were encountered, particularly in regards to the availability of data for model parameterization. Hence, further work will involve developing an initial suite of alternatives for EFH and HAPC designation and management measures in consultation with NOAA Fisheries as well as an analysis of the projected effects of alternatives on groundfish habitat.

- What areas could qualify as essential pursuant to section 303(a)(7) of the Magnuson Act?

- Given past inputs (anthropogenic and environmental), what is the probability that the condition of Pacific coast groundfish habitat has been degraded to an extent that function has been impaired?
- Given foreseeable inputs (anthropogenic and environmental) and regulatory regimes, how are trends in Pacific coast groundfish habitat expected to respond? What areas are at risk of impaired function and of particular concern?
- How might trends in habitat function be affected by altering anthropogenic inputs and regulatory regimes?
- What types of fisheries management alternatives could be applied to mitigate the effects of fishing on habitat? What are the likely impacts to habitat of specific fisheries management alternatives?
- What are the scientific limitations of assessing habitat?

The data analysis undertaken to address these questions will include spatial and temporal analysis of the distribution of habitat types, distribution of fish species, habitat use by fish, sensitivities of habitat to perturbations, and the dynamics of fishing effort.

3.2 <u>Network models</u>

3.2.1 <u>Why Network Models?</u>

Traditional statistical modeling defines and builds models for a response (outcome) in terms of sets of explanatory variables (attributes). Each explanatory variable in a model is seen as *directly* impacting on the response variable. With explanatory variables x_1, x_2, …, x_p, and response y, the situation can be represented by the following diagram:

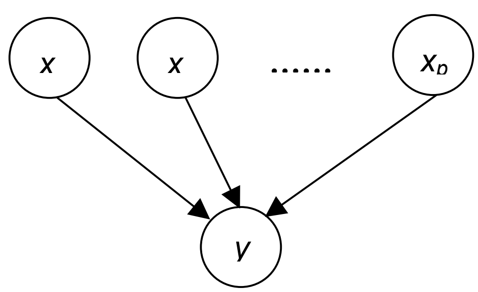

Figure 2 Explanatory variables directly impacting on a response variable

In reality, however, it can happen that the relationships between variables are not as simple as this model allows. The effect of one x-variable on the response y may be mediated through another x-variable, or through two or more x-variables. It could also happen that some of the x-variables affect some of the others. Indeed, with datasets containing many variables, it is easy to envisage quite complex patterns of association. The roles of “response” and “explanatory” become blurred, with variables taking on each role in turn. In a simple example, illustrated in Figure 3, variables *E* and *D* could be regarded as “responses”, and *A* and *B* as “explanatory”. But *C* seems to play both roles. It looks like a response with *A* and *B* acting as explanatory variables, and it is an "explanatory" variable for *E*. The variables are modeled as random variables and the links are probabilistic. A link from *A* to *C* would be interpreted as meaning that the value of *A* affects the value of *C* by means of influencing the probability distribution of *C*.

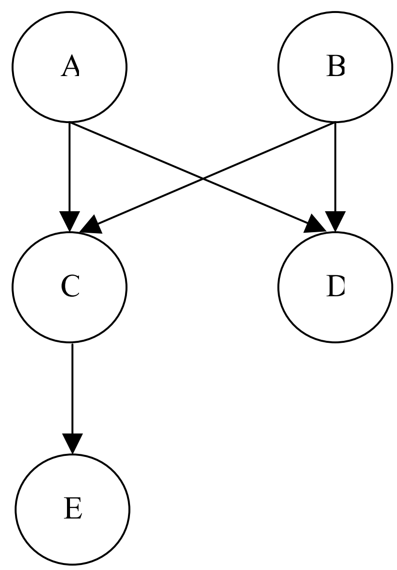

Figure 3 Indirect mediation of effects of explanatory variables

Historically, these models evolved largely in the artificial intelligence (AI) community, and form the basis of *expert systems*. Generally they are not tools for statistical inference but rather they are mechanisms for encoding probabilistic causal relationships and making predictions from them. Because of their AI background, it is not surprising that the current terminology of network models is quite different from statistical jargon, and is perhaps less familiar. Sometimes there is an exact correspondence between an AI term and a statistical one, the two terms being different names for the same concept.

3.2.2 Bayesian Networks

Early applications of BNs were in medical diagnosis and genetics, but recently there has been an explosion in their use, including for environmental impact assessment, tracing faults in computer systems and software, robotics and many other areas (see Appendix 5 for sources of information on BNs). A growing area of interest is the management of natural resources under uncertainty. For example, a BBN model was developed for assessing the impacts of land use changes on bull trout populations in the USA (Lee, 2000). Another recent application of BNs is modeling uncertainties in fish stock assessment and the impact of seal culling on fish stocks (Hammond & O'Brien, 2001). Marcot et al. (2001) have used BNs for evaluating population viability under different land management alternatives, while Wisdom et al. (2002) used BNs in conservation planning for the greater sage-grouse.

The network models that we are using consist of a number of *nodes* (random variables) connected by *directed* links. A node which has a directed link leading from it to another node is called a *parent* node; the latter is a *child* node. Cycles are not permitted: that is, it is not possible to start from any node and, following the directed links, end up back at the same node.

A model with these properties, after specifying the probabilities that govern the links, is called a *Bayesian Belief Network*, or just a Bayesian Network (BN). Most of the currently available software for building and analyzing BNs requires that the nodes are discrete, taking only a finite set of possible values, and we assume this to be the case in what follows. Continuous variables can be accommodated by grouping their values into class intervals. An introductory account of BNs is given by Jensen (1996) while a more rigorous and complete treatment is Cowell *et al* (1999).

To explain the basic ideas, consider the simple example of Figure 3. For simplicity, assume that all of the nodes are binary variables, taking values T or F (true or false). The probabilistic mechanism which governs the relationship between, say, *E* and its parent *C* is the *conditional probability distribution* of *E* given *C*. This can be expressed as a table:

	E	
C	*F*	*T*
F	p_{00}	p_{01}
T	p_{10}	p_{11}

The table of conditional probabilities for node *C*, which has parents *A* and *B* would have the following form:

		C	
A	*B*	*F*	*T*
F	*F*	p_{000}	p_{001}
F	*T*	p_{010}	p_{011}
T	*F*	p_{100}	p_{101}
T	*T*	p_{110}	p_{111}

A node with no parents (*A* or *B* in the example) would have just a *prior* probability table:

A	
F	*T*
P_0	p_1

The complete specification of a BN consists of

(a) the set of nodes,
(b) the directed causal links between the nodes,
(c) the tables of conditional probabilities for each node.

3.2.3 Estimating the Conditional Probabilities

In practice, there are several possible ways of obtaining estimates for the conditional (and prior) probabilities. If sufficient data are available then cross-tabulating each node with its parents should produce the estimates. There are alternatives to deriving the probabilities from data, however. It is possible to use *subjective* probabilities or *degrees of belief*, usually encoded from expert opinions. In many of the early applications of BNs in medical diagnosis this was generally the approach that was used. There has been some recent research into developing systematic ways of *eliciting* prior beliefs from experts and building probability distributions from them (O'Hagan, 1998).

3.2.4 Evidence and Updating

In the simple example of Figure 3, if the states of the nodes (i.e. the values of the variables) *A* and *B* were known, then it would be possible to use the rules of probability to calculate the probabilities of the various combinations of values of the other nodes in the network. This kind of reasoning in a BN can be called "prior to posterior", in the sense that the reasoning follows the directions of the causal links in the network. Suppose now that the state of node *E* were known. What could be said about the other nodes? The *updating algorithm* of Lauritzen and Spiegelhalter (1998) allows us to calculate the posterior probabilities of all other nodes in the network (and this works for *any* BN), given the known value at *E*, or indeed, given any combination of known nodes. In the jargon of expert systems, "knowing" the value of a node is called "entering evidence". This is "posterior to prior" reasoning and allows us to infer something about the states of nodes by reasoning *against* the direction of the causal links. The updating algorithm is a very powerful tool in BNs and enables us to make useful predictions and examine "what if" scenarios with ease. Various software packages are available which facilitate the construction of BNs and implement the updating algorithm. For this project, we are using the program Netica (Norsys, 1998).

3.3 Essential Fish Habitat

3.3.1 Introduction

The M-S Act defined essential fish habitat to mean "those waters and substrate necessary to fish for spawning, breeding, feeding or growth to maturity" (M-S Act § 3(10)). This defines EFH, but does not specify how to distinguish among various parts of a species' range to determine the portion of the range that is essential. The EFH Final Rule (50CFR Part 600) elaborates that the words "essential" and "necessary" mean identification of sufficient EFH to "support a population adequate to maintain a sustainable fishery and the managed species' contributions to a healthy ecosystem."

The process of distinguishing between all habitats occupied by managed species and their EFH requires one to identify some difference between one area of habitat and another. In essence, there needs to be a characterization of habitats and their use by managed species that contains sufficient contrast to enable distinctions to be drawn, based on available information. This needs to be a data driven exercise, and the methodology we are developing aims to use all available data with which to make such a determination.

In this context, we also note that if a species is overfished and habitat loss or degradation may be contributing to the species being identified as overfished, all habitats currently used by the species may be considered essential. In addition, certain historic habitats that are necessary to support rebuilding the fishery and for which restoration is technologically and economically feasible may also be considered as essential. Once the fishery is no longer considered to be overfished, the EFH identification should be reviewed and amended, if appropriate (EFH Final Rule CFR 600.815(a)(1)(iv)(C)). A list of the Gulf of Mexico species that are considered to be overfished or experiencing overfishing is provided in Section 3.2.4. Fish stocks depleted by overfishing, or by other factors, tend to not use as much of the available habitat as a virgin stock or a stock at optimum biomass would use. The picture is complex, however, because other species may have expanded their range to fill some of these ecological niches.

3.3.2 Habitat characteristics of importance for fish

Habitat characteristics comprise a variety attributes and scales, including biological, physical (geological), and chemical parameters, location, and time. It is the interaction of environmental variables which make up habitat that determine a species' biological niche. These variables include both physical variables such as depth, substrate, temperature range, salinity, dissolved oxygen, and biological variables such as the presence of competitors, predators or facilitators.

Species distributions are affected by characteristics of habitats that include obvious structure or substrate (e.g., reefs, marshes, or kelp beds) and other structures that are less distinct (e.g., turbidity zones, thermoclines, or fronts separating water masses). Fish habitat utilized by a species can change with life history stage, abundance of the species, competition from other species, environmental variability in time and space and human induced changes. Occupation and use of habitats by fish may change on a wide range of temporal scales: seasonally, inter-annually, inter-decadal (e.g. regime changes), or longer. Habitat not currently used but potentially used in the future should be considered when establishing long-term goals for EFH and species productivity. Habitat restoration will be a vital tool to recover degraded habitats and improve habitat quality and quantity, enhancing benefits to the species and society.

Fish species rely on habitat characteristics to support primary ecological functions comprising spawning, breeding, feeding and growth to maturity. Important secondary functions that may form part of one or more of these primary functions include migration and shelter. Most habitats provide only a subset of these functions. The type of habitat available, its attributes, and its functions are important to species productivity and the maintenance of healthy ecosystems.

3.3.3 Identifying EFH for the FMP

According to the M-S Act, EFH must be designated for the fishery as a whole (16 U.S.C. §1853(a)(7)). The final rule clarifies that every FMP must describe and identify EFH for each life stage of each managed species. As further clarification, NOAA General Counsel has stated that "Fishery" as used in the M-S Act in reference to EFH refers to the FMU of an FMP. The EIS must therefore develop alternatives for EFH based on individual species/life stages aggregated to a single EFH designation for Pacific Coast Groundfish. In the EIS, a single map will be used to describe and identify EFH for the fishery. However, the analysis that produces that maps will include the preparation of electronic maps of EFH for as many species and life stages as possible.

Designation of EFH for a fishery is therefore achieved through an accounting of the habitat requirements for all life stages of all species in the FMU. Prior to designating EFH for a fishery, the information about that fishery needs to be organized by individual species and life stages. If data gaps exist for certain life stages or species, the EFH Final Rule suggests that inferences regarding habitat usage be made, if possible, through appropriate means. For example, such inferences could be made on the basis of information regarding habitat usage by a similar species or another life stage (50 CFR Pt. 600.815(a)(iii)). All efforts must be made to consider each species and life stage in describing and identifying EFH for the fishery and to fill in existing data gaps using inferences prior to determining that the EFH for the fishery does not include the species or life stage in question. As explained in Section 2.1.2, the CEQ Regulations mandate a process for dealing with incomplete or unavailable information

While describing and identifying EFH is carried out at the fishery (FMP) level, the determination of whether an area should be identified as EFH depends upon habitat requirements at the level of individual species and life stages. Potentially, only one species/life stage in the FMU may be required to describe and identify an area as EFH for the FMP. Many areas of habitat, however, are likely to be designated for more than one species and life stage. The composite habitat requirements for all the species in the Pacific coast groundfish FMP, are likely to result in large areas of habitat being described and identified as EFH, due to the overlay multiple species habitat needs. The FMP for the groundfish fishery includes 83 species. Descriptions of groundfish fishery EFH for each of the 83 species and their life stages resulted in over 400 EFH identifications in the 1998 EFH Amendment. When these EFHs were taken together, the groundfish fishery EFH included all waters from the mean higher high water line, and the upriver extent of saltwater intrusion in river mouths, along the coasts of Washington, Oregon and California seaward to the boundary of the U.S. Exclusive Economic Zone.

Some see this as a weakness in the EFH designation process, because if EFH is "everything" then the designation process apparently fails to focus conservation efforts on habitats that are truly "essential." However, this conclusion fails to take into consideration that the distinction between all habitats occupied by a species and those that can be considered "essential" is made at the species and life stage level. What the designation of EFH at the FMP level does is delineate the reference area for consultation purposes. A consultation process will be triggered when an agency plans to undertake an activity that potentially impacts habitat within the area designated as EFH. The resulting consultations will consider how the proposed action potentially impacts EFH. The detailed characteristics of the habitat in the relevant location will be an important part of this analysis. In this context, it is possible to envision that an area of EFH that has been designated as such for a particularly large number of species and life stages, or is particularly rare, or stressed or vulnerable might be of particular concern. In recognition of this, the Final Rule encourages regional Fishery Management Councils to identify habitat areas of particular concern (HAPC) within areas designated as EFH (600.815(a)(8)).

3.3.4 Types and levels of information

The EFH Final Rule explains that the information necessary to describe and identify EFH should be organized at four levels of detail, level 4 being the highest and level 1 the lowest:

- Level 4 – production rates by habitat are available
- Level 3 – growth, reproduction, or survival rates within habitats are available
- Level 2 – habitat-related densities of the species are available; and
- Level 1 – distribution data are available for some or all portions of the geographic range of the species.

The table below provides additional detail on the meanings to be inferred from this list.

Layer	Possible units/information sources
Level 4: Production rates	Overall production rates can be calculated from growth, reproduction and survival rates. However, using this information to describe and identify EFH requires not only that production rates have been calculated, but also that they have been calculated for different patches of habitat that can then be distinguished from each other. According to the EFH Final Rule, at this level, data are available that directly relate the production rates of a species or life stage to habitat type, quantity, quality, and location. Essential habitats are those necessary to maintain fish production consistent with a sustainable fishery and the managed species' contribution to a healthy ecosystem.

Layer	Possible units/information sources
Level 3: Growth, reproduction or survival rates	Similar to information on overall production rates, it can be used to describe and identify EFH. Growth, reproduction and survival rates would need to have been calculated for different patches of habitat that can then be distinguished from each other. According to the EFH Final Rule, at this level, data are available on habitat-related growth, reproduction, and/or survival by life stage. The habitats contributing the most to productivity should be those that support the highest growth, reproduction, and survival of the species (or life stage).
Level 2: Density	Relative density information may be available from surveys, or it could perhaps be inferred from catch per unit effort data, although only for those areas that have been fished. According to the EFH Final Rule, at this level, quantitative data (i.e., density or relative abundance) are available for the habitats occupied by a species or life stage. Because the efficiency of sampling methods is often affected by habitat characteristics, strict quality assurance criteria should be used to ensure that density estimates are comparable among methods and habitats. Density data should reflect habitat utilization, and the degree that a habitat is utilized is assumed to be indicative of habitat value. When assessing habitat value on the basis of fish densities in this manner, temporal changes in habitat availability and utilization should be considered.
Level 1: Distribution	Distribution information is available from surveys, catch/effort data, and evidence in the biological literature, including ecological inferences (e.g. - a habitat suitability index, HSI). According to the EFH Final Rule, distribution data may be derived from systematic presence/absence sampling and/or may include information on species and life stages collected opportunistically. In the event that distribution data are available only for portions of the geographic area occupied by a particular life stage of a species, habitat use can be inferred on the basis of distributions among habitats where the species has been found and on information about its habitat requirements and behavior. Habitat use may also be inferred, if appropriate, based on information on a similar species or another life stage.

In developing a model for identifying EFH we wish to express the probability that a particular location contains suitable habitat for a given species life stage, based on our knowledge of the environmental conditions within that habitat and of the species/life stage's biological niche. As recognized in the EFH Final Rule, the only true measure of habitat suitability is obtained through measurement of demographic parameters (production, mortality, growth, and reproductive rates – levels 4 and 3 described above). For example, EFH could be defined as areas with above-average survival, growth or recruitment (which for ease of exposition we will refer to as areas of high growth potential). However, data on these parameters are notoriously difficult to obtain. Fish population density, or even presence/absence in data-poor situations (levels 2 and 1 described above) are often used as a proxy for growth potential. However, growth potential and density are not necessarily well correlated. For example, in source-sink systems source populations may have lower densities than sink populations (because they are exporting propagules), even though they are the basis for the overall population's growth potential (Lundberg & Jonzen 1999a, b).

In a spatially heterogeneous system, in which source-sink dynamics are likely to be occurring, EFH should be protecting source areas, and not inadvertently protecting sink areas. There is a risk that this can occur if population density is used as a proxy for growth potential. The risk is further exacerbated under harvesting pressure, if source populations are being more heavily fished than sink areas (Tuck & Possingham 1994). Similarly, in a heavily perturbed system, in which external factors such as pollution may be distorting the natural spatial patterns of growth potential, current population density may be a poor proxy for EFH under protected conditions. The question then is whether EFH or HAPC designation should be acting to protect areas that would have high growth potential if protected, or whether we should be protecting areas that currently have higher growth potential regardless of their intrinsic value as EFH. By using data on presence/absence or population density that are collected in a perturbed system under current conditions, we are attempting to do the latter, but without a clear understanding of the relationship between density and growth potential.

In accordance with this theoretical discussion, the EFH Final Rule requires using the highest level of information (production rates) first if it is available, followed by the second highest level (growth, reproduction or survival rates) and so on. The guidelines also call for applying this information in a risk-averse fashion to ensure adequate areas are protected as EFH. The most complete information available should be used to determine EFH for each species and life stage. If higher level information is available only for a portion of the species/life stage range then a decision needs to be made regarding how the information should be used – for example can the knowledge from the portion of the range covered be extrapolated to the rest of the range? In accordance with the requirement to use the highest level of detail available, the highest-level information should be used for the portion of the species/life stage range for which it is available, or to which the information could be validly extrapolated. Information at lower levels should be used only where higher-level information is unavailable and cannot be validly extrapolated.

If only Level 1 information is available, distribution data should be evaluated (e.g., using a frequency of occurrence or other appropriate analysis) to identify EFH as those habitat areas most commonly used by the species. Information at levels 2 through 4, if available, should be used to identify EFH as the habitats supporting the highest relative abundance; growth, reproduction, or survival rates; and/or production rates within the geographic range of a species. FMPs should explain the analyses conducted to distinguish EFH from all habitats potentially used by a species. Such analyses should be based on geo-referenced data that show some areas as more important than other areas, to justify distinguishing habitat and to allow for mapping. The data must at least show differences in habitat use or in habitat quality that can be linked to habitat use.

There is an implicit link between the level of information available for species and life stages and the extent of EFH that is likely to be designated (Figure 2.1.1). As the information used to describe and identify EFH becomes less complex, so the area identified as EFH is likely to grow. For example, a determination based on areas where of production rates are highest is likely to result in a smaller area than a determination based on basic distribution data, because production rates are unlikely to be at their highest level throughout the species range. Rather they will be highest where habitat conditions are optimal for the species and life stage in question. This increase in the extent of EFH as the level of available information drops is in accordance with the risk-averse approach required by the EFH Final Rule. However, it is not always the case that the EFH identified based on the higher level of information will be entirely within the area identified based on the lower level. For example, a designation based on the areas of highest density (level 2) might not necessarily encompass the areas of highest productivity for some life stages (see discussion above).

Identifying a large area, based on distribution, would seem to be the most risk averse approach, but it is not sufficient to designate a large area of habitat as EFH without adequate justification. As mentioned previously, the EFH Final Rule (600.815(a)(1)(iv)(A)) requires that FMPs explain how EFH for a species is distinguished from all habitats potentially used by that species, in order to improve understanding of the basis for the designations.

If no information for a species/life stage is available at the lowest level (distribution) and it is not possible to infer distribution from other species or life stages, then EFH cannot be identified for that species designated (600.815(a)(1)(iii)(B)). CEQ regulations (1502.22) require agencies to make clear when information is lacking.

There are two main categories of information available that can be used to describe and identify EFH:

- Empirical geo-referenced data on species distributions, densities, and/or productivity rates derived from analyses of surveys and commercial catches. These data are essentially independent of the underlying habitat.

- Information about associations and functional relationships between species/life stages and habitat that can be used to make inferences about species distributions, density and/or productivity rates, based on the distribution of habitat.

Information at all four of the levels of detail described in the EFH Final Rule may exist in both of these categories. Examples of such are provided Table 7.

Table 7 Types of information at the four levels of detail described in the EFH Final Rule

Replace contents of table with what is actually available (where it is). Indicate what is not available, but would be desirable

	Empirical geo-referenced information	**Species-Habitat relationship modeling**
Level 4 – production rates by habitat	*In situ* physiological experiments and mortality experiments	Life history-based meta-population models
Level 3 – growth, reproduction, or survival rates within habitats	Tagging data (growth) Fecundity data by area	Spatially discreet stock/recruitment relationships; Bio-energetics models
Level 2 – habitat-related densities of the species	Survey/fishery related CPUE as proxy for density	Spatial modeling of probability of occurrence, or other forms of HSM

Level 1 – distribution data	Trawl survey data and the NOAA Atlas (Sections 2.2.1 and 2.2.2)	Simple habitat-species associations (Section 2.2.3)

Virtually no information at levels 3 and 4 exist for Pacific coast groundfish, and none that could be used to distinguish between different areas of habitat with sufficient contrast to indicate that one should be identified as EFH and another should not.

3.3.5 BN model for identification of EFH

Robust methods need to be devised for identifying EFH in a climate of uncertainty. Various sources of data are available for doing this (Section 3.3.4), but there are minimal data for many of the species and life stages. The main sources of data for the EFH model are the habitat suitability indices resulting from the NOS project (Section 2.2.3.3) and the habitat use database (Section 2.2.3.2). Appendix 3 provides a discussion of the implications of using from these two main data sources. Although the use of habitat suitability indices in designating EFH does raise the concerns expressed in Section 2.2.3.3, these concerns can be alleviated to some extent by rigorous validation of HSI models under a range of conditions(see Section 3.3.6), for example, using trawl survey data (Section 2.2.1) and commercial fishery data, and by careful selection of the data sources used to build the HSI models. It would also be worth exploring whether particular life stages give a better indication of an area's growth potential than others; in this context, the presence of juvenile stages or of spawning-age adults may be particularly useful in the identification of EFH.

3.3.5.1 Current model specification

In our BN model for EFH designation, we use physical variables obtained from the GIS, combined with an HSI score or information from the habitat use database, to give a probability that a particular area is suitable habitat for a particular species or life stage. Figure 4 provides an indicative influence diagram for the EFH model. In this example, the *observed* characteristics were substrate = "sand", depth in range "depth3" and latitude in range "lat3". Data quality was "lo" for substrate and "med" for depth. The resulting probability that the parcel is suitable habitat for Species Sp1 (life-stage LS1) is 4.2%.

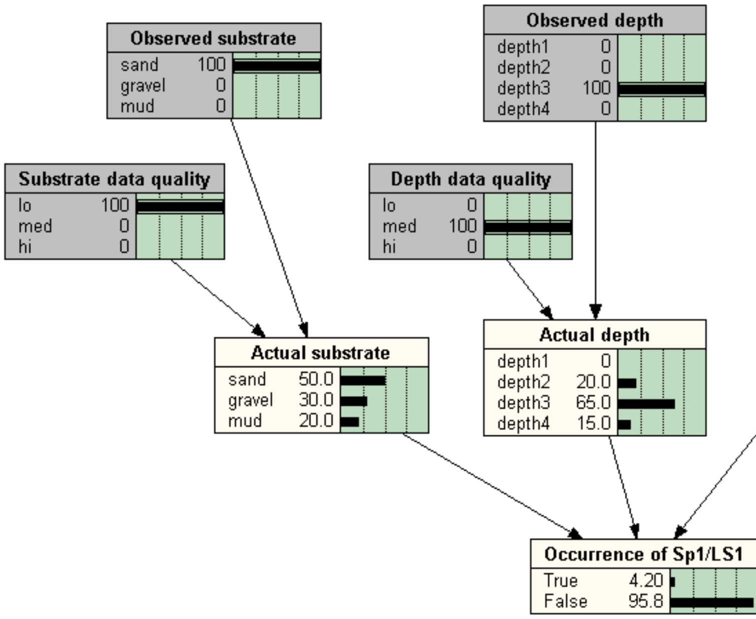

Figure 4 A simple EFH model with 4 depth ranges, 3 substrates and 5 latitude ranges substrate and depth data quality nodes (assuming these are available)

3.3.5.2 Treatment of uncertainty

There are a number of sources of uncertainty in determining the physical characteristics of a potential EFH parcel. These include:

- measurement errors (e.g. when a parcel has a probability of being assigned to one substrate type or depth when in fact it is another - caused by the methods used for assignation);
- transition zones (e.g. between 2 substrate types, or areas where depth changes sharply); and
- genuine mixtures within the parcel (e.g. gradual changes in depth or latitude).

The extent to which each is important will vary with the physical factor being measured (measurement error being more likely for substrate type than for latitude, for example). It will also vary with the degree of spatial resolution of the GIS and the size of EFH parcels.

As currently formulated, the model is focussed on the effect of measurement error, because it is demonstrating the procedure for assigning EFH by substrate type. It is assumed that there are several methods of determining substrate type within a potential EFH parcel. One method may give near-100% certainty that the substrate type recorded is actually present, the other method may only give 40% certainty. If there is uncertainty in the assignation of substrate type, it is necessary to adjust the expected substrate mix within the parcel to reflect the other possible substrates that may be present. This requires that some ground-truthing of the method has taken place, so that these probabilities can be assigned.

An alternative to this formulation for data quality is instead to give an EFH parcel a probability of having a certain physical characteristic (such as being mud) based on the characteristics of the surrounding parcels; hence a parcel in the middle of a mud area that is estimated also to be mud would have 100% probability of being mud, whereas a parcel near the edge of the area, which is thus likely to be in the transition zone between mud and sand, would be assigned a lower probability of being mud and a correspondingly higher probability of being sand. This would better reflect the issue of uncertainty in transition zones.

3.3.5.3 Identification of EFH

A probability is calculated that a parcel is of a particular substrate type (or depth range or latitude), based on the uncertainty in the data. These probabilities are combined to give an expectation of the substrate mix within the parcel. For each substrate type, a habitat suitability score is available. Hence the final probability of a parcel being suitable for a given species or life stage is the combination of the expected substrate mix and the suitability score for each substrate type. A similar procedure is envisaged for depth and latitude (with appropriate modifications to account for differing sources of uncertainty). The identification of EFH can then proceed by selecting a threshold probability value above which the parcel is deemed to be EFH, and below which it is not.

3.3.6 Validation of model results

To be completed

3.4 Habitat Areas of Particular Concern

3.4.1 Introduction

The EFH regulations encourage regional Fishery Management Councils to designate habitat areas of particular concern (HAPC) within areas identified as EFH to focus conservation priorities on specific habitat areas that play a particularly important role in the life cycles of federally managed fish species. EFH potentially encompasses a very broad range of habitat used by managed species. The designation of EFH is focussed on the habitat needs of individual species and life stages. EFH designation does not identify or attempt to add additional protection for areas of habitat within EFH that are most important to the survival and productivity of managed species, or particularly in need of protection for some other reason. EFH could be a very large component of the Pacific Coast ecosystem. However, identifying a few most important habitat areas as HAPC on the basis of their habitat attributes encourages a higher level of scrutiny for conservation, will afford those habitats extra protection, and give the fish species that occur there an extra buffer against adverse impacts. HAPCs may be designated for purposes other than mitigating adverse fishing impacts. This is reasonable since there may be some habitats that in an area that is stressed, but for which the threat from fishing activities is low.

3.4.2 Habitat considerations for designating HAPC

Whereas EFH must be described and identified for each species and life stage in the FMUs, HAPCs are identified on the basis of habitat level considerations. The Final Rule lists the following considerations that should guide the designation of HAPCs (50 CFR 600.815 (a) (8)):

- The importance of the ecological function provided by the habitat;
- The extent to which the habitat is sensitive to human-induced environmental degradation;
- Whether and to what extent development activities are or will be stressing the habitat; and
- The rarity of the habitat type.

Musick (1999) proposed using three principles to determine important habitat areas: utilization, availability, and vulnerability. DeAlteris (2002) advanced this concept by recommending priorities for habitat conservation inversely related to availability (comparable to the concept of rarity in the above list) and directly related to utilization (comparable to ecological importance) and vulnerability (comparable to sensitivity and stress). DeAlteris quantified these principles in evaluating effects of mobile fishing gears for the NE United States in making recommendations for prioritizations of fish habitat.

The designation of HAPCs is intended to identify to anyone considering actions that might be potentially threatening to habitat those areas of EFH considered to be of the highest importance in the life cycles of managed species and most in need of protection. An HAPC is expected to be a localized area of EFH that is especially ecologically important, sensitive, stressed, or rare when compared to the rest of EFH.

3.4.2.1 Ecological importance

In the context of this EIS, the ***ecological importance*** of a habitat stems from the function that it provides to the managed fish species. However, the Final Rule is not explicit regarding the metrics that should be used for measuring ecological importance Pacific coast fish utilize many types of habitat. A variety of approaches could be used to measure or represent ecological importance, including:

- habitats that support the ecological activities of a larger number of managed species life stages;
- habitats that support important ecological functions of managed species (bottlenecks); and
- habitats that support species that play an important role in the food web (e.g. forage species)

Insert description of the method for measuring ecological importance in the BN model – to be developed from the bullet list above

3.4.2.2 Sensitivity to human-induced environmental degradation

Human induced environmental degradation can result from both fishing activities and non-fishing activities such as coastal development and pollution. Certain habitat structures such as relief, hard/live bottom, kelp beds, seagrasses, and marshes are particularly sensitive to human-induced environmental degradation. They are sensitive to fishing gears and other activities such as dredging, mining, pipeline construction, coastal development, shipping, contaminants, and disposal.

Metrics for sensitivity should consider the inherent susceptibility of habitats to fishing and non-fishing impacts that are likely to result in impairment of the function of the habitat for fish species. This does not mean these impacts and the impairment have occurred, are occurring or will necessarily occur in the future. It is a measure of the potential for impairment given the types of activities that could affect the habitat, and the natural characteristics and situation of the habitats themselves.

An evaluation of fishing impacts is important both in the identification of potential sites of HAPC and to provide guidance on the types of impacts that need to be prevented, mitigated, or minimized under the requirements of the EFH Final Rule (600.815(a)(2)). In addition to providing a metric for identifying HAPCs, the evaluation of non-fishing impacts contributes to the evaluation of the likely benefits of possible modifications to fishing activity by providing information about cumulative impacts. Bearing in mind that only reasonably foreseeable changes to non-fishing activities can be considered in this EIS, an evaluation of non-fishing impacts is important in evaluating the practicability of the fishing impacts alternatives.

3.4.2.2.1 Sensitivity of habitats to fishing impacts

Different fishing gears affect habitats to different degrees. Mobile gears, such as bottom trawls and dredges, have a potential to affect habitat over a wide area, because the gear is in direct contact with and moves across the substrate and any biogenic structures. Non-mobile gears fish primarily in a fixed location, so their direct effects on habitat are generally confined to that location or "footprint." The damage from a single encounter in either case can range from negligible to severe. However, the adverse effects on EFH of fishing that are to be prevented, mitigated, or minimized relate to the functional relationship between habitat and fish.

Insert the sensitivity matrix from the west coast impacts analysis – to be completed

3.4.2.2.2 Sensitivity of habitats to non-fishing impacts

A number of non-fishing impacts to EFH occur throughout the Pacific coast region. These impacts include a variety of physical, water quality, and biological effects.

The analysis of non-fishing impacts should be conducted using a three-staged approach:

1. evaluate sensitivity of each habitat type to each potentially impacting non-fishing activity
2. develop quantitative and spatial measure of non-fishing impacts
3. estimate the habitat stress from non-fishing impact on the finest spatial scale possible.

(see below for stages 2 and 3)

e.g see approaches recently used in habitat and ecological stressor evaluations in the Tampa Bay area and elsewhere (Hession *et al*., 1996; Jackson *et al*., 2000; Kurz *et al*., 2001; Kurz *et al*., 2002).

3.4.2.3 Stress from development activities

Assessing the extent to which development activities are stressing or will stress areas of habitat requires knowledge of the spatial distribution of those activities in the past, present and possible future in relation to local habitats. To obtain a measure of the risk that an area is or will be stressed by development activities, data on the spatial intensity of these non-fishing activities must be combined with the sensitivity of habitats to impacts that they might cause.

The consideration of stress of habitat areas from development activities in identifying HAPCs offers two possible interpretations. First, identify stressed areas or areas likely to become stressed as HAPC. This approach is based on the concept of rehabilitation of areas for which recovery is possible. Secondly, identify areas free of stress as HAPC. This approach is based on the concept of protecting pristine areas through an increased conservation focus on the area. While many areas of the Gulf of Mexico have experienced irreversible stress from development (shoreline armor, dredge and fill), the continuum from pristine or nearly so to seriously degraded but capable of recovery covers a large amount of the Gulf of Mexico.

The interpretation used here is that the intention of the inclusion of the stress consideration for HAPC in the EFH Final Rule was to identify areas that are more stressed or in danger of becoming more stressed. The expectation is that areas that are pristine and are ecologically important for managed species will be identified through one or more of the other three considerations.

3.4.2.3.1 Distribution of development activities

To quantify the effects of non-fishing activities, GIS data that represented these activities need to be gathered from various sources throughout the Pacific coast region. Possible sources include the USGS, NOAA, USACOE, MMS, EPA, and local government agencies. Types of activities include the following:

- Dredge and fill (area in acres and numbers of fill points) – e.g. number of acres of dredge and fill within each statistical Point values can be created from the following data: aids to navigation, oil/gas structures, and marine facilities. These data are indicators of dredging since this would typically occur to facilitate passage of vessels in intercoastal waterways and access to marinas.
- Shoreline hardening (length in miles) – e.g. number of miles of shoreline modification values created from the following data: Environmental Sensitivity Index Shoreline.
- Impingement/entrainment/thermal impacts (point) – e.g. number of impingement and thermal points within each Statistical Zone.
- Structural Shading (points) – e.g. structural shading point values created form the following data: Marine Facilities (docks/piers) and Oil/Gas Structures (platforms).
- Boating Impacts (points and area in acres) – e.g. number of boating activity points ; number of acres of boating activity
- Altered Freshwater Inflow (points) – e.g. number of dams within a statistical zone.
- Point Source Pollution (points) – e.g. number of pollution points created from national pollution points maps (EPA).
- Non-Point Source Pollution (area in acres) – e.g. based on the total area of urban and agricultural land use (from USGS) within the contributing watersheds for a given statistical zone.
- Oil/Gas Operations (points, lines) – e.g. number of oil and gas operations and number of miles of oil and gas pipelines recorded within a statistical zone created from MMS database.
- Industrial Spills (points) – e.g. number of reported industrial spills from EPA databases.
- Toxic release (points) – e.g. number of toxic release points within each statistical zone created from EPA databases.
- Hypoxia (area in acres) – e.g. zones of low oxygen conditions.
- Harmful Algal Blooms (points) – e.g. from harmful algal bloom databases.

3.4.2.3.2 Risk of habitat stress from development activities

The third tier of the analysis is to develop the measure of stress. Risk of habitat stress depends on the sensitivity of the habitat to non-fishing (development) activities, and the intensity of those activities on a local scale. For each habitat type, habitat zone and non-fishing impact type:

$$\textit{risk of habitat stress} = \textit{sensitivity to non-fishing impact} \times \textit{intensity of non-fishing activity}$$

3.4.2.4 Habitat rarity

Musick (1999) recommended considering the availability of habitat in evaluating the need for habitat protection. Similarly, DeAlteris (2002) recommended an inverse relationship between availability (equivalent to a direct relationship with rarity) and habitat protection. If a habitat is ecologically important, and it is also rare, then the benefit of protecting it from adverse impacts will likely be greater than if it is more common. A unit loss of more rare habitat will likely cause a higher loss in production for the species using that habitat, than for more common habitat, where species have the opportunity to utilize other areas with similar habitat characteristics.

Calculation of habitat rarity requires subdivision of the total area into parcels of contiguous patches of a single habitat type, characterized, for example, by substrate/biogenic structure type, depth, and latitude. Ideally, the parcels should be of the same sort of local scale as that envisioned in the EFH Final Rule, so that the analysis can be used to identify viable candidate areas for HAPCs.

The ***rarity*** of a habitat parcel can be measured in terms of the mapped area of the habitat type relative to the total area of all mapped habitat types multiplied by the distance to the nearest neighboring parcel(s). Calculations of this type can be implemented relatively easily in a GIS that maps out all the habitats. The following is an example of a habitat rarity index calculation:

$$\text{Rarity Index Score for habitat type within Unit} = \frac{\text{Total Area of Unit}}{\text{Total area of habitat type within the Unit}} \times \text{Average of the nearest neighbor distance for the parcels of habitat type within the Unit}$$

Need to check on the effects of the nearest neighbor distance component of this formula

3.4.3 <u>BN model for identification of HAPCs</u>

3.4.3.1 Decision tree

The basic process of identifying HAPCs on the basis of the four considerations is illustrated in the decision tree in Figure 5. According to the current form of the decision tree, candidate areas must, in addition to meeting the "high" thresholds for one or more of the four considerations, meet a minimum threshold for ecological importance (in the current specification, the habitat use index must be above the lowest quartile). The rationale for this is that if an area is not above this threshold level of importance for the managed species from an ecological standpoint then it should not be identified as an HAPC. In practice, any area identified as a potential HAPC that does not meet this threshold would probably not be within any of the areas identified as EFH in any case. However, this will not be known until decisions have been made on the EFH alternatives.

The EFH Final Rule states that HAPCs are localized areas that are especially vulnerable or ecologically important. The decision tree refers to "EFH parcels" which are parcels or polygons identified in the GIS with particular levels for each of the indices linked to the four considerations.

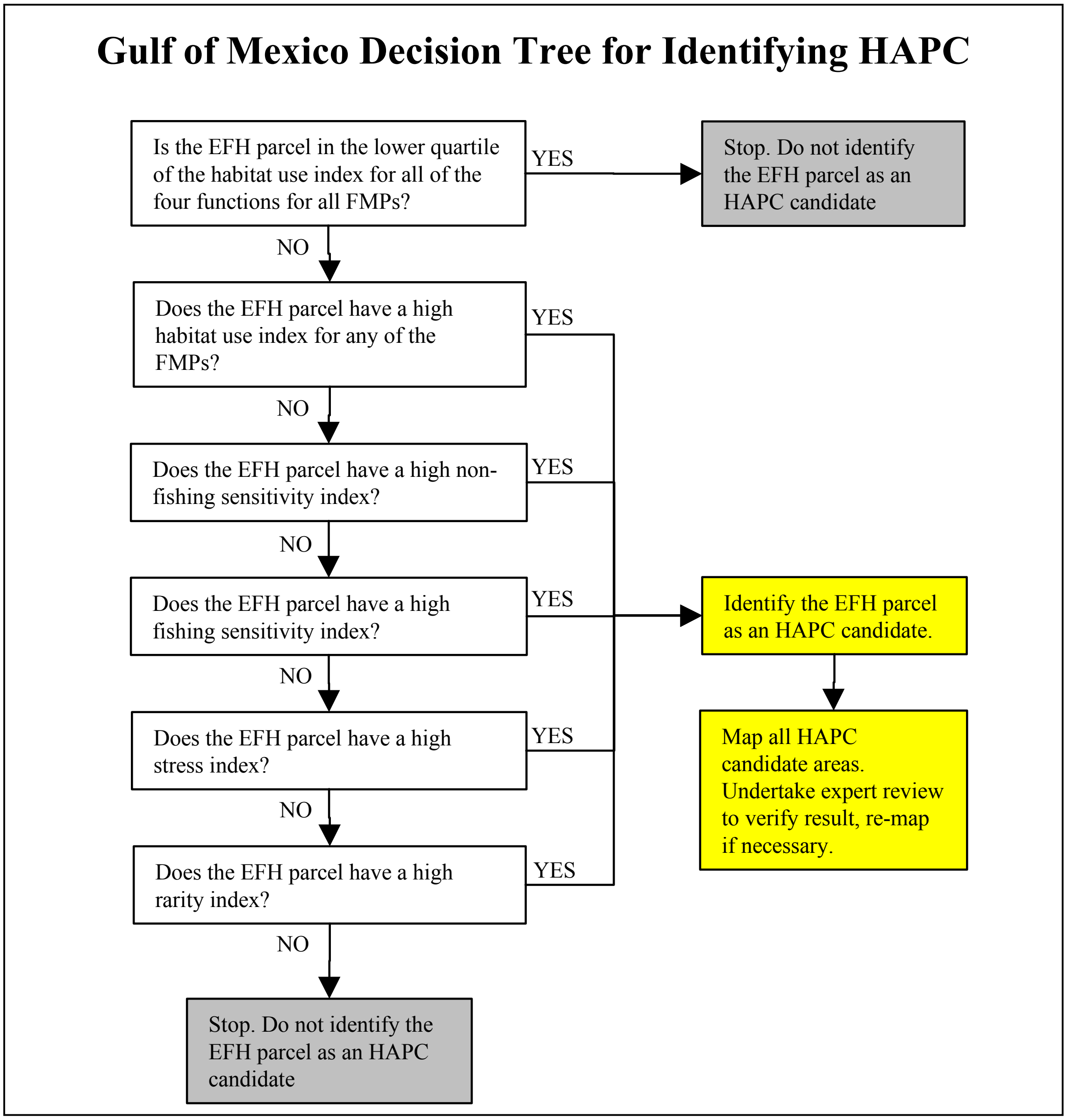

Figure 5 Decision tree for identifying HAPC candidate areas

3.4.3.2 Current model specification

At this stage we have developed only a preliminary network model to describe and identify habitat areas of particular concern (HAPC). The metrics for the considerations described in Section 3.4.2 could provide a basis from which to develop such a model, with nodes reflecting ecological importance, habitat sensitivity, habitat stress and habitat rarity. Figure 6 provides a simple diagrammatic representation of such a model.

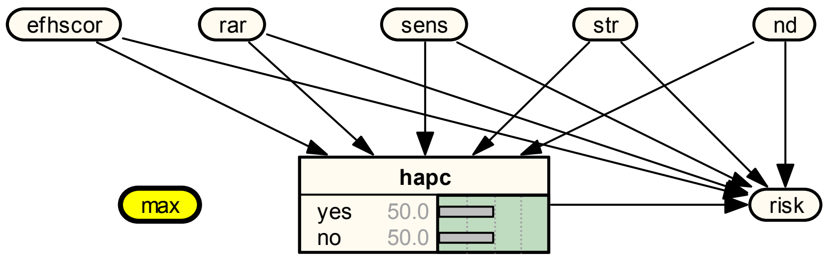

fig5.dne

Figure 6 Influence diagram for the BN model for identification of HAPC candidate areas

Each state within a node represents a score, quartile or similar measure for that characteristic. It is relatively easy to use the model to determine HAPC by measuring whether each characteristic exceeds a management threshold. Different thresholds may be defined for different characteristics. In terms of the regulations, if one of the nodes exceeds a threshold in a given habitat parcel then an area is defined as HAPC. In addition it is possible to then estimate a combined score for each of the nodes (as indicated by the node risk), based on a weighting of importance.

3.4.4 Validation of model results

To be completed

3.5 Fishing Impacts

3.5.1 Introduction

Councils must act to prevent, mitigate, or minimize any adverse effects from fishing, to the extent practicable, if there is evidence that a fishing activity adversely affects EFH in a manner that is more than minimal and not temporary in nature. Each FMP must therefore be amended, as necessary, to prevent, mitigate, or minimize to the extent practicable adverse effects from fishing on EFH, including EFH designated under other Federal FMPs (600.815(a)(2)(ii)). In addition, Federal agencies must consult with NOAA Fisheries on Federal projects that may adversely impact EFH. These requirements recognize that both fishing and non-fishing actions may adversely affect fisheries productivity through a variety of impacts on EFH.

The EFH Final Rule (50 CFR 600.815(a)(2)(ii)) establishes a threshold for determining which fishing activities warrant analysis to prevent, mitigate, or minimize to the extent practicable the adverse effects of fishing on EFH:

> "Councils must act to prevent, mitigate, or minimize any adverse effects from fishing, to the extent practicable, if there is evidence that a fishing activity adversely affects EFH in a manner that is more than minimal and not temporary in nature, based on the evaluation conducted pursuant to paragraph (a)(2)(i) of this section and/or the cumulative impacts analysis conducted pursuant to paragraph (a)(5) of this section."

As discussed in the preamble to the EFH Final Rule at 67 FR 2354, management action is warranted to regulate fishing activities that reduce the capacity of EFH to support managed species, not fishing activities that result in inconsequential changes to the habitat. The "minimal and temporary" standard in the regulations, therefore, is meant to help determine which fishing activities, individually and cumulatively, cause inconsequential effects to EFH.

In this context, temporary effects are those that are limited in duration and that allow the particular environment to recover without measurable impact. The following types of factors should be considered when determining if an impact is temporary:

- The duration of the impact;
- The frequency of the impact.

Minimal effects are those that may result in relatively small changes in the affected environment and insignificant changes in ecological functions. Whether an impact is minimal will depend on a number of factors:

- The intensity of the impact at the specific site being affected;
- The spatial extent of the impact relative to the availability of the habitat type affected;
- The sensitivity/vulnerability of the habitat to the impact;
- The habitat functions that may be altered by the impact (e.g., shelter from predators)
- The timing of the impact relative to when the species or life stages need the habitat.

3.5.2 Fishing impacts review

To be completed (see also Section 2.3.2)

3.5.3 BN model for fishing impacts

3.5.3.1 Current model specification

In this section, a simple model is developed to assess the impacts of alternative gear types on fish habitat. The model is parameterized to take advantage of a range of existing data sources. Figure 7 presents a simple influence diagram categorizing interactions between variables:

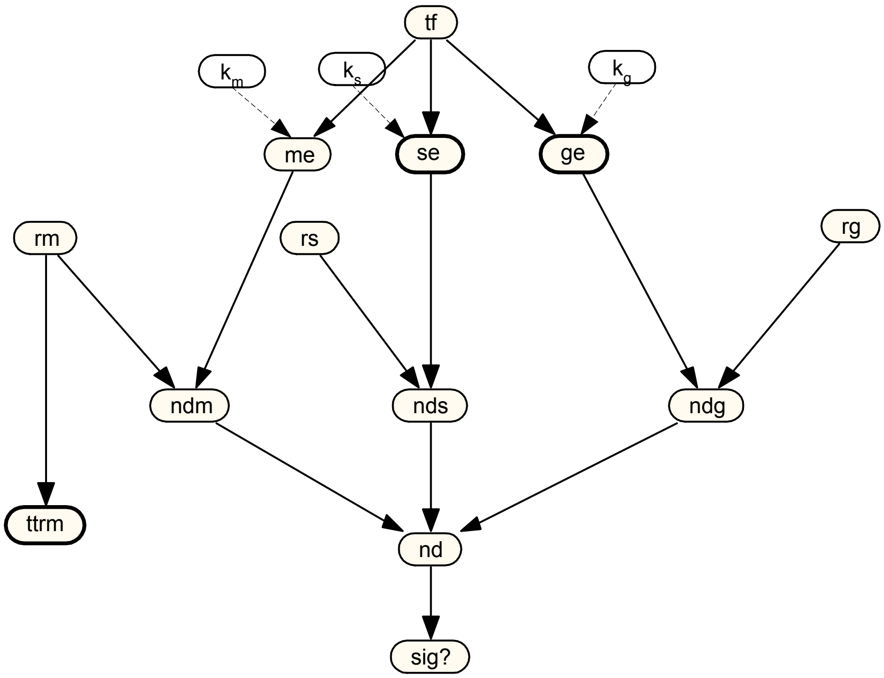

Figure 7 Influence diagram to estimate total impact of fishing gear

Total footprint (tf) is the proportion of a particular habitat parcel covered by a gear type. For trawls, the area is calculated as the product of width, total duration, and speed. Since the effort database currently contains information on total duration and set point location per vessel and per gear type, it is possible to determine the location of effort. However, since direction is not recorded, the proportions of any given area impacted can only be approximated. In the model, this is represented as a probability distribution.

Total footprint is multiplied by the proportion of each substrate type in habitat, to obtain an estimate of area trawled for each substrate. The implicit assumption is that trawl effort is uniform across substrates, in other words that fishing vessels do not favor fishing areas containing a particular habitat type. The proportion of each substrate trawled is then multiplied by a damage sensitivity score (k) for each substrate to derive a total damage for that substrate. In the influence diagram, three substrates are illustrated, mud (me), sand (se) and gravel (ge). Sensitivity of substrate to damage (k) is either represented as a constant, or, more likely, a probability distribution as reflected in the influence diagram (k_m, k_s and k_g). The relationship is indicated with a dotted line in the network diagram.

In a dynamic context, damage combines with habitat recovery in some functional relationship to obtain a net impact. In the network model, this is reflected in nodes for each substrate (ndm, nds and ndg). Appendix 4 describes one functional form that could be used to derive net damage. Summing across the nodes provides an estimate for net damage (nd). For management purposes it may be desirable to evaluate whether an impact is significant by identifying those impacts that exceed a certain threshold. The node ‘sig’ is included for that purpose.

3.5.3.2 Model extensions

We envisage the expansion of the network model by the addition of parent nodes for each gear type in the fishery. In the first instance, however, it will be necessary to develop a uniform measure for assessing footprint across alternative gear types. In the network model we then link the footprint of each gear type in the fishery with total footprint. We illustrate this for three gear types in Figure 8 by the addition nodes: f_{gt1}, f_{gt2} and f_{gt3}.

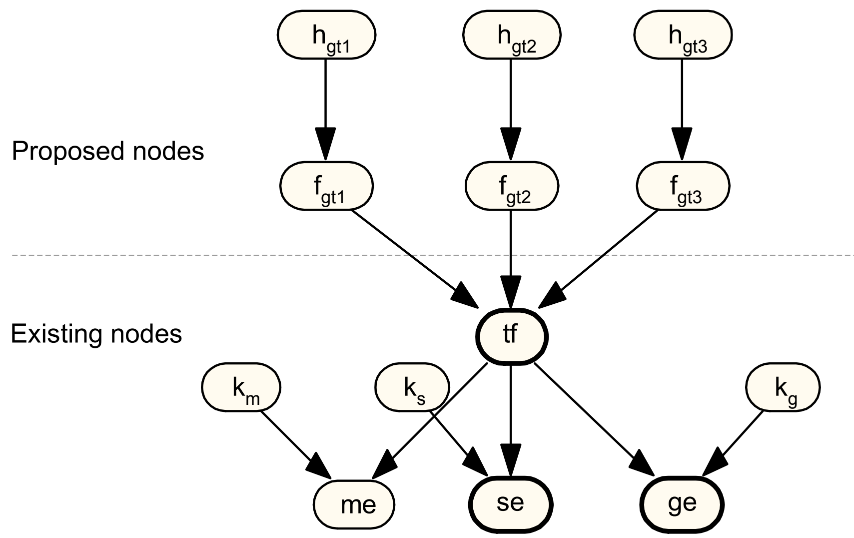

fig3.dne

Figure 8 Expanded influence diagram to estimate total impact of fishing gear

In the influence diagram this is done through the addition of a further layer of parent nodes (illustrated by h_{gt1}, h_{gt2} and h_{gt3}) to reflect harvest rates per gear type, by using some measure of catch per unit area. It is possible to use the model to simulate policy interventions such as fishing gear restrictions, seasonal/temporal area closures and harvesting quotas.

Management policies targeting specific fisheries sectors can also be modeled by reclassifying effort in the model. For example, Figure 9 illustrates the three management sectors: commercial limited entry (cle), commercial open access (coa) and recreational (rec), and two gear types, trawl (ft) and non-trawl (fnt):

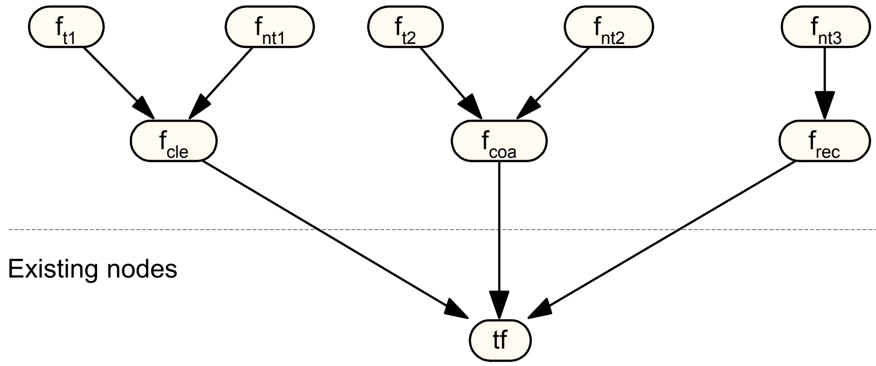

fig4.dne

Figure 9 Influence diagram showing the modeling of management options for adderssing fishing impacts

A variety of other specifications of effort are also possible, dependent on management objectives and the availability of data.

3.5.4 Validation of model results

To be completed

3.6 Further development of the BN models

[this section will be removed when the analysis is complete]

As described in this report, the team is developing three BN models for identification of EFH and HAPCs and for quantification of fishing impacts. These models have been populated with indicative data for demonstration purposes. The models show the power of the BN approach for addressing issues in the EFH EIS. The approach to fishing impacts is particularly promising. It is a step forward compared to other methods that have been proposed in that it includes a probability function for the footprint of each gear, which takes into account fisher behavior. Hence the area impacted is a function both of fishing effort and the degree to which vessels cover areas which have been previously fished during the same season. The model also incorporates the rate of recovery from fishing impacts, which varies with substrate type. The EFH model is able to accommodate a range of measures of the probability of an area being essential habitat, including Habitat Suitability Indices. It incorporates uncertainty both in terms of fish habitat associations, measurement error and a range of values for input variables within a single EFH parcel.

The models are still being developed. Several adjustments to the original models were suggested at the TRC meeting in February and have been implemented in the theoretical treatments presented here. The project is now in the phase of putting theory into practice by programming the models. This will be done using the Netica software and the C programming language. The programs are being designed to interface specifically with the main data sources and the GIS.

The programming phase of the project will address the following objectives:

(1) Address issues of scale and resolution in the use of data, particularly effort data in the impacts model and GIS data in the EFH model. Hence ensure that appropriate data are available to populate the models.

(2) Develop and program the algorithm for defining habitat units as intersections of latitude, depth contours and substrate boundaries, allowing for a probabilistic specification of depth and substrate to reflect uncertainties.

(3) Use the Pacific Coast Habitat Use Database (MRAG Americas), HSI data (NOS) and the RACE database (NMFS) to derive tables of conditional probabilities of presence of suitable habitat for each species/life-stages for each species (or species group) in each habitat unit.

(4) For the EFH model, using the Netica API (software that enables calls to BN procedures from a programming environment), program an algorithm to produce estimates of species/life stage presence probabilities for habitat units obtained from the existing GIS habitat data, and write the probabilities back to the GIS.

(5) Develop more realistic functional forms and statistical distributions for the impacts model. In particular for modeling: (i) fisher behavior, in terms of the degree of overlap of footprints from individual trawls (currently modeled using a Normal distribution); (ii) the impact of repeated trawls over the same location in one time period on net damage in that location (currently assumed that repeated trawls do not increase damage over a single trawl); (iii) the recovery rate (currently modeled as a logistic function).

(6) Investigate the use of Bayesian learning from cases to allow the adaptive improvement of the models over time as more data become available. This is particularly pertinent in the case of the impacts model. This is because substrates vary significantly in their rate of recovery from fishing impacts. Rate of recovery may also vary with gear type. Some indicative data exist on recovery rates and effort, but the availability of data currently and during future use of the model will be investigated; in particular, future data availability will have a strong influence on the best way to incorporate changes over time into the model. Although the importance of recovery over time may indicate the need for a dynamic model, the flexibility and relative simplicity of a learning by case approach is attractive. Also, given the uncertainties inherent in the system, learning by cases may be a more robust and realistic way to proceed, and one that is more suited to application in the real world.

(7) Based on the results of the impacts model and the EFH model, develop a BBN model for defining HAPC. This will involve: obtaining data to parameterize the non-fishing impacts node, programming the interaction with the GIS to get a habitat rarity score, and determining an appropriate weighting for combining inputs to get an HAPC score.

(8) Carry out scenario modeling using the completed EFH, HAPC and impacts models, so that the effects of mitigation strategies can be seen. In particular, this will involve trailing the use of learning by cases, ensuring that there are no paradoxical effects of reductions in fishing impact on HAPC designation, and evaluating the likely effects of fishing reduction on habitat in the light of the other factors causing concern about an EFH parcel (i.e. are they insignificant compared to non-fishing impacts). This modeling would take place within the GIS framework, hence the production of a working model that can be handed over to potential users will be a substantial programming task.

The main constraint on progress is now the availability of data. Once the GIS is completed and data on fishing impacts and fish habitat associations are available in the correct format, it will be possible to link the BN models with these databases. The models can then be used predictively.

Potential data bottlenecks include:

- entry of data into the habitat use database from the updated life histories appendix (needed for all three components of the analysis – EFH, HAPC and fishing impacts)
- completion of the GIS substrate and biogenic habitat layers, including the habitat quality information (needed for all three components of the analysis)
- preparation of a review of fishing impacts on habitat for the west coast, including development of indices of habitat sensitivity and recovery (needed for HAPC and fishing impacts)
- review and completion of the fishing effort data layers (needed for HAPC and fishing impacts)
- preparation of non-fishing impacts layers in the GIS (needed for cumulative impacts and practicability analyses)

4 RESULTS

This section is under development

4.1 Habitat maps

Maps of
benthic habitat
data quality
Bathymetry
Estuaries
Coastline
EEZ Existing management/protected areas

4.2 Network model results

4.2.1 EFH

Maps of probability of suitable habitat for species groups

8 species groups?
life stage groups?
Overall composite map

4.2.2 HAPC

Maps showing locations of habitat polygons identified as candidate sites for HAPCs
Separate maps for each of the 4 considerations (5 if you separate out fishing and non-fishnig sensitivity)
Compare with existing protected sites

4.2.3 Fishing Impacts

5 DISCUSSION

This section is under development

5.1 EFH

5.2 HAPC

5.3 Fishing Impacts

5.4 Potential structure of the alternatives

5.4.1 EFH alternatives

EFH must be described and identified the groundfish FMP as a whole.

5.4.1.1 Concepts for describing and identifying EFH

5.4.1.1.1 Concept 1: No action

This concept covers the requirement under NEPA for a "no action" alternative. It would result in no EFH being described and identified under the Pacific Coast Groundfish FMP. The No Action Alternatives would roll back the Council's designation of EFH under Amendment 11 to the Groundfish FMP. The purpose of including this alternative is primarily to provide a baseline against which the consequences of the other alternatives are compared.

5.4.1.1.2 Concept 2: Status quo

Under this concept, EFH is described and identified as in the Council's designation of EFH under Amendment 11 to the Groundfish FMP: the entire EEZ and marine and coastal waters inshore of the EEZ.

5.4.1.1.3 Concept 3: Threshold levels of probability of suitable habitat for managed species

Describe how threshold levels applied to the output of the Bayesian model would result in a range of alternatives for areas to be identified as EFH

5.4.2 HAPC alternatives

HAPC, by its definition in the EFH Final Rule, is a sub-set of EFH. HAPCs can therefore only be designated within the area described and identified as EFH under the FMP.

5.4.3 Fishing impacts alternatives

5.4.3.1 Possible Council actions

This section describes the types of actions that were considered when developing the range of fishing impacts alternatives to mitigate potential adverse impacts by a gear on a habitat. Many different actions are possible for each gear, and a subset of reasonable possibilities is presented below by gear type. The actions considered in developing the alternatives fell generally under five concepts: no action, gear modifications, time/area management, reduce fishing effort and full prohibition of the activity causing the impact. These concepts are described in more detail in the text table below.

Concept	Description
No action	No action alternatives are required by NEPA in part to provide a baseline for the consequences analysis, against which the consequences of all the other alternatives can be compared. Under this concept, no new measures for preventing, minimizing or mitigating adverse effects of fishing on EFH would be introduced. Adopt this concept as the fishing impacts alternative would require a determination that existing management measures adequately minimize, mitigate, or prevent potential adverse fishing impacts for all gears in all FMPs, to the degree practicable using best available scientific information (see Section 2.5.2 for a more complete rationale for the Alternative).
Gear modifications	Under this concept, alternatives are developed for modifications to the design and/or use of specific fishing gears that have a high potential of preventing, minimizing, or mitigating the adverse fishing impacts they cause. Fishing gears to which habitats are sensitive are identified and several alternatives for gear modifications to reduce adverse impacts are proposed.
Time/area closures	Alternatives create specific closed areas and closed seasons to prevent, minimize, or mitigate adverse fishing impacts in particular areas and at particular times of the year (as appropriate).
Reduce effort	The M-S act restricts access limitation to programs designed to achieve optimum yield.

Concept	Description
Gear prohibitions	This is the most restrictive approach to preventing, minimizing or mitigating adverse effects of fishing on EFH. Prohibition of gears on sensitive habitat could occur at two scales. First, prohibit the gear on only the habitats that the gear adversely impacts. This would require mapping of the habitats and drawing enforceable boundaries around the sensitive habitats. Second, prohibit gear throughout the EEZ. Such a prohibition would prevent a gear adversely affecting a habitat (to the extent it is enforced), but would also prevent use of the gear on habitats where it causes no adverse impact.

5.4.3.2 Previous Council actions

5.4.3.3 Possible further actions

5.5 Evaluating the consequences of the alternatives

Under development

Describe how the models can be used to evaluate the consequences of alternatives

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APPENDIX 1: LIST OF GROUNDFISH SPECIES IN LIFE HISTORIES APPENDIX

Count is 80 species. Two are missing

LEOPARD SHARK (Triakis semifasciata)
SOUPFIN SHARK (Galeorhinus zyopterus)
SPINY DOGFISH (Squalus acanthias)
BIG SKATE (Raja binoculata)
CALIFORNIA SKATE (Raja inornata)
RATFISH (Hydrolagus colliei)
FINESCALE CODLING (Antimora microlepis)
PACIFIC RATTAIL (Coryphaenoides acrolepis)
LINGCOD (Ophiodon elongatus)
CABEZON (Scorpaenichthys marmoratus)
KELP GREENLING (Hexagrammos decagrammus)
PACIFIC COD (Gadus macrocephalus)
PACIFIC WHITING (PACIFIC HAKE) (Merluccius productus)
SABLEFISH (Anoplopoma fimbria)
AURORA ROCKFISH (Sebastes aurora)
BANK ROCKFISH (Sebastes rufus)
BLACK ROCKFISH (Sebastes melanops)
BLACK-AND-YELLOW ROCKFISH (Sebastes chrysomelas)
BLACKGILL ROCKFISH (Sebastes melanostomus)
BLUE ROCKFISH (Sebastes mystinus)
BOCACCIO (Sebastes paucispinis)
BRONZESPOTTED ROCKFISH (Sebastes gilli)
BROWN ROCKFISH (Sebastes auriculatus)
CALICO ROCKFISH (Sebastes dalli)
CALIFORNIA SCORPIONFISH (Scorpaena guttata)
CANARY ROCKFISH (Sebastes pinniger)
CHILIPEPPER (Sebastes goodei)
CHINA ROCKFISH (Sebastes nebulosus)
COPPER ROCKFISH (Sebastes caurinus)
COWCOD (Sebastes levis)
DARKBLOTCHED ROCKFISH (Sebastes crameri)
DUSKY ROCKFISH (Sebastes ciliatus)
FLAG ROCKFISH (Sebastes rubrivinctus)
GOPHER ROCKFISH (Sebastes carnatus)
GRASS ROCKFISH (Sebastes rastrelliger)
GREENBLOTCHED ROCKFISH (Sebastes rosenblatti)
GREENSPOTTED ROCKFISH (Sebastes chlorostictus)
GREENSTRIPED ROCKFISH (Sebastes elongatus)
HARLEQUIN ROCKFISH (Sebastes variegatus)
HONEYCOMB ROCKFISH (Sebastes umbrosus)

KELP ROCKFISH (Sebastes atrovirens)
LONGSPINE THORNYHEAD (Sebastolobus altivelis)
MEXICAN ROCKFISH (Sebastes macdonaldi)
OLIVE ROCKFISH (Sebastes serranoides)
PACIFIC OCEAN PERCH (Sebastes alutus)
PINK ROCKFISH (Sebastes eos)
QUILLBACK ROCKFISH (Sebastes maliger)
REDBANDED ROCKFISH (Sebastes babcocki)
REDSTRIPE ROCKFISH (Sebastes proriger)
ROSETHORN ROCKFISH (Sebastes helvomaculatus)
ROSY ROCKFISH (Sebastes rosaceus)
ROUGHEYE ROCKFISH (Sebastes aleutianus)
SHARPCHIN ROCKFISH (Sebastes zacentrus)
SHORTBELLY ROCKFISH (Sebastes jordani)
SHORTRAKER ROCKFISH (Sebastes borealis)
SHORTSPINE THORNYHEAD (Sebastolobus alascanus)
SILVERGRAY ROCKFISH (Sebastes brevispinis)
SPECKLED ROCKFISH (Sebastes ovalis)
SPLITNOSE ROCKFISH (Sebastes diploproa)
SQUARESPOT ROCKFISH (Sebastes hopkinsi)
STARRY ROCKFISH (Sebastes constellatus)
STRIPETAIL ROCKFISH (Sebastes saxicola)
TIGER ROCKFISH (Sebastes nigrocinctus)
TREEFISH (Sebastes serriceps)
VERMILION ROCKFISH (Sebastes miniatus)
WIDOW ROCKFISH (Sebastes entomelas)
YELLOWEYE ROCKFISH (Sebastes ruberrimus)
YELLOWMOUTH ROCKFISH (Sebastes reedi)
YELLOWTAIL ROCKFISH (Sebastes flavidus)
BUTTER SOLE (Isopsetta isolepis)
CURLFIN SOLE (Pleuronichthys decurrens)
DOVER SOLE (Microstomus pacificus)
ENGLISH SOLE (Pleuronectes vetulus)
FLATHEAD SOLE (Hippoglossoides elassodon)
PACIFIC SANDDAB (Citharichthys sordidus)
PETRALE SOLE (Eopsetta jordani)
REX SOLE (Errex zachirus)
ROCK SOLE (Lepidopsetta bilineata)
SAND SOLE (Psettichthys melanostictus)
STARRY FLOUNDER (Platichthys stellatus)

APPENDIX 2: GEAR TYPES IN THE PACFIN DATABASE

The following table provides a list of the gear types contained in PacFIN database, and shows how these have currently been classified in the effort database for the GFR project

Need to update with Fran's recent table(s)

Gear Name	GRID	GFR Code	Summarized Gear Group
Bottom Trawl			
ALL TRAWLS EXCEPT SHRIMP TRAWLS	TWL	VG1	TRAWL
BEAM TRAWL	BMT	VG1	TRAWL
BOTTOM TRAWL	BTT	VG1	TRAWL
FLATFISH TRAWL	FFT	VG1	TRAWL
GROUNDFISH TRAWL (OTTER)	GFT	VG1	TRAWL
GROUNDFISH TRAWL FOOTROPE > 8 in.	GFL	VG1	TRAWL
GROUNDFISH TRAWLFOOTROPE < 8 in.	GFS	VG1	TRAWL
ROLLER TRAWL	RLT	VG1	TRAWL
Midwater Trawl			
BOTTOM TRAWL SMALL FREEZER TRAWLER	SFZ	VG2	TRAWL
BOTTOM TRAWL SURIMI TRAWLER	SRM	VG2	TRAWL
MIDWATER TRAWL - CATCHER/PROCESSOR	MDT	VG2	TRAWL
PAIR TRAWL	PRT	VG2	TRAWL
Long Line			
LONG LINE OR SETLINE	LGL	VG3	LONG LINE
Hook and Line			
ALL HOOK AND LINE GEAR EXCEPT TROLL	HKL	VG4	HOOK AND LINE
BOTTOMFISH TROLL	BTR	VG4	HOOK AND LINE
DROP LINE	DRL	VG4	HOOK AND LINE
HAND LINE	HDL	VG4	HOOK AND LINE
JIG	JIG	VG4	HOOK AND LINE
POLE (COMMERCIAL)	POL	VG4	HOOK AND LINE
SETLINE	STL	VG4	HOOK AND LINE
VERTICAL HOOK AND LINE GEAR	VHL	VG4	HOOK AND LINE
Pot and Trap			
FISH POT	FPT	VG5	POT AND TRAP

Gillnet			
DIP NET	DPN	VG6	OTHER
DRIFT GILL NET	DGN	VG6	OTHER
GILL NET	GLN	VG6	OTHER
OTHER NET GEAR	ONT	VG6	OTHER
SET NET	STN	VG6	OTHER
Other			
ALL DREDGE GEAR	DRG	VG7	OTHER
ALL GEARS	ALL	VG7	OTHER
ALL NET GEAR EXCEPT TRAWL	NET	VG7	OTHER
ALL OTHER MISCELLANEOUS GEAR	MSC	VG7	OTHER
ALL POT AND TRAP GEAR	POT	VG7	OTHER
BOTTOM TRAWL CATCHER BOAT FOREIGN	CBF	VG7	OTHER
BOTTOM TRAWL CATCHER BOAT JV	CBJ	VG7	OTHER
BOTTOM TRAWL LARGE FREEZER TRAWLER	LFZ	VG7	OTHER
DIVING GEAR	DVG	VG7	OTHER
HOOK AND LINE (RECREATIONAL)	HLR	VG7	OTHER
OTHER DREDGE GEAR	ODG	VG7	OTHER
OTHER KNOWN GEAR	OTH	VG7	OTHER
RIVER TRAWL	RVT	VG7	OTHER
SCALLOP DREDGE	SCD	VG7	OTHER
SEINE	SEN	VG7	OTHER
SUNKEN GILLNET	SGN	VG7	OTHER
TRAMMEL	TML	VG7	OTHER
UNKNOWN GEAR (BDS)	XXX	VG7	OTHER
UNKNOWN OR UNSPECIFIED GEAR	USP	VG7	OTHER
Other Trawl			
DANISH/SCOTTISH SEINE (TRAWL)	DNT	VG8	TRAWL
OTHER TRAWL GEAR	OTW	VG8	TRAWL
Shrimp Trawl			
ALL SHRIMP TRAWLS	TWS	VG9	TRAWL
PRAWN TRAWL	PWT	VG9	TRAWL
SHRIMP TRAWL DOUBLE RIGGED	DST	VG9	TRAWL
SHRIMP TRAWL SINGLE OR DOUBLE RIG	SHT	VG9	TRAWL
SHRIMP TRAWL-SINGLE RIGGED	SST	VG9	TRAWL
Troll			

ALL TROLL GEAR	TLS	VG10	OTHER
HAND TROLL	HTR	VG10	OTHER
POWER GURDY TROLL	PTR	VG10	OTHER
TROLL	TRL	VG10	OTHER
Crab Pot			
CRAB AND LOBSTER POT	CLP	VG11	POT AND TRAP
CRAB POT	CPT	VG11	POT AND TRAP
LOBSTER POT	LPT	VG11	POT AND TRAP
Other Pot			
OTHER POT GEAR	OPT	VG12	POT AND TRAP
PRAWN TRAP	PRW	VG12	POT AND TRAP
SNAIL TRAP	SPT	VG12	POT AND TRAP
Other Hook and Line			
OTHER HOOK AND LINE GEAR	OHL	VG13	HOOK AND LINE

APPENDIX 3: COMPARING THE HSI AND HABITAT USE DATABASE INFORMATION TO ESTIMATE CONDITIONAL PROBABILITIES FOR EFH

This appendix develops a methodology to compare suitability scores derived from information contained in the habitat use database with estimates derived using the habitat suitability (HSI) methodology. This has potential application in populating the conditional probabilities table of habitat suitability node used in the EFH model.

From the species-lifestage appendix the following physical information is available:

	Eggs	Larvae	Juveniles	Adults
Preferred depth (m)	0-50	0-50	200-700	200-500
Depth range (m)	0-50	0-600	100-700	9-1450
Hard	?	?	No	No
Soft	?	?	Yes	Yes

In converting this information into suitability scores we need an understanding of the relationship between preferred depth, depth range and probability of suitability. Ideally this should be derived from literature or expert review. In this case our choice reflects a precautionary approach, in that we assume habitat is suitable unless additional information is available to further delineate at higher resolution. We assume for illustrative purposes that the preferred depth provides a suitability of 1.00, and the depth range provides a suitability score of 0.75. Depth ranges outside the species-lifestage's indicated range receives a score of zero. Information on substrate association is less informative, so in cases of uncertainty we assign equal scores to both habitats.

Combining each depth range score with the score for each substrate type provides an indication of the suitability of that species lifestage to a range of environmental parameters (see Excel spreadsheet DoverSoleExample.xls for data used). Figure A1 provides a comparison between the habitat suitability tables and the data from lifestage appendix (substrate=soft, Dover sole, adult lifestage). The lifestage appendix provides a much flatter (and less informative) distribution of suitability across depth range than the HSI approach.

*Example using Dover sole (**Microstomus pacificus**)*

A. HSI method (adult lifestage only)

Depth	H.S.I	Suitability	Substrate	H.S.I	Suitability
0-50	2	0.20	hard	1.00	0.10
51-100	5	0.50	soft	10.00	1.00
101-200	6	0.60			
201-300	10	1.00			
301-400	10	1.00			
401-600	10	1.00			

601-800	8	0.80			
801-1000	6	0.60			
1000-2000	5	0.50			
>2000		0.00			

Suitability score for a given substrate and depth

Adults		Hard=	Soft=
		0.10	1.00
Depth	SI value	Suitability	Suitability
0-50	0.20	0.14	0.45
51-100	0.50	0.22	0.71
101-200	0.60	0.24	0.77
201-300	1.00	0.32	1.00
301-400	1.00	0.32	1.00
401-600	1.00	0.32	1.00
601-800	0.80	0.28	0.89
801-1000	0.60	0.24	0.77
1000-2000	0.50	0.22	0.71
>2000	0.00	0.00	0.00

B. Lifestage appendix method (Access database)

Depth ranges for different lifestages where species is known to occur

	Eggs	Larvae	Juveniles	Adults
Highest abundance	0-50	0-50	200-700	200-500
Range	0-50	0-600	100-700	9-1450

In the absence of data we need to make an assumption about the relationship between species occurrence and suitability. We assume in this example that, in areas of highest abundance the suitability score is 1.00. In other areas where the species is known to occur, the suitability score is 0.75. Outside the known range the suitability is 0.

Suitability score for different depth ranges

	Eggs	Larvae	Juveniles	Adults
	Suitability	Suitability	Suitability	Suitability
0-50	1	1	0	0.75
51-100	0	0.75	0	0.75
101-200	0	0.75	0.75	0.75
201-300	0	0.75	1	1
301-400	0	0.75	1	1

401-600	0	0.75	1	1
601-800	0	0	1	0.75
801-1000	0	0	0	0.75
1000-2000	0	0	0	0.75
>2000	0	0	0	0

For substrate, a species lifestage is given a probability of 1.00 if it is known to occur on that substrate, and 0 if it is known not to occur. In data poor areas we assume the highest suitability score so that the largest area possible is designated. We expect that, with improved data availability these scores may be refined. In areas where species are known to occur in both substrates, these may be accorded equal scores.

Suitability score for different substrates

	Eggs	Larvae	Juveniles	Adults
	Prob	Prob	Prob	Prob
Hard	1	1	0.01	0.01
Soft	1	1	1	1

Suitability score for a given substrate and depth

		Eggs	Larvae	Juveniles	Adults
		Prob	Prob	Prob	Prob
Hard	0-50	1.00	1.00	0.00	0.09
Hard	51-100	0.00	0.87	0.00	0.09
Hard	101-200	0.00	0.87	0.09	0.09
Hard	201-300	0.00	0.87	0.10	0.10
Hard	301-400	0.00	0.87	0.10	0.10
Hard	401-600	0.00	0.87	0.10	0.10
Hard	601-800	0.00	0.00	0.10	0.09
Hard	801-1000	0.00	0.00	0.00	0.09
Hard	1000-2000	0.00	0.00	0.00	0.09
Hard	>2000	0.00	0.00	0.00	0.00
Soft	0-50	1.00	1.00	0.00	0.87
Soft	51-100	0.00	0.87	0.00	0.87
Soft	101-200	0.00	0.87	0.87	0.87
Soft	201-300	0.00	0.87	1.00	1.00
Soft	301-400	0.00	0.87	1.00	1.00
Soft	401-600	0.00	0.87	1.00	1.00
Soft	601-800	0.00	0.00	1.00	0.87
Soft	801-1000	0.00	0.00	0.00	0.87
Soft	1000-2000	0.00	0.00	0.00	0.87
Soft	>2000	0.00	0.00	0.00	0.00

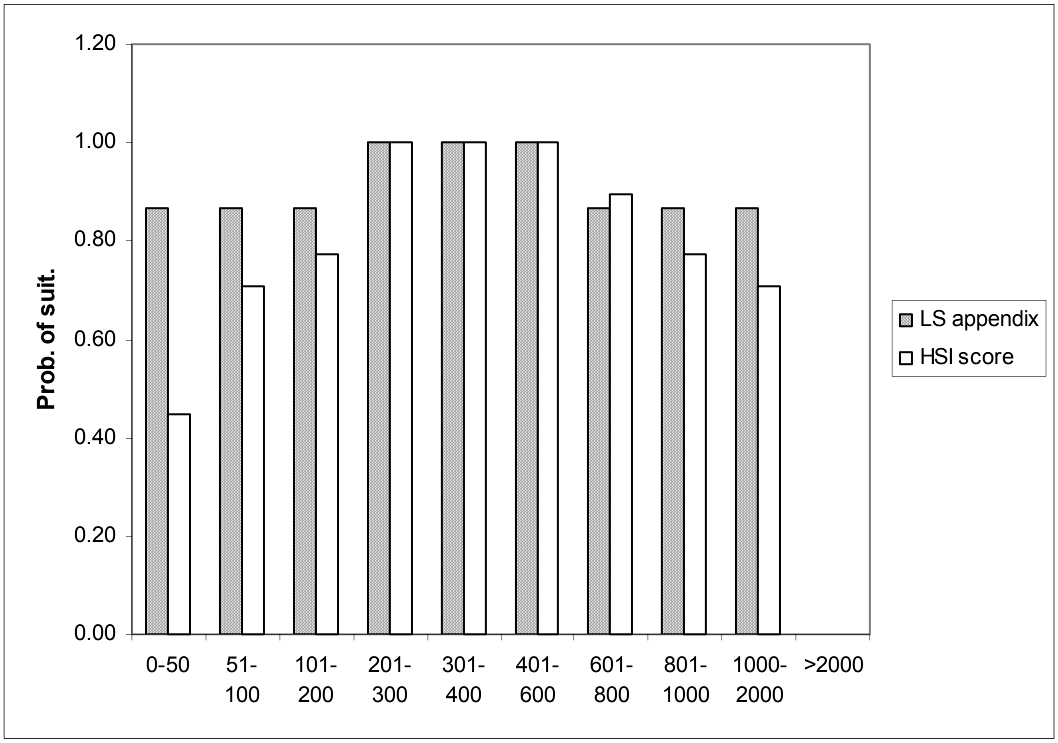

Figure A1. Comparing the probability distribution for the LS appendix with the HSI scoring (Illustrated with Dover Sole, adult lifestage. Results displayed for soft substrate).

APPENDIX 4: DISCRETE TIME DAMAGE MODEL FOR FISHING IMPACTS

A simple discrete time model may be developed by looking at the relationship between habitat, recovery and damage. While this model assume homogeneity across substrates, it is relatively easy to generalize this model to consider impacts on a substrate level. Let h_t be the percentage of a total habitat in an undamaged (pristine) state. The rate at which habitat recovers in time t+1 may then be written in the form:

$$h_{t+1} = h_t + r(h_t) - q(h_t, d_t) \qquad (1)$$

where $r(h_t)$ is a function representing habitat recovery, and $q(h_t, d_t)$ is a damage function, which is a function of the available habitat.

Various specifications of the damage function are possible. A simple time dependent relationship between habitat and damage may be represented as:

$$q(h_t, d_t) = d_t h_t,\ 0 \leq d_t \leq 1 \qquad (2)$$

where $d_t = (k * s * w * l_t * n_t)/(1000 * A)$ is the damage per unit of habitat, s is the average speed of a vessel of a given gear (km/hr), w is the width of that gear type (m), l is the duration of an average trawl and n is the number of trawls in a given area of size A km^2. Finally, k is a weighting factor that reflects the sensitivity of a given habitat to damage from a certain gear-type.

We specify the growth function as a logistic equation:

$$r(h_t) = (e^r.h_t)/(1+ch_t) - h_t, \qquad (3)$$

where $c = (e^r-1)/100$ and r is the maximum recovery rate of the habitat per annum.

Constant damage rate
If we assume that the damage rate remains constant over time, in other words that $q(h_t) = dh_t$, it is possible to derive the conditions where habitat will stabilize. This occurs in the discrete time formulation when $h_{t+1} = h_t$. By solving equation 1 for the aforementioned conditions, the following equilibrium state is achieved:

$$h_t^* = (e^r-d-1)/(c(d+1)) \text{ for all } e^r>d+1, 0 \text{ otherwise} \qquad (4)$$

The net area damaged in equilibrium (nd) is then $100 - h_t^*$.

Variable damage rate
It will often be useful to relax the assumption of a constant damage function over time. For example, we may want to make use of historical data, or predict habitat change under variable conditions. The model that is used is a combination of equations (1), (2) and (3). It is useful in this case to plot the time path of the model, to consider the dynamic behavior of the model.

We demonstrate the model by showing habitat recovery (h) for a range of recovery (r) and damage (d) rates, and for different levels of variability (Figure A2). Variability is introduced by allowing damage to vary stochastically by drawing dt from a normal distribution with mean d and standard deviation δ. As damage rates are increased, overall habitat recovery is reduced. Increasing recovery rates for a given damage rate increases the percentage of habitat that is undamaged. Increasing variability in the damage rate causes greater inter-annual variability in the proportion of habitat that has recovered, for high recovery rates. Over the long term habitat recovery fluctuates around its equilibrium value.

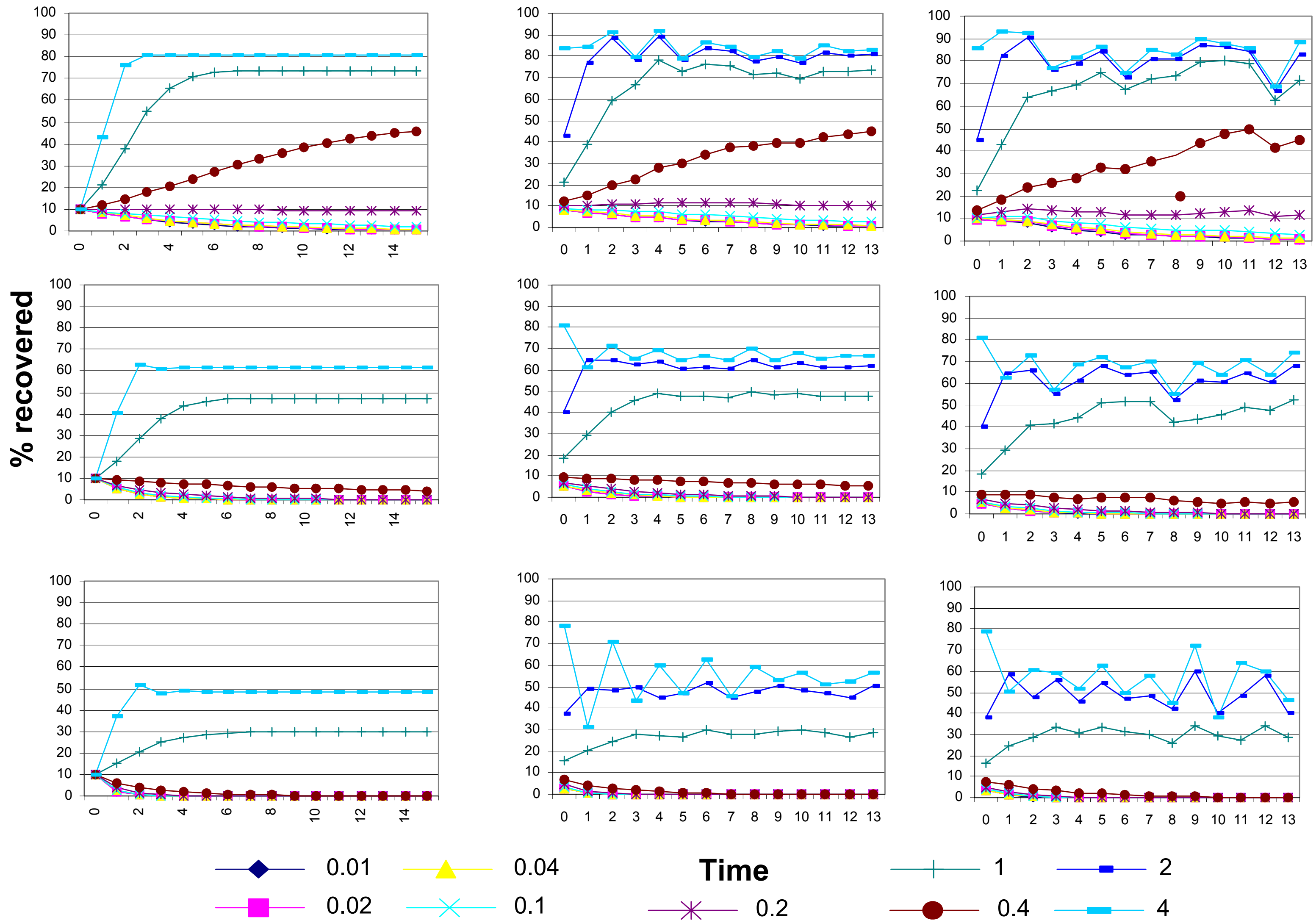

Figure A2. Dynamics of model for varying damage rates. Damage in each time period is sampled from a normal distribution, with mean 0.2 (row 1), 0.5 (row 2) and 0.8 (row 3), and standard deviation 0 (column 1) 0.05 (column 2) and 0.1 (column 3). Recovery rates vary from 0.01 to 4 (maximum 2 in the case of sd = 0) within each figure. The initial value for the percentage of habitat undamaged (h0) is 10%.

APPENDIX 5: USEFUL WEBSITES ON BAYESIAN BELIEF NETWORKS

General theory of network and other graphical models, with links to other sites
http://www.ai.mit.edu/~murphyk/Bayes/bnintro.html

Software products for creating network models
http://bayes.stat.washington.edu/almond/belief.html

Website for Bayes Net project
http://www.cs.orst.edu/~dambrosi/bayesian/frame.html

Genie product
http://www2.sis.pitt.edu/~genie

Netica product
www.norsys.com

Hugin product
www.hugin.com

Microsoft belief network Product
http://www.research.microsoft.com/dtg/msbn

Online tutorial for Bayesian inference and modelling
http://b-course.cs.helsinki.fi/

Exhibit B.11.d
Public Comment
June 2003

OCEANA

175 SOUTH FRANKLIN STREET, SUITE 418 JUNEAU, ALASKA 99801 907.586.4050 WWW.OCEANA.ORG

Dr. Hans Radke
Pacific Fishery Management Council
7700 N.E. Ambassador Place
Suite 200
Portland, OR 97220

RECEIVED
APR 18 2003
PFMC

Mr. Steve Copps
National Marine Fisheries Service
7600 Sand Point Way N.E.
Bin C 15700
Seattle, WA 98115

April 7, 2003

Dear Chairman Radke and Mr. Copps:

Oceana appreciates the work and the process the National Marine Fisheries Service (NMFS) and the Pacific Fishery Management Council are undertaking in the development of the Essential Fish Habitat Environmental Impact Statement (EFH EIS). As part of this process, it is critical that all relevant habitat data be brought forward to the public and be directly used to develop alternatives that prevent and mitigate the adverse impacts of fishing on essential fish habitat. This is crucial for the continued viability of our West Coast fisheries.

In the North Pacific region, we have worked extensively with NMFS and the North Pacific Fishery Management Council to develop a management alternative that protects habitat while maintaining vibrant fisheries. A seafloor habitat protection alternative was developed by Oceana and presented by Oceana and The Ocean Conservancy. With support from the fishing community, the North Pacific Fishery Management Council has adopted Oceana's alternative for the Aleutian Islands region for inclusion in their EFH EIS. The Oceana Approach contains the following elements:

- Compilation and analysis of habitat data and fishing effort data;
- Allowance of trawling only in specific open areas to maximize protection of EFH while minimizing economic impacts on the fishing industry;
- Enforcement of bycatch caps on benthic habitat indicators;
- Initiation of comprehensive research, mapping, and monitoring, including local knowledge; and
- Expansion and improvement in observer coverage, with the requirements of electronic logbooks and vessel monitoring systems.

Oceana, in collaboration with Mark Powell of The Ocean Conservancy, will develop the same approach as a comprehensive habitat protection alternative for waters off California and the Pacific Northwest to be considered for inclusion in the Pacific EFH EIS. We look forward to working with you to obtain all relevant habitat and fishery information to develop this alternative that will substantially protect essential fish habitat while maintaining vibrant fisheries.

Sincerely,

Jim Ayers
Oceana, Pacific Regional Director

§ 73.202 [Amended]

2. Section 73.202(b), the Table of FM Allotments under Texas, is amended by adding Channel 248C2 and removing Channel 248C1 at Archer City.

Federal Communications Commission.

Peter H. Doyle,

Chief, Audio Division, Media Bureau.

[FR Doc. 03–12201 Filed 5–15–03; 8:45 am]

BILLING CODE 6712–01–P

FEDERAL COMMUNICATIONS COMMISSION

47 CFR Part 73

[DA 03–1533; MM 00–148; RM–9939, RM–10198]

Radio Broadcasting Services; Archer City, TX, Ardmore, OK, Converse, TX, Durant, OK, Elk City, OK, Flatonia, TX, Georgetown, TX, Healdton, OK, Ingram, TX, Keller, TX, Knox City, TX, Lakeway, TX, Lago Vista, TX, Llano, TX, Lawton, OK, McQueeney, TX, Nolanville, TX, Quanah, TX, Purcell, OK, San Antonio, Seymour, Waco and Wellington, TX

AGENCY: Federal Communications Commission.

ACTION: Proposed rule, dismissal.

SUMMARY: This document dismisses a proposal filed by Nation Wide Radio Stations for the allotment of Channel 233C3 to Quanah, Texas. This document also dismisses a Counterproposal jointly filed by First Broadcasting Company, L.P., Rawhide Radio, L.L.C., Next Media Licensing, Inc., Capstar TX Limited Partnership and Clear Channel Broadcast Licenses, Inc. *See* 65 FR 53689, published September 5, 2000. With this action, the proceeding is terminated.

FOR FURTHER INFORMATION CONTACT: Robert Hayne, Media Bureau (202) 418–2177.

SUPPLEMENTARY INFORMATION: This is a synopsis of the Commission's *Report and Order* in MM Docket No. 00–148, adopted May 7, 2003, and released May 8, 2003. The full text of this decision is available for inspection and copying during normal business hours in the FCC's Reference Information Center at Portals II, CY–A257, 445 12th Street, SW., Washington, DC. The complete text of this decision may also be purchased from the Commission's copy contractor, Qualex International, Portals II, 445 12th Street, SW., Room CY–B402, Washington, DC 20554, telephone 202–863–2893, facsimile 202–863–2898, or via e-mail *qualexint@aol.com*.

Federal Communications Commission.

Peter H. Doyle,

Chief, Audio Division, Media Bureau.

[FR Doc. 03–12204 Filed 5–15–03; 8:45 am]

BILLING CODE 6712–01–P

DEPARTMENT OF COMMERCE

National Oceanic and Atmospheric Administration

50 CFR Part 660

[I.D. 050703A]

Fisheries off the West Coast States and in the Western Pacific; Pacific Coast Groundfish Fishery; Amending the Notice to Prepare a Programmatic Environmental Impact Statement for Fishing Conducted Under the Pacific Coast Groundfish Fishery Management Plan (FMP)

AGENCY: National Marine Fisheries Service (NMFS), National Oceanic and Atmospheric Administration (NOAA), Commerce.

ACTION: Notice of intent to revise the scope of a Programmatic Environmental Impact Statement (PEIS); request for written comments.

SUMMARY: On April 10, 2001, NOAA announced in the **Federal Register** its intention to prepare a PEIS, in accordance with the National Environmental Policy Act (NEPA), to assess the impacts of Federal management of the Pacific Coast groundfish fishery on the human environment. The proposed scope of the PEIS analysis included many issues related to the conduct of the fishery, including the effects of the groundfish fishery on essential fish habitat (EFH). As a result of public comments received during the scoping process, NMFS enhanced the description of the purpose and need for NMFS' action, clearly identified significant issues related to the proposed action, and a distinction between proposed actions related to EFH and the broader management program for Pacific groundfish. To avoid confusion as a result of this distinction, NMFS decided to prepare a separate EIS to address EFH issues. Subsequent to that decision, the Pacific Fishery Management Council (Council) and NMFS have taken a number of management actions to prevent overfishing and to rebuild overfished groundfish stocks. In addition, a number of court cases have affected the fishery regulatory processes and have required additional analysis of environmental impacts of the Federal groundfish fishery management program. NMFS believes these events and activities have influenced the purpose of and need for action and is considering revision to the scope of the alternatives and analysis. The intent of this document is to describe the rationale for revising the purpose and need for action and the scope of the analysis.

DATES: Written comments will be accepted on or before June 13, 2003. A public scoping meeting is scheduled for June 16, 2003 (see **SUPPLEMENTARY INFORMATION**).

ADDRESSES: Written comments on suggested alternatives and potential impacts, and any other issues or concerns related to the proposed action which should be analyzed in detail in the PEIS, as described in this scoping notice, should be sent to Robert Lohn, Administrator, Northwest Region, NMFS, 7600 Sand Point Way N.E., BIN C15700, Bldg. 1, Seattle, WA 98115 0070. Comments also may be sent via facsimile (fax) to 206 526 6736. Comments will not be accepted if submitted via e-mail or Internet.

FOR FURTHER INFORMATION CONTACT: Jim Glock, Northwest Region, NMFS, 503–231–2178; fax: 503–872–2737 and email: *jim.glock@noaa.gov*.

SUPPLEMENTARY INFORMATION:

Electronic Access

This **Federal Register** scoping notice is also available on the Government Printing Office's website at: *http://www.nwr.noaa.gov/1sustfsh/gdfsh01.htm*.

Background

In June 2001, NMFS concluded the initial scoping process for a PEIS on the Federal management of the Pacific Coast Groundfish Fishery and published a summary report. Scoping was initiated on April 10, 2001, through publication of a Notice of Intent (66 FR 18586). The report was initially published on the NMFS, Northwest Region website in August 2001 to provide a summary of all comments received and key issues identified during the scoping process. In February 2002 NMFS clarified the purpose and need for Federal action and revised the scope of analysis, which resulted in the preparation of two separate EISs. The PEIS was intended to be a broad analysis of the Federal fishery management program, and the additional EIS was specific to the designation of EFH and associated management measures, including measures to reduce effects of fishing on EFH. This separation was intended to improve public understanding and participation in the NEPA process, make each EIS more useful in future management decisions, and to more clearly distinguish between programmatic groundfish fishery management and specific EFH issues.

NMFS had intended the PEIS to analyze continued management of the Pacific Coast groundfish fishery pursuant to the FMP, and to consider alternative groundfish management programs. The Council prepared the original FMP and an EIS in the late 1970s, and NMFS implemented the FMP in 1982. Since then, the Council has amended the FMP 13 times and has three additional amendments in process. These amendments were in response to development of the commercial and recreational groundfish fisheries, changes in the groundfish resources, and amendments to the Magnuson-Stevens Fishery Conservation and Management Act (Magnuson-Stevens Act). NMFS initiated this PEIS to update the original EIS to reflect changes in the fishery and to evaluate the impacts of the Federal groundfish management program on the human environment, including the marine fish resources, the physical ocean environment and ecosystem, and human society.

The Council established an ad hoc Groundfish PEIS Oversight Committee (Committee) shortly after NMFS began preparation of the draft PEIS. The Committee met twice during 2002 to advise the drafting team and help develop a range of alternatives for managing the Pacific Coast groundfish fishery. The Council adopted the alternatives recommended by the Committee in October 2002. The Committee met again on April 22–23, 2003, and reviewed the status of the PEIS and the alternatives under consideration. The Committee reviewed the events leading up to initiation of the PEIS and subsequent to the initial scoping period. The consensus of the Committee was to narrow the scope of the PEIS to deal with bycatch issues. The Committee prepared a revised set of alternatives to encompass the range of approaches to resolve bycatch and incidental catch monitoring, reporting and reduction issues. The following chronology summarizes the basis for the Committee's recommendation to focus this PEIS more narrowly on bycatch.

Immediately before and since the initial scoping period (April-June, 2001), several events and activities have occurred that have substantially affected the groundfish management program. In December 2000, NMFS approved Amendment 13 to the FMP, which was designed to implement bycatch management measures to bring the FMP into compliance with the Magnuson-Stevens Act. In January 2001, NMFS determined that widow and darkblotched rockfishes were overfished, and implemented the Council's recommendations to impose broad harvest reductions to restrict the take of canary rockfish (also designated overfished) and darkblotched rockfish. Soon after the PEIS scoping comment period closed, a group of environmental organizations filed suit on NMFS' approval of Amendment 13, claiming NMFS had not considered all reasonable bycatch management and reduction alternatives. As explained below, the Court ultimately agreed with the plaintiffs.

NMFS prepared a scoping summary report and made it available in August 2001. The agency immediately began working with the Council to develop a range of alternatives for consideration and analysis in the PEIS. In January 2002, yelloweye rockfish and Pacific whiting were determined to be overfished. In February 2002, NMFS determined the analytical requirements for a programmatic EIS were different from those envisioned for EFH, and decided to prepare a separate EIS to deal exclusively with EFH issues. In April, Amendment 13 was declared invalid by Federal District Court and remanded to the agency. In June, initial rebuilding analyses for bocaccio and canary rockfish indicated extensive harvest restrictions were needed immediately in order to meet the rebuilding mandates. In response, the Council delayed adoption of the PEIS alternatives in order to concentrate on preparing an immediate response to the new scientific information. Major groundfish fishery closures were imposed mid-season, and proposals for further restrictions were developed and evaluated as part of the annual management process for the 2003 fishing year. The Council prepared an EIS in conjunction with its management recommendations (referred to as the "annual specifications"), evaluating the impacts of the proposed management measures on the biological resources and the social and economic environment. NMFS approved the Council's recommendations and issued a rule effectively closing much of the outer continental shelf from the border with Canada to the border with Mexico. Vessel catch allowances were developed through the use of a computer model that applies observed catch ratios of various depleted and healthy stocks to the available amounts of overfished stocks. In April 2003, NMFS and the Council became aware that data from the 2001–2002 Federal observer program clearly demonstrated some ratios substantially underestimated the catches of bocaccio and canary rockfish. NMFS implemented additional fishery restrictions on May 1, 2003 (68 FR 23901, May 6, 2003).

NMFS believes the most critical need at this time is improvement of the catch monitoring program and development of a system to enhance individual vessel flexibility and accountability, including opportunities and incentives to improve the selectivity of fishing operations. The current management program provides little opportunity or incentive for individuals to improve their catch selectivity (i.e., avoid overfished species). Changes to the bycatch reduction program may require revisions to the catch and bycatch reporting and monitoring systems. NMFS believes these issues should be the sole focus of the current PEIS. The current need is to focus the analysis on bycatch, incidental catch, and discard issues. A determination will be made after consulting with the Council at its June 2003 meeting.

NMFS invites written public comment on these issues until June 13. On June 16, 2003, at 7:30 p.m., NMFS will hold a public forum in conjunction with the Council meeting in Foster City, CA. Scoping documents which identify the management issues, initial alternatives, and an outline of the proposed analysis are available on request (see FOR FURTHER INFORMATION CONTACT, above) and will also be posted on the NOAA Fisheries Northwest Region website (*http://www.nwr.noaa.gov/1sustfsh/gdfsh01.htm*). Additional copies will be available at the scoping meeting.

Special Accommodations

These meetings are accessible to people with physical disabilities. Requests for sign language interpretation or other auxiliary aids should be directed to Carolyn Porter, 503–820–2280 (voice) or 503–820–2299 (fax), at least 5 days prior to the scheduled meeting date.

Authority: 16 U.S.C. 1801 *et. seq.*

Dated: May 12, 2003.

Bruce C. Morehead,

Acting Director, Office of Sustainable Fisheries, National Marine Fisheries Service.

[FR Doc. 03–12315 Filed 5–15–03; 8:45 am]

BILLING CODE 3510–22–S

UPDATE ON GROUNDFISH FISHERY MANAGEMENT PLAN PROGRAMMATIC
ENVIRONMENTAL IMPACT STATEMENT

Situation: NOAA announced its intention to prepare a Programmatic Environmental Impact Statement (PEIS) for the Pacific Coast Groundfish Fishery Management Plan (FMP) in 2001. At that time the proposed scope of the PEIS analysis included many issues related to the conduct of the fishery, including the effects of the groundfish fishery on essential fish habitat (EFH). NMFS subsequently decided to prepare a separate EIS to address EFH issues.

Based on this change in scope, the Ad Hoc Groundfish FMP EIS Oversight Committee (Committee) met twice during 2002 to advise the drafting team and help develop a range of alternatives for managing the Pacific Coast groundfish fishery. The Council adopted the alternatives recommended by the Committee in October 2002. The Committee met again on April 22-23, 2003, and reviewed the status of the PEIS and the alternatives under consideration. On the recommendation of NMFS, the consensus of the Committee was to narrow the scope of the PEIS to deal with bycatch issues.

NMFS published a revised Notice of Intent in the *Federal Register* on May 16, 2003 (Attachment 1), which summarizes the basis for the Committee's recommendation to focus this PEIS more narrowly on bycatch. Preparation of several other environmental impact analyses is a key consideration in deciding that the scope of the PEIS should be narrowed. These analyses cover some of the issues that would be evaluated in the PEIS including the EFH EIS, mentioned above; an EIS prepared in connection with 2003 groundfish harvest specifications and management measures; and, in preparation, the EIS supporting Amendment 16-2, covering rebuilding plans for four overfished species.

NMFS believes the PEIS should focus solely on issues related to bycatch, incidental catch, and discard issues. This includes improving catch and bycatch reporting and monitoring systems, enhancing individual vessel flexibility and accountability, including opportunities, and developing incentives to improve the selectivity of fishing operations.

The Committee prepared a revised set of alternatives to encompass the range of approaches to resolve bycatch and incidental catch monitoring, reporting and reduction issues (see Attachment 2).

Council Task:

1. **Consider adopting the change of scope for the Programmatic EIS.**
2. **Consider approving the revised set of alternatives focusing on bycatch-related issues.**

Reference Materials:

Attachment 1: 68 FR 26557; notice of intent to revise the scope of the PEIS.
Attachment 2: DRAFT Bycatch Alternatives writeup, Council's Ad Hoc Groundfish FMP EIS Oversight Committee, April 22-23, 2003.

Agenda Order:

a. Agendum Overview — Kit Dahl
b. NMFS Report — Jim Glock
c. Reports and Comments of Advisory Bodies
d. Public Comment
e. Council Discussion on PEIS Process

PFMC
06/02/03

NRDC
THE EARTH'S BEST DEFENSE

The Ocean Conservancy

OCEANA

BY FACSIMILE (206-526-6736) AND MAIL

June 13, 2003

D. Robert Lohn
Regional Administrator
National Marine Fisheries Service
7600 Sand Point Way N.E., Bldg. 1
Seattle, WA 98115-0070

Dear Mr. Lohn:

On behalf of the Natural Resources Defense Council, Oceana and The Ocean Conservancy, we offer the following comments on the draft alternatives for bycatch reduction. We consider bycatch reduction a critical issue that must be expeditiously addressed.

Overall, we believe the agency has done an excellent job in compiling a comprehensive list of bycatch reduction alternatives. We are pleased that NMFS has included certain measures, such as the use of discard caps, marine protected areas ("MPAs"), and incentives for cleaner fishing (setting aside a portion of the total allowable catch for vessels with the lowest catch rates of overfished species or bycatch rates). Nevertheless, there are a few areas we believe need improvement.

First, we believe NMFS should include a clean fishing incentive alternative. Such an alternative would set aside a portion of the total allowable catch for fishing sectors with the lowest catch rates of overfished species or bycatch rates (based on previous years' observer data), and allocate it during the annual specifications process rather than in season. This alternative would differ from the current incentive scheme incorporated in alternatives 5 and 6 by operating on a per sector rather than a per vessel basis, and an annual rather than an in-season basis. We believe such an alternative could result in greater long-term bycatch reduction than NMFS's current incentive scheme and would encourage innovations in gear and fishing practices.

Second, we request that alternatives be developed that integrate the tool of MPAs with a variety of other measures, not just the particular measures identified in Alternative 6. As you develop alternatives that incorporate protected areas, it will also be important to define the nature and requirements of those MPAs.

Third, we would like further clarification on certain issues. Specifically, does the 50% reduction in harvest capacity proposed in Alterative 2 refer to all commercial fishing vessels or just certain sectors?

Fourth, we request that when NMFS does the full analysis of each alternative that is required by NEPA, it also consider the merits of each bycatch reduction measure individually. For example, when considering alternative 6 (the use of both MPAs and bycatch caps), we anticipate NMFS will weigh the pros and cons of discard caps and MPAs individually before accepting or rejecting the alternative as a whole. Such individual analysis of each bycatch reduction measure within each alternative will ensure full compliance with both NEPA and the Magnuson-Stevens Act, 16 U.S.C. § 1801 et seq., ("MSA").

Fifth, we ask that NMFS analyze the pros and cons of bycatch reduction measures with respect to other conservation requirements of the Magnuson-Stevens Act, such as habitat protection and rebuilding overfished species. That analysis will help NMFS and the Council make reasoned decisions about the overall comparative benefits and costs of various measures.

Sixth, we anticipate that NMFS will make the requisite practicability determinations with respect to each of the bycatch reduction measures as required by the MSA, 16 U.S.C. § 1851(a), before the agency chooses its preferred bycatch reduction measure(s), and that the EIS will present the public and the decisionmaker with several implementable alternatives with practicable bycatch reduction measures.

Successful management of the Pacific groundfish fishery requires that NMFS adopt better measures to assess and reduce bycatch. However, bycatch is only one of many problems affecting the fishery. In order to reverse the trend of overfishing, rebuild depleted species and protect the marine environment, NMFS must conduct a full and thorough environmental analysis of the Federal management of the fishery. This has been NMFS's intent since it decided to prepare the PEIS, and the factors that made this a smart decision then are just as relevant today.

Sincerely,

Karen Garrison
Elizabeth deLone
NRDC

Jim Ayers
Oceana

Chris Dorsett
The Ocean Conservancy

cc: Dr. Don McIsaac
Bill Robinson
Jim Glock

Exhibit B.13
Attachment 3
June 2003

CHAPTER 5.0
CUMULATIVE IMPACT ANALYSIS
FOR

DRAFT AMENDMENT 16-2
TO THE PACIFIC COAST GROUNDFISH FISHERY MANAGEMENT PLAN

REBUILDING PLANS FOR DARKBLOTCHED ROCKFISH, PACIFIC OCEAN PERCH, CANARY ROCKFISH, AND LINGCOD

5.0 COMBINED EFFECTS ACROSS STOCKS AND CUMULATIVE EFFECTS

Groundfish species managed under the FMP exist in a mixed stock assemblage of other groundfish and nongroundfish species. While the mix of species varies by area, depth, season, and time of day, there are some recognizable patterns that are borne out in the co-occurrence of species landed or observed in fisheries catches. West Coast groundfish management is largely based on the need to control the total fishing-related mortality of overfished groundfish species caught in fisheries targeting healthy groundfish and nongroundfish species. The patterns of fishery interceptions of target species and overfished groundfish species are quantified as bycatch rates. Bycatch is discarded coincidental catch and bycatch rates are an important part of developing the total mortality estimate for coincidental catch. Projecting total mortality of overfished groundfish species entails applying coincidental catch, rates to landings of target species in a model that also projects vessel participation (effort) in the fishery given allowable landing and trip limits. Often it is impossible to design a management system that allows fisheries full access to healthy stocks due to the coincidental catch of overfished species. When a fishery cannot catch the full amount of fish they are entitled to due to coincidental mortality of overfished stocks, it is said to be constrained by the overfished stock. When the harvest level prescribed for any one overfished stock limits a fishery, the stock is referred to as the binding constraint on the fishery. While previous sections describe the fishery constraints over time imposed by the need to rebuild the individual species subject to rebuilding plans analyzed in this EIS, this section seeks to understand the combined effect of rebuilding all nine overfished groundfish species simultaneously.

Analyses done to understand the cumulative effects of rebuilding West Coast groundfish are stratified to comprehend these effects during the course of stock rebuilding and after target biomasses (B_{MSY}) are attained and stocks are rebuilt. This analytical framework endeavors to both analyze the potential costs of rebuilding in terms of stock interactions and foregone harvest and consequent socioeconomic effects across combinations of rebuilding alternatives as well as potential future benefits after rebuilding is accomplished. The cumulative effects during rebuilding are analyzed by combining the following rebuilding alternatives for all nine groundfish species, (1) all overfished species managed under the *Maximum Conservation* alternative, (2) all overfished species managed under the *Maximum Harvest* alternative, (3) all overfished species managed under the *Council Interim* alternative, and (4) bocaccio, canary rockfish, widow rockfish, and yelloweye rockfish managed under the *Mixed Stock Exception* alternative with the other five overfished species managed under the *Maximum Harvest* alternative. On the last cumulative effects alternative, it is noted that of the four species modeled under the *Mixed Stock Exception*, only three are modeled quantitatively; bycatch data for yelloweye rockfish are too sparse for similar analytical treatment. Under each rebuilding alternative scenario, it is assumed that all nonoverfished species are at their 2003 OY level. Models used to develop regulations for the 2003 fishery were used to project harvest regulations in the first year of management under the different rebuilding options. Using the depth-based management regime recommended by the Council for the 2003 fishery and assuming all other overfished species had been rebuilt, an analysis was conducted to evaluate the degree to which the fishery would be constrained by each particular overfished species under each rebuilding option for that species. Assuming average conditions and response to reduction in harvest mortality, the first year of the rebuilding plan should be the year that is most constrained.

The cumulative effects after species are rebuilt are analyzed by estimating MSY using proxy estimates of F_{MSY} (sustainable fishing rate) and B_{MSY} (biomass that supports MSY). A number of simplifying assumptions have been made in order to project the regulatory framework. The analysis assumes all other presently overfished stocks are rebuilt and are being harvested at a long-term, sustainable level. Proxy values for F_{MSY} and B_{MSY} were generally used to determine proxy estimates of "MSY" for these analyses. The proxy F_{MSY} for overfished rockfish species is generally $F_{50\%}$ (i.e. the harvest rate that corresponds to the spawning output being reduced to 50% of its unfished equilibrium level [B_0] assuming recruitment is independent of spawning output). Because some decline in recruitment is expected as the spawning stock declines, the equilibrium spawning biomass that will result from a $F_{50\%}$ harvest rate will be probably be somewhat less than $B_{50\%}$, and presumably near $B_{40\%}$, the rebuilding target and generally considered a reasonable proxy for B_{MSY}. $F_{45\%}$ was used to define harvest rates for calculating proxy MSY levels for lingcod and Pacific whiting. These proxy MSY harvest rates were recommended by participants in the West Coast Groundfish Harvest Rate Policy Workshop that was sponsored by the SSC, and adopted by Council action in 2000 (PFMC 2000b). Considered risk-neutral, these harvest rates were substantially lower than those previously used to manage groundfish stocks. They are considered to meet the Magnuson-Stevens Act mandate to "...achieve and maintain, on a continuing basis, the optimal yield from each fishery...". Note that the caveat presented in section 4.4 regarding the use of proxy F_{MSY} and B_{MSY} estimates applies for these analyses as well.

It should also be noted that cumulative effects analyses for the limited entry trawl fishery are largely quantitative while analogous analyses for the other sectors are qualitative. This is due to the lack of supporting data, such as estimated bycatch rates and logbook records, for any sector other than limited entry trawl.

5.1 Cumulative Impacts to Habitat and the Ecosystem, Including Protected Species

Quantitative analysis of habitat and ecosystem impacts from fishing related activities is complicated. When considering the long-term perspective of cumulative impacts to the ecosystem it is difficult to determine which rebuilding plan alternatives have the greatest effect on EFH. For example the *Maximum Conservation* alternative would provide the largest amount of habitat protection in the short term, but is projected to allow a relatively rapid increase in fishing effort once B_{MSY} is attained. This is further complicated by the need to consider which of the overfished species under rebuilding is the most constraining to fisheries within a geographic area or ecological group (See Sections 3.1 and 4.1).

5.1.1 Ecological Interactions

Scientists have identified cyclic changes in ocean conditions that are more or less favorable to groundfish populations, which can last for a year or two, as in the case of El Niño and La Niña, to much longer cycles of 25 years to about 60 years, which are different phases of the PDO regime shift. A more general warming trend, commonly referred to as climate change and linked to anthropomorphic carbon dioxide emissions, is likely to have profound and essentially permanent effects (the most directly measurable effects, like average surface temperature, exhibit a generally unidirectional upward trend). The ecological effects of cyclic climate change are becoming better understood; periods with warmer sea surface temperatures seem to be unfavorable for many groundfish species' population growth.

As would be expected, climate produces many broad-scale effects that can interact directly and indirectly with fishing activity. Climate regime effects are related to the proposed action through their effects on the productivity of stocks caught in fisheries. Different groundfish species may respond to these changes in different ways. Recruitment surveys also show that adverse environmental conditions during the 1990s affected some species, such as shortbelly rockfish, chilipepper rockfish, and bocaccio much more than other species, such as widow, canary, and black rockfish, as evidenced in fishery independent recruitment surveys (Dr. Alec MacCall, NMFS, pers. comm. 12/13/2002). Even shortbelly rockfish, a relatively pelagic species that is not exploited, has experienced severe declines during the last decade. Differential effects of climate regime likely correlate with the ecological habit of a particular species so that, for example, pelagic species show similar responses in comparison to neritic species. However, at present there is neither a strong theoretical basis or observational evidence that would allow prediction of such differential responses.

Changes in productivity are by themselves only relevant as another source of variation in a complex system. They become meaningful in the management context if an understanding of system response is critical to the desired outcome (maximum or optimum yield, for example). Fishery management is largely an exercise in prediction based on accumulated knowledge about how stocks have responded in the past to fishery removals. In developing assessment models it may be explicitly or implicitly assumed that past relationships between stock size and recruitment, for example are reasonably static and may apply in the future. (Bearing in mind that there may be considerable parametric uncertainty). If underlying conditions change, components of the predictive model may be wrong, resulting in the mis-specification of harvest levels.

MacCall (2002b) describes a simulation of stock response to the kind of low frequency environmental variability produced by the PDO. In the absence of fishing, long-lived species are "remarkably insensitive to the magnitude of environmental fluctuations" due to their longevity and late recruitment age. These characteristics give the population a resilience to long periods of unfavorable environmental conditions. MacCall's simulation shows a constant fishing rate harvest policy, as currently employed in managing groundfish, would be preferable for long-lived species, because of the long lag in biomass response to environmental change. However, once overfished, low frequency environmental variability can complicate rebuilding efforts.

The relationship between environmental regime, productivity, and the management process is particularly relevant to rebuilding overfished stocks, because management is now largely structured around minimizing their harvest (both retained and bycatch). MacCall simulated rebuilding trajectories from the start of both a favorable and unfavorable environmental regime, in the absence of fishing. If started at the beginning of a favorable period, population increases faster than under unfavorable conditions, but the increase stalls just as the target is reached because of the advent of an unfavorable period. If initiated at the onset of unfavorable conditions, it takes 70 years, as opposed to 40 years, for the population to reach target biomass and again stalls as a second unfavorable period begins. Thus, in both cases "little happens during the first 10 years, because the recruiting cohorts already exist in the population and are little affected by the cessation of fishing" and in both cases "the population enters an unproductive period just as the target is reached, and no further rebuilding occurs fo the 30-year duration of the unfavorable regime" (MacCall 2002b, p. 620). Any level of fishing would, of course, lengthen the rebuilding period, with the population stalling for an additional unfavorable phase in the environmental cycle, adding at least another 30 years to the trajectory. It is very important to recognize that these are models of idealized systems used to illustrate possible effects of environmental phenomena on population dynamics. They exclude the "noise," or stochasticity, of real world systems, which can mask the underlying dynamic and make outcomes more erratic. In most cases, fishery managers do not yet have the time series data to build predictive models for actual fish stocks. Once this data is available, rebuilding analyses could be refined to incorporate predicted recruitment variability. But even if fishery scientists were in a position to reliably correlate environmental conditions and stock productivity in predictive models, management policies would have to account for environmentally induced variations in productivity over very long cycles, something the current system is not well-equipped to do.

5.1.2 Interspecies Competition and Trophic Interactions

Ecosystem structure may change as a result of both natural and anthropomorphic effects. Structural change becomes an effect itself that could interact cumulatively with the effects of the alternatives. Ultimately, it is the presence and differing abundances of species that constitutes ecosystem structure. The abundance of a given species is in turn the result of physiographic conditions (water temperature, relief, depth, etc.), processes external to an arbitrarily bounded system (e.g., fishing mortality) and interactions between system components (trophic relationships). Structure can change as a result of internal feedback. For example, scientists have posited "cultivation/depensation effects" that may be lead to recruitment failure even though one would expect compensation to declines in biomass (Walters and Kitchell 2001). (Compensatory response assumes that growth and survival is density dependant.) In the paper cited above (MacCall 2002b), MacCall also simulates this phenomenon, which has been posited for large rockfish species, which may be displaced by smaller rockfish species in some habitats. Large species have declined due to exogenous factors (including fishing mortality); the greater relative abundance of fish preying on juveniles primarily other, smaller species of rockfish depresses recruitment of the larger species. MacCall calculated surplus production curves for a single species and two-species model and points out that at low exploitation rates the two curves are similar and "the collapse in productivity would be unexpected under most conventional single-species fishery-management policies." Furthermore, because higher short-term yields could be achieved during a period of fishing down an unexploited population, "the change in productivity of the large species could be mistakenly attributed to low-frequency climate change" (MacCall 2002b, p. 634). Thus in the simulated two-species system the harvestable surplus for the larger species is much smaller, and B_{MSY} is much larger in comparison to a single species model. Fishery scientists cannot yet incorporate these ecological effects into predictive models for real world species. Because these interspecific dynamics substantially lengthen rebuilding time periods once the larger species become depleted, the management system has to adapt to very long planning horizons. MacCall (2002b, p. 626) concludes "The growing emphasis on rebuilding of depleted stocks may have an unexpected benefit to fishery management. In addition to the economic benefit of restoring fish productivity, stock rebuilding requires adoption of much longer planning horizons; specifically, planning horizons associated with the scale of long-term variability in fish stocks."

Interspecific competition, although difficult to quantify, has a substantial role in the potential rebuilding of overfished species, particularly when several species are under rebuilding plans concurrently. Cumulative impact analyses, like rebuilding trajectories, are unable to fully consider or quantify interspecific relationships. Therefore, some of the assumptions utilized to illustrate harvest realizations under various rebuilding alternatives may not be attainable. For example, due in part to interspecific competition, it is conceivable it is not possible to achieve MSY for all stocks simultaneously under any of the rebuilding plan alternatives as presented in Section 5.4.

In addition to interspecific effects, a range of non-fishing impacts can affect essential fish habitat; these change physiographic conditions, which may produce changes in ecosystem structure. (Section 11.10.4 of the Groundfish FMP describes these effects.) These activities such as dredging, oil and gas exploitation, wastewater discharge, aquaculture and coastal development generally affect inshore habitats. With some notable exceptions (such as the live fish fishery in Southern California) most limited entry and directed open access fisheries do not occur in the inshore areas directly affected by these activities. However, according to EFH descriptions in the Groundfish FMP, early life stages of some target species such as Pacific whiting and bocaccio use estuarine habitat, so these stocks could be affected if nearshore non-fishing activities reduce productivity by damaging habitat.

5.2 Cumulative Impacts to Overfished Species, Other Groundfish, and Nongroundfish Stocks

Projected harvests (round weight) of overfished and co-occurring species under the cumulative effects analyses are shown in Table 5.2-1.

5.2.1 The *Maximum Conservation* Alternative

All nine overfished species would be managed for zero fishing mortality under this cumulative impact alternative. Therefore, all fisheries operating inshore of about 250 fm north of 38° N latitude and inside 150 fm south of that latitude that show a demonstrated impact on overfished groundfish species would be closed or modified to eliminate those impacts. In such a case, all co-occurring species that had some fishing-related mortality from these affected fisheries would incur significantly less anthropogenic impacts (direct impacts from fishery interceptions and indirect impacts from habitat disturbance). Future abundance and productivity of these co-occurring species would then be solely influenced by the environmental, ecological, and trophic interactions discussed in Section 5.1. Some species, such as those that competitively interact with overfished groundfish species, may actually decline under this no-fishing state, while others may increase in abundance with the release of fishing-related mortality. All currently overfished groundfish species would be expected to rebuild at fast rates, perhaps faster than the rebuilding trajectories in Chapter 4 would indicate due to greater survival of juvenile fish and potentially greater productivity due to less fishing-related disturbance of habitats.

5.2.2 The *Maximum Harvest* Alternative

If all the overfished groundfish species were managed under a *Maximum Harvest* alternative, then fishing mortality rates would be significantly higher than they are currently with the likely outcome of a greater number of species declining to an overfished status. Some species would thrive under this state due to the competitive interactions previously discussed. There is also a higher risk of retarding the rebuilding progress of overfished species beyond that described for the individual species' realizations denoted in Chapter 4 (with the end result being actual P_{MAX} could be less than the 50% modeled). This could be due to unaccounted sources of mortality engendered by higher fishing rates. Habitat impacts would be greater with the greater level of fishing activity. Depth-based restrictions may not be needed on the slope (150 fm to 250 fm) north of 38° N latitude, but there may be a need for some seasonal or permanent coastwide depth-based restrictions on the shelf (50 fm to 150 fm north of Cape Mendocino and 20 fm to 150 fm south of Cape Mendocino) to protect bocaccio, canary rockfish, cowcod, and yelloweye rockfish.

5.2.3 The *Council Interim* Alternative

Managing all the overfished species under the *Council Interim* alternative would have intermediate effects relative to the *Maximum Conservation* and *Maximum Harvest* alternatives. Depth-based restrictions would probably be needed in the 50 fm to 250 fm zone north of 38° N latitude and in the 20 fm to 150 fm zone south of 38° N latitude, but they may be relaxed in some areas and during some seasons depending on fishery bycatch rates. There is a chance that fishing mortality rates in general are too high for some of the co-occurring species which might lead to continued overfishing. However, this alternative, especially with the implementation of depth-based restrictions and the advent of observer data, is precautionary and is expected to rebuild overfished and co-occurring species.

5.2.4 The *Mixed Stock Exception* Alternative

Managing bocaccio, canary rockfish, widow rockfish, and yelloweye rockfish under a *Mixed Stock Exception*, with the other species managed under *Maximum Harvest* results in the highest fishing mortality rates for overfished and co-occurring species. While the four species managed under the *Mixed Stock Exception* certainly do not rebuild, there is a greater risk of continued overfishing for the other five overfished species. Some co-occurring species would undoubtedly become overfished as well. Smaller rockfish and some of the other co-occurring species might thrive due to lesser competition and predation of exploited species. Potential habitat impacts would be greatest in this case due to a significantly larger fishing effort.

Table 5.2-1. Projected landings by cumulative analysis scenario (round weight mt) (Page 1 of 2) a/ b/

	2002	Council Interim	Max Harvest	MSE	Max Conservation	MSY c/
North of Cape Mendocino						
Limited Entry Trawl						
At-Sea Whiting	84,419	85,866	88,856	88,856	-	100,953
Shoreside Whiting	45,707	50,838	62,331	62,331	-	108,823
Sablefish	1,201	1,750	1,756	1,740	-	1,758
Nearshore Species	667	337	488	503	-	578
Shelf and Midwater Spp	7,399	6,824	8,142	9,193	-	11,408
Slope Spp	6,339	6,993	7,391	7,398	-	7,699
Other Groundfish	11	6	9	10	-	12
Total	145,743	152,614	168,974	170,032	-	231,231
Limited Entry Fixed Gear						
Sablefish	1,105	1,325	d/	d/	-	d/
Nearshore Species	55	31	d/	d/	-	d/
Shelf and Midwater Spp	430	430	d/	d/	-	d/
Slope Spp	55	55	d/	d/	-	d/
Other Groundfish	0	0	d/	d/	-	d/
Total	1,645	1,840	d/	d/	-	d/
Open Access (> 5% Revenue from Groundfish)						
Sablefish	576	604	d/	d/	-	d/
Nearshore Species	318	212	d/	d/	-	d/
Shelf and Midwater Spp	483	483	d/	d/	-	d/
Slope Spp	31	31	d/	d/	-	d/
Other Groundfish	5	5	d/	d/	-	d/
Total	1,413	1,334	d/	d/	-	d/
Open Access (<= 5% Revenue from Groundfish)						
Sablefish	28	34	d/	d/	-	d/
Nearshore Species	5	4	d/	d/	-	d/
Shelf and Midwater Spp	48	48	d/	d/	-	d/
Slope Spp	3	3	d/	d/	-	d/
Other Groundfish	0	0	d/	d/	-	d/
Total	85	89	d/	d/	-	d/
Nongroundfish						
Shrimp	24,908	24,908	24,908	24,908	-	24,908
Prawns	0	0	0	0	0	0
Dungeness Crab	13,483	13,483	13,483	13,483	13,483	13,483
Other Crustaceans	180	180	180	180	72	180
Pacific Halibut	421	421	421	421	-	421
California Halibut	4	4	4	4	4	4
Salmon	2,628	2,628	2,628	2,628	-	2,628
Sea Cucumber	374	374	374	374	374	374
Gillnet Complex	1	1	1	1	1	1
Squid	2	2	2	2	2	2
CPS Finfish	39,335	39,335	39,335	39,335	39,335	39,335
HMS	8,418	8,418	8,418	8,418	8,418	8,418
Other Species	5,453	5,453	5,453	5,453	5,453	5,453
Total Nongroundfish	95,207	95,207	95,207	95,207	67,141	95,207
Total North of Cape Mendocino	244,093	251,085	d/	d/	67,141	d/
South of Cape Mendocino						
Limited Entry Trawl						
Shoreside Whiting	0	0	0	0	-	0
Sablefish	393	602	600	594	-	596
Nearshore Species	403	352	484	527	-	724
Shelf and Midwater Spp	1,799	1,571	1,716	2,269	-	2,858
Slope Spp	2,353	2,681	2,861	2,896	-	3,197
Other Groundfish	15	11	16	16	-	19
Total	4,963	5,218	5,678	6,302	-	7,394
Limited Entry Fixed Gear						
Sablefish	280	430	d/	d/	-	d/
Nearshore Species	9	8	d/	d/	-	d/
Shelf and Midwater Spp	12	12	d/	d/	-	d/
Slope Spp	217	217	d/	d/	-	d/
Other Groundfish	2	2	d/	d/	-	d/
Total	519	669	d/	d/	-	d/

Table 5.2-1. Projected landings by cumulative analysis scenario (round weight mt) (Page 2 of 2) a/ b/

	2002	Council Interim	Max Harvest	MSE	Max Conservation	MSY c/
Open Access (> 5% Revenue from Groundfish)						
Sablefish	216	274	d/	d/	-	d/
Nearshore Species	176	156	d/	d/	-	d/
Shelf and Midwater Spp	74	74	d/	d/	-	d/
Slope Spp	84	84	d/	d/	-	d/
Other Groundfish	3	3	d/	d/	-	d/
Total	554	592	d/	d/	-	d/
Open Access (< 5% Revenue from Groundfish)						
Sablefish	9	11	d/	d/	-	d/
Nearshore Species	15	16	d/	d/	-	d/
Shelf and Midwater Spp	26	26	d/	d/	-	d/
Slope Spp	4	4	d/	d/	-	d/
Other Groundfish	9	9	d/	d/	-	d/
Total	63	66	d/	d/	-	d/
Nongroundfish						
Shrimp	373	373	373	373	-	373
Prawns	393	393	393	393	79	393
Dungeness Crab	2,008	2,008	2,008	2,008	2,008	2,008
Other Crustaceans	1,256	1,256	1,256	1,256	880	1,256
Pacific Halibut	0	0	0	0	-	0
California Halibut	305	305	305	305	-	305
Salmon	2,411	2,411	2,411	2,411	-	2,411
Sea Cucumber	425	425	425	425	425	425
Sea Urchins	6,157	6,157	6,157	6,157	6,157	6,157
California Sheephead	52	52	52	52	52	52
Gillnet Complex	352	352	352	352	-	352
Squid	72,878	72,878	72,878	72,878	72,878	72,878
CPS Finfish	67,318	67,318	67,318	67,318	67,318	67,318
HMS	4,477	4,477	4,477	4,477	4,477	4,477
Other Species	3,763	3,763	3,763	3,763	3,763	3,763
Total Nongroundfish	162,167	162,167	162,167	162,167	158,036	162,167
Total South of Cape Mendocino	168,265	168,712	d/	d/	158,036	d/
Coastwide Total	412,358	419,796	d/	d/	225,178	d/

a/ Includes Tribal fisheries
b/ "0" indicates an amount of landing less than 0.5 mt.
c/ Based on all stocks at 2002 harvest levels with overfished species rebuilt. Does not capture differences in the time of rebuilding between the options or the possibility that sustained yield levels for nonoverfished species might increase as a result of conservation measures designed to protect overfished species.
d/ No projection is available.

5.3 Cumulative Socioeconomic Impacts

The effects of reduced harvest of overfished species on West Coast fishery revenues is evaluated here in terms of impact on commercial seafood exvessel value and recreational fishing. For the commercial seafood fishery, exvessel value is an indicator of direct impacts on vessels and indirect impacts on seafood buyers, processors, businesses supplying vessels and processors, and the communities in which they reside. There is a similar chain of impacts for the recreational fishery. The recreational fishery has a directly impacted sector, charter vessels, as well as those indirectly impacted sectors that supply charter vessels and private fishermen. As for the seafood fishery, the direct and indirect impacts for the recreational fishery are distributed among coastal communities. The cumulative effects on the recreational fishery will be addressed primarily qualitatively due to uncertainty about allocational decisions the Council would make, the likely regulations that would be imposed, and the lack of models to project effort response under possible regulatory regimes. Only for the trawl sector is an attempt made to provide a quantitative estimate under each of the cumulative impact scenarios.

5.3.1 Cumulative Impacts of Past Actions

The cumulative economic impacts of past actions can be evaluated by comparing information on 1998 to information on 2002. Such information is provided for all fisheries in Chapter 3.

Between 1998 and 2002, significant actions have been taken to constrain fish harvest. As a result of those actions, it is likely stock biomasses and potential harvests in the coming years are greater than they would have otherwise been. At the same time, it is likely the industry and communities relying on the fisheries are already under significant economic and social stress. These stresses vary by the geographic region and fisheries in which vessels participate. Looking at the shoreside tribal and nontribal fisheries for all species, exvessel revenue north of Cape Mendocino has increased from $112 million in 1998 (Table 3.4-9) to $131 million in 2002 (Table 3.4-11). South of Cape Mendocino all fisheries in aggregate have remained relatively stable in terms of exvessel value, $88 million in 1998 (Table 3.4-10) to $87 million in 2002 (Table 3.4-12). However, for the groundfish fishery, there has been substantial reductions. In 1998, the total value of the nontribal groundfish harvest was $64 million (including the at-sea whiting fishery). By 2002, conservation measures had reduced total vessel receipts to $47 million (Table 3.4-33). None of the values cited here are adjusted for inflation. The groundfish fishery was declared an economic disaster in the year 2000.

Similarly, on the recreational side, 2002 groundfish seasons (Figure 3.4-6) were significantly constrained as compared to 1998 seasons (Figure 3.4-7). While groundfish fisheries have been constrained, the catch of bocaccio and lingcod appear to be higher in 2002 relative to 1998 and the catch of other overfished species are substantially lower in 2002 relative to 1998 (Table 3.4-47). Important caveats in presenting this information on the recreational fishery is that the MRFSS program from which the data is derived is subject to variability due to the statistical methods used to develop the estimates and some changes in the scope of the survey between years. Data provided represent best available estimates.

5.3.2 Cumulative Impacts of Current Actions

5.3.2.1 Short Term

The short-term analysis focuses on the effects that different cumulative impact scenarios would have had if imposed on the 2003 fishery. It provides a reasonable estimate of likely impacts for 2004, assuming that information on stock biology and conditions do not change. Because at present some substantial changes appear likely, these estimates should be considered as illustrations of the magnitude of the likely differences between the various types of rebuilding policies.

The 2002 fishery is provided as a comparison point, because actual harvest data is available for this fishery. Table 5.3-1a shows the postseason estimates of the distribution of the 2002 harvest of overfished species across fishery sectors. Table 5.3-1b shows the preseason estimates for 2003. Quantitative models are available only for the nonwhiting limited entry trawl harvest. Based on these models, estimates were developed of the amount of harvest that would be expected for trawlers under each of the scenarios (Table 5.3-2). In general, darkblotched rockfish and bocaccio constrained the *Council Interim*, *Maximum Harvest*, and MSE rebuilding scenarios (Table 5.3-3). These amounts of overfished species expected to be taken by nonwhiting trawlers are subtracted from the total OYs to determine the harvest available for distribution among the whiting, nontrawl commercial, and recreational sectors. For a point of comparison, the difference between the amounts of harvest expected to be taken in these sectors in 2003 (*Council Interim* scenario) and the amounts that would be available for these sectors if one of the other cumulative impact scenarios were implemented is provided in Table 5.3-4. Thus, Table 5.3-4 shows the changes in amounts of OY available for all other sectors after accounting for the amount expected to be taken in the trawl fishery.

In order to construct the *Maximum Conservation* alternative (zero harvest of overfished species), the amount of overfished groundfish species landed on trips targeted primarily on nongroundfish species was evaluated (Table 5.3-5). For presentation of revenue estimates in Table 5.3-6, those nongroundfish target strategies for which more than 1,000 pounds of at least one overfished species was taken in the regional fishery (north of Cape Mendocino and south of Cape Mendocino, respectively) were assumed to be closed in order to reach a zero morality for overfished species. The amounts of overfished species landed on nongroundfish trips may or may not reflect actual bycatch (see Section 3.4.2.1 for important assumptions and caveats). For overfished groundfish species that are not the direct subject of this amendment (widow rockfish, bocaccio, cowcod, yelloweye, and whiting) coincident landed catch and value of the fishery are presented in Tables 5.3-7 through 5.3-11. Tables 5.3-7 through 5.3-11 are similar to Tables 4.4-9 through 4.4-12 that present coincident landing information for darkblotched rockfish, POP, canary rockfish, and lingcod. Additional description of the information provided in these tables is provided in Section 4.4.2.

Table 5.3-6 shows projected exvessel values for the shoreside and at-sea limited entry trawl groundfish fisheries, including whiting, under each of the rebuilding scenarios. North of Cape Mendocino, the Council interim fishery provides trawlers with approximately $34 million of exvessel value while the MSE alternative may provide an additional $4 million dollars of exvessel value. For the trawl fishery, the additional value of the MSE alternative for the trawl fishery, as compared to the *Maximum Harvest* scenario (without the *Mixed Stock Exception*), is about $1 million. The mixed stock exception is modeled for bocaccio, canary rockfish, and widow rockfish. However, darkblotched rockfish is the major constraint on the northern trawl fishery. Therefore, the additional benefit of the MSE alternative for this fishery is limited. South of Cape Mendocino, the Council interim fishery provides trawlers with approximately $6.5 million of exvessel value while the MSE alternative may provide an additional $1.1 million dollars of such value. The additional value of the MSE alternative for the trawl fishery, as compared to the *Maximum Harvest* scenario without the mixed stock exception, is about $0.6 million.

In the short term, the *Maximum Conservation* scenario would likely cause closure or severe constraints in all groundfish fisheries as well as a number of nongroundfish fisheries. As compared to the Council interim scenario, the *Maximum Conservation* scenario might reduce coastwide exvessel value from about $228 million (*Council Interim*) to $135 million (*Maximum Conservation*). These estimates assume that absent restrictions related to groundfish, the nongroundfish fisheries will otherwise experience stable harvests and exvessel prices.

Reduction in groundfish harvest opportunities will likely encourage fishers to move into fisheries where regulations allow some expansion of harvest and that are not subject to restrictions to protect overfished groundfish species. While this strategy may allow fishers to recover some revenue in the short term, there may be adverse impacts in the intermediate and long term.

5.3.2.2 Intermediate

In the long term it is expected that all stocks will rebuild. The length of time it takes to rebuild will vary inversely with the degree of protection afforded. Faster rebuilding also implies reduced economic benefits in any single year during the rebuilding period. The time path of rebuilding for individual overfished species covered in this amendment is addressed in Section 4.4.1. In addition to the overfished species, there are a number of groundfish stocks that are at depressed but not overfished levels. The protection afforded these stocks by measures taken to rebuild overfished species may result in increasing the biomass of the depressed stocks, eventually increasing the OYs for nonoverfished species as well as the overfished species. These depressed species will benefit from the additional protection afforded under any of the rebuilding alternatives, the main difference being the degree and duration of the protection.

While both groundfish and nongroundfish stocks may benefit from measures to protect groundfish, reduction in groundfish harvest opportunities will likely encourage fishers to move into fisheries that are not subject to restrictions to protect overfished groundfish species. Unless biology and biomass of the stocks targeted in these other fisheries are appropriately assessed, and unless management measures in these other fisheries are adequately conservative and adequately enforced, there may be detrimental effects on other fisheries. Reduction in sustainable yields could then result, causing reduction in economic benefits over the intermediate and long-term.

5.3.2.3 Long-term

Over the long term, overfished stocks are expected to rebuild to MSY levels under all scenarios (except the MSE option for which some stocks would not be rebuilt). In Table 5.3-6, the "MSY" column shows projected exvessel revenues for the trawl fishery if all species are rebuilt to MSY. The values for the nongroundfish stocks assume that nongroundfish species have stable harvest levels and prices. The "Long-term MSY" row of Table 5.3-4 lists the additional catch of overfished species available for whiting, nontrawl, and recreational fisheries assuming all stocks are rebuilt. These show substantial potential increases in OYs for lingcod, canary, POP and especially widow and bocaccio. Increasing these OYs would support considerably higher levels of all west Coast groundfish activity in the future.

5.3.3 Cumulative Impacts of Future Actions

This cumulative impact analysis takes into account future adoption of rebuilding plans for stocks currently declared overfished that are not part of the this amendment (widow rockfish, bocaccio, cowcod, yelloweye, and whiting). The scenarios, discussion and modeling include these other stocks, though in some cases, such as for yelloweye, the preseason models for the 2003 trawl fishery have not been developed to quantitatively assess harvest and the interaction of such constraints within the model. For such cases, catch estimates were developed outside the model based on evaluation of expected (preseason) impacts on the 2003 trawl fishery.

Capacity reduction, particularly for the trawl fleet, is expected in the near future. To the degree that industry pays for capacity reduction, average short-term net revenue per pound of fish may decrease. However, there will likely be an increase in the total catch available per vessel, increasing average exvessel revenue per vessel, and exerting an upward influence on net profits.

The effects of concurrent and future actions discussed here are not likely to vary between the alternatives but may mitigate or exacerbate impacts of the actions proposed in this amendment.

Table 5.3-1a. 2002 base landed catch by fishery for overfished species (mt)

	1998 Total Catch OY	2002 Total Catch OY	Postseason Catch Estimates for 2002: Total Postseason Catch Estimate e/	Recreational f/	Fixed Gear Limited Entry	Directed Open Access	Other Commercial	Tribal	Research d/	Trawl (Shoreside)	Trawl (At Sea)
Lingcod	838	577	778.6	570.1	9.8	68.6	16.0	11.3	3.3	99.2	0.3
Canary a/	1045	93	71.5	18.0	1.6	0.2	1.4	6.1	0.1	41.7	2.4
POP b/	650	350	151.0	0.4	0.2	0.0	0.1	0.5	0.3	145.9	3.6
Darkblotched	n/a	168	82.1	0.0	0.2	0.1	0.8	1.6	0.1	76.2	3.1
Widow	4,960	856	429.9	2.6	0.0	0.5	0.4	32.1	0.3	258.8	135.2
Bocaccio c/	230	100	102.7	81.6	0.2	2.7	0.6	0.0	0.1	17.5	0.0
Cowcod	n/a	5	0.6	0.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Yelloweye	n/a	182	6.9	6.2	0.0	0.0	0.2	0.0	0.1	0.4	0.0
Whiting	232,000	129,600	130,506	1	0	0	183	21,815	7	45,565	62,935

a/ 1998 OY is for Vancouver and Columbia INFPC areas. 2002 and 2003 OYs are coastwide.
b/ 1998 OY is for landed catch in the Vancouver and Columbia INPFC areas. 2002 and 2003 OYs are total catch OYs for Vancouver, Columbia and Eureka INPFC areas.
c/ 1998 OY is for Eureka, Monterey and Conception INPFC areas. 2002 and 2003 OYs are for Monterey and Conception areas.
d/ Federal permits only. Doesn't include Oregon and California state-issued scientific fishing permits.
e/ Category totals include landings made on exempted fishing permits (EFPs).
f/ Preliminary

Table 5.3-1b. 2002 base and 2003 (Council interim) catch mortality, including bycatch, by fishery for overfished species (mt).

	1998 Total Catch OY	2002 Total Catch OY	2003 Total Catch OY	Preseason Catch Estimates for 2003: Total Preseason Catch Estimate	Recre-ational	Fixed Gear Limited Entry	Directed Open Access	Other Commercial	Tribal	Research	Exempt Fishing Permits	Trawl (Shoreside & At Sea) d/	Shoreside Non-whiting Trawl only d/
Lingcod	838	577	651	512.8	355.0	20.0	50.0	0.8	5.2	3.0	15.2	63.6	63.1
Canary a/	1045	93	44	43.5	15.0	0.5	0.3	2.2	2.3	1.0	6.5	15.7	12.3
POP b/	650	350	377	109.7	0.0	0.0	0.0	0.0	0.0	3.0	1.0	105.7	96.5
Darkblotched	n/a	168	172	98.9	0.0	0.0	0.0	0.0	0.0	1.6	4.1	93.2	86.7
Widow	4,960	856	832	289.4	5.0	0.0	0.0	0.1	45.0	1.5	14.0	223.8	11.8
Bocaccio c/	230	100	< 20	10.3	5.0	0.1	0.2	1.8	0.0	0.2	1.6	1.4	1.4
Cowcod	n/a	5	5	1.7	0.0	0.1	0.0	0.1	0.0	0.0	1.5	0.0	0
Yelloweye	n/a	182	22	19.5	7.7	1.0	0.5	0.9	3.1	0.6	4.2	1.5	1.5
Whiting	232,000	129,600	148,200	148,251	0	0	0	1	25,000	200	50	123,000	1,800

a/ 1998 OY is for Vancouver and Columbia INFPC areas. 2002 and 2003 OYs are coastwide.
b/ 1998 OY is for landed catch in the Vancouver and Columbia INPFC areas. 2002 and 2003 OYs are total catch OYs for Vancouver, Columbia and Eureka INPFC areas.
c/ 1998 OY is for Eureka, Monterey and Conception INPFC areas. 2002 and 2003 OYs are for Monterey and Conception areas.
d/ These values are from Table 4.4-1 in the 2003 annual spex EIS (Council, 2003). Values used in the trawl model are slightly higher due to some final adjustments to the model.

Table 5.3-2. Total catch OYs by scenario and projected nonwhiting trawl harvest.

	Estimated Total Catch OYs (in 2003) under the Cumulative Analysis Scenarios (mt)					Non-whiting Trawl OYs under each Scenario (mt) c/					Total Catch OYs Available Net of Non-whiting Trawl OYs (mt)				
	Council Interim c/	Max Harvest	MSE b/	Max Conser-vation	Long-term MSY	Council Interim c/	Max Harvest	MSE b/	Max Conser-vation	Long-term MSY	Council Interim c/	Max Harvest	MSE b/	Max Conser-vation	Long-term MSY
Lingcod a/	651.0	725.0	725.0	0	1,373.0	66.8	100.3	107.0	0	153.6	584.2	624.7	618.0	0	1,219.4
Canary a/	44.0	45.0	214.0	0	622.0	13.0	12.1	24.1	0	40.2	31.0	32.9	189.9	0	581.8
POP a/	377.0	496.0	496.0	0	1,164.0	97.7	208.0	204.3	0	292.4	279.3	288.0	291.7	0	871.6
Darkblotched a/	172.0	205.0	205.0	0	360.0	87.0	205.0	198.0	0	284.9	85.0	0.0	7.0	0	75.1
Widow	832.0	916.0	2,272.5	0	7,196.0	12.4	23.3	29.6	0	45.7	819.6	892.7	2,242.9	0	7,150.3
Bocaccio	< 20	< 20	34.0	0	3,481.0	1.5	3.8	11.4	0	42.3	18.5	16.2	22.6	0	3,438.7
Cowcod d/	4.8			0	30.0	0.0					4.8				
Yelloweye d/	22.0	27.0	55.6	0	47.0	1.5					20.5				
Whiting d/	148,200	173,600	173,600	0	284,438	1,800					146,400				

a/ Overfished species covered in Amendment 16-2.
b/ MSE are invoked for canary, widow, bocaccio, and yelloweye.
c/ 2003 preseason specifications are used to model each scenario.
d/ Not included in the non-whiting trawl bycatch model.

Table 5.3-3. Rebuilding species constraining the non-whiting trawl fishery under each scenario.

Council Interim	North of Cape Mendocino: Darkblotched, Canary South of Cape Mendocino: Bocaccio
Max Harvest	North of Cape Mendocino: Darkblotched, Canary South of Cape Mendocino: Bocaccio
MSE	North of Cape Mendocino: Darkblotched South of Cape Mendocino: Bocaccio
Max Conservation	All groundfish fisheries and fisheries that may take rebuilding groundfish species incidentally are zeroed out.
Long-term MSY	None of the currently-rebuilding groundfish species constrain the non-whiting trawl fishery. a/

a/ The model does not currently include directed fisheries for bocaccio and chilipepper.

Table 5.3-4. Possible adjustments in other fisheries compared with Council Interim alternative based on results from non-whiting trawl model.

	Fisheries in Which Adjustments Might be Made							
	Recreational	Fixed Gear Limited Entry	Directed Open Access	Other Commercial	Tribal	Research	EFPs	Whiting Trawl
Max Harvest	Compared with Council Interim, there is an additional 40 mt lingcod OY, 2 mt canary OY and 73 mt widow OY for allocation to remaining fishery sectors. Bocaccio OY is 2 mt less than under Council interim. Darkblotched OY is 85 mt less than under Council interim. a/							
MSE	Compared with Council Interim, there is an additional 34 mt lingcod OY, 159 mt canary OY, 12 mt POP OY, 4 mt bocaccio OY and 1,423 mt widow OY for allocation to remaining fishery sectors. Darkblotched OY is 78 mt less than under Council interim. a/							
Max Conservation	Zero harvest							
Long-term MSY	OY levels are much higher for all rebuilding species under the Long-term MSY scenario. Fisheries other than non-whiting trawl would see increased OYs as follows: lingcod +635 mt, canary +551 mt, POP +592 mt, widow +6,331 mt and bocaccio +3,420 mt. Darkblotched OY is 10 mt less than under Council interim. a/							

a/ In 2003, only about 57% of available darkblotched OY was allocated to fisheries. Under the scenarios, additional darkblotched OY is allocated to the non-whiting trawl sector. Darkblotched rockfish bycatch in non-whiting trawl and non-trawl fisheries is relatively rare.

Table 5.3-5. Presence of any of the nine overfished species in nongroundfish fisheries (summarized from Tables 3.3-3 through 3.3-8).

Target	North of Mendocino			South of Mendocino		
	1998	2000	2002	1998	2000	2002
Pink Shrimp	+++	+++	+++	+++	+	-
Prawns	-	-	-	+++	++	+
Dungeness Crab	+	+	+	+	-	-
Other Crustaceans	+++	+	-	+	+	+
Pacific Halibut	+++	+++	+++	+	-	-
California Halibut	-	-	+	+++	+	+++
Salmon	+++	+++	+++	++	++	+++
Sea Cucumbers	-	-	-	+	-	+
Sea Urchins	-	-	-	+	-	+
California Sheephead	-	-	-	+	+	+
Gillnet Complex	-	-	-	+++	+	+
Squid	-	-	-	-	-	-
CPS Finfish	-	-	-	+	+	+
Highly Migratory Species	+	+	-	+	+	+
Other Species	+++	+++	+++	++	+	+

+++ = >1,000 pounds of a single overfished species in landings with the indicated primary target species.
++ = >1,000 pounds of all overfished species combined in landings with the indicated primary target species.
+ = <=1,000 pounds of all overfished species combined in landings with the indicated primary target species.
- = no overfished species present in landings with the indicated primary target.

Table 5.3-6. Projected ex-vessel revenue by cumulative analysis scenario ($,000) (Page 1 of 2) a/ b/ c/

	2002	Council Interim	Max Harvest	MSE	Max Conservation	MSY d/
North of Cape Mendocino						
Limited Entry Trawl						
At-Sea Whiting	9,119	9,276	9,599	9,599	-	10,906
Shoreside Whiting	4,554	5,066	6,211	6,211	-	10,843
Sablefish	2,956	4,605	4,622	4,582	-	4,631
Nearshore Species	648	313	452	465	-	534
Shelf and Midwater Spp	6,263	5,912	6,903	7,931	-	10,062
Slope Spp	7,848	8,823	9,241	9,225	-	9,568
Other Groundfish	8	5	7	8	-	10
Total	31,397	33,999	37,034	38,022	-	46,553
Limited Entry Fixed Gear						
Sablefish	4,393	5,268	e/	e/	-	e/
Nearshore Species	281	156	e/	e/	-	e/
Shelf and Midwater Spp	222	222	e/	e/	-	e/
Slope Spp	70	70	e/	e/	-	e/
Other Groundfish	1	1	e/	e/	-	e/
Total	4,967	5,717	e/	e/	-	e/
Open Access (> 5% Revenue from Groundfish)						
Sablefish	2,000	2,096	e/	e/	-	e/
Nearshore Species	1,378	848	e/	e/	-	e/
Shelf and Midwater Spp	631	631	e/	e/	-	e/
Slope Spp	34	34	e/	e/	-	e/
Other Groundfish	23	23	e/	e/	-	e/
Total	4,065	3,633	e/	e/	-	e/
Open Access (<= 5% Revenue from Groundfish)						
Sablefish	90	108	e/	e/	-	e/
Nearshore Species	12	8	e/	e/	-	e/
Shelf and Midwater Spp	56	56	e/	e/	-	e/
Slope Spp	4	4	e/	e/	-	e/
Other Groundfish	0	0	e/	e/	-	e/
Total	162	176	e/	e/	-	e/
Nongroundfish						
Shrimp	15,022	15,022	15,022	15,022	-	15,022
Prawns	1	1	1	1	1	1
Dungeness Crab	48,813	48,813	48,813	48,813	48,813	48,813
Other Crustaceans	1,690	1,690	1,690	1,690	579	1,690
Pacific Halibut	1,817	1,817	1,817	1,817	0	1,817
California Halibut	20	20	20	20	20	20
Salmon	7,054	7,054	7,054	7,054	0	7,054
Sea Cucumber	357	357	357	357	357	357
Gillnet Complex	0	0	0	0	0	0
Squid	1	1	1	1	1	1
CPS Finfish	4,858	4,858	4,858	4,858	4,858	4,858
HMS	11,992	11,992	11,992	11,992	11,992	11,992
Other Species	1,431	1,431	1,431	1,431	1,431	1,431
Total Nongroundfish	93,057	93,057	93,057	93,057	68,052	93,057
Total North of Cape Mendocino	133,648	136,582	e/	e/	68,052	e/

Table 5.3-6. Projected ex-vessel revenue by cumulative analysis scenario ($,000) (Page 2 of 2) a/ b/ c/

	2002	Council Interim	Max Harvest	MSE	Max Conservation	MSY d/
South of Cape Mendocino						
Limited Entry Trawl						
Shoreside Whiting	0	0	0	0	-	0
Sablefish	865	1,367	1,360	1,347	-	1,350
Nearshore Species	382	308	423	461	-	629
Shelf and Midwater Spp	1,652	1,311	1,439	2,026	-	2,603
Slope Spp	3,203	3,555	3,749	3,776	-	4,125
Other Groundfish	17	10	14	14	-	17
Total	6,119	6,552	6,984	7,624	-	8,724
Limited Entry Fixed Gear						
Sablefish	837	1,317	e/	e/	-	e/
Nearshore Species	61	57	e/	e/	-	e/
Shelf and Midwater Spp	53	53	e/	e/	-	e/
Slope Spp	869	869	e/	e/	-	e/
Other Groundfish	4	4	e/	e/	-	e/
Total	1,824	2,300	e/	e/	-	e/
Open Access (> 5% Revenue from Groundfish)						
Sablefish	643	861	e/	e/	-	e/
Nearshore Species	1,732	1,449	e/	e/	-	e/
Shelf and Midwater Spp	222	222	e/	e/	-	e/
Slope Spp	128	128	e/	e/	-	e/
Other Groundfish	8	8	e/	e/	-	e/
Total	2,733	2,667	e/	e/	-	e/
Open Access (< 5% Revenue from Groundfish)						
Sablefish	27	35	e/	e/	-	e/
Nearshore Species	65	65	e/	e/	-	e/
Shelf and Midwater Spp	43	43	e/	e/	-	e/
Slope Spp	8	8	e/	e/	-	e/
Other Groundfish	20	20	e/	e/	-	e/
Total	162	170	e/	e/	-	e/
Nongroundfish						
Shrimp	333	333	333	333	-	333
Prawns	3,977	3,977	3,977	3,977	1,589	3,977
Dungeness Crab	9,035	9,035	9,035	9,035	9,035	9,035
Other Crustaceans	6,479	6,479	6,479	6,479	6,160	6,479
Pacific Halibut	1	1	1	1	-	1
California Halibut	1,968	1,968	1,968	1,968	-	1,968
Salmon	7,069	7,069	7,069	7,069	-	7,069
Sea Cucumber	792	792	792	792	792	792
Sea Urchins	9,919	9,919	9,919	9,919	9,919	9,919
California Sheephead	391	391	391	391	391	391
Gillnet Complex	1,503	1,503	1,503	1,503	-	1,503
Squid	18,260	18,260	18,260	18,260	18,260	18,260
CPS Finfish	7,086	7,086	7,086	7,086	7,086	7,086
HMS	10,037	10,037	10,037	10,037	10,037	10,037
Other Species	3,314	3,314	3,314	3,314	3,314	3,314
Total Nongroundfish	80,163	80,163	80,163	80,163	66,581	80,163
Total South of Cape Mendocino	91,001	91,852	e/	e/	66,581	e/
Coastwide Total	224,649	228,435	e/	e/	134,633	e/

a/ Includes Tribal fisheries
b/ Current dollars (not indexed for inflation).
c/ "0" indicates an amount less than $500.
d/ Based on all stocks at 2002 harvest levels with overfished species rebuilt. Does not capture differences in the time of rebuilding between the options or the possibility that sustained yield levels for nonoverfished species might increase as a result of conservation measures designed to protect overfished species.
e/ No projection is available.

Table 5.3-7. Catch and/or landed catch of widow rockfish and exvessel revenue by trip target type (1998 & 2002).[a/] (Page 1 of 4)

Primary Target for Trip	Trips	Percent of Primary Target Trips with Widow in Landing	Total Exvessel Revenue	Widow Landed (mt)	Widow Landed or Estimated Catch (mt)	Cumulative Widow (Mt)	Total Exvessel Revenue for Area: Percent of Total	Total Exvessel Revenue for Area: Cumulative Percent	Exves Rev/Lb Widow (Landed & Bycatch)
1998									
North of Mendocino									
Dungeness Crab	15,336	0.0%	38,526,779	0.000	0.000	0.000	34.5%	35%	38,526,779
LE Fxd Gr SF, No Strata	600	0.2%	1,487,843	0.002	0.002	0.002	1.3%	36%	371,961
HMS Plan Species	1,533	0.1%	15,868,173	0.004	0.004	0.006	14.2%	50%	1,983,522
LE Fxd Gr, Oth GF, Slope	7	14.3%	5,649	0.004	0.004	0.010	0.0%	50%	706
OA, SF, Shelf	94	2.1%	198,436	0.007	0.007	0.017	0.2%	50%	12,402
LE Fxd Gr, Oth GF, Nearshore	215	2.8%	119,541	0.020	0.020	0.036	0.1%	50%	2,780
Pacific Halibut	214	0.5%	755,531	0.021	0.021	0.057	0.7%	51%	16,425
OA, Slope	11	27.3%	1,768	0.037	0.037	0.094	0.0%	51%	22
Oth Crustaceans	2,060	0.4%	1,421,789	0.101	0.101	0.195	1.3%	52%	6,376
LE Fxd Gr SF, Shelf	182	3.3%	710,550	0.102	0.102	0.298	0.6%	53%	3,158
Salmon	4,027	1.6%	2,763,425	0.313	0.313	0.610	2.5%	55%	4,011
GF/Shrimp Combinations	11	54.5%	16,294	0.417	0.417	1.027	0.0%	55%	18
LE TWL, Petrale Sole	115	15.7%	630,545	6.391	1.159	2.186	0.6%	56%	247
OA, Nearshore	2,201	1.0%	498,681	1.271	1.271	3.457	0.4%	56%	178
LE TWL, Leftover	106	23.6%	330,150	16.013	1.971	5.428	0.3%	57%	76
Oth Species	1,428	1.8%	9,261,628	2.502	2.502	7.930	8.3%	65%	1,679
Oth GF (plurality but <50%)	179	20.1%	241,047	3.382	3.382	11.312	0.2%	65%	32
LE TWL, POP	14	71.4%	67,290	3.653	3.653	14.965	0.1%	65%	8
Pink Shrimp	1,105	11.4%	4,960,814	4.396	4.396	19.361	4.4%	70%	512
LE Fxd Gr, Oth GF, Shelf	313	20.4%	295,262	4.661	4.661	24.021	0.3%	70%	29
LE TWL, Flatfish	957	26.0%	4,000,469	104.139	6.071	30.093	3.6%	74%	299
LE TWL, DTS	1,627	35.8%	10,067,097	344.652	14.167	44.259	9.0%	83%	322
LE TWL, Yellowtail	93	59.1%	399,104	18.971	18.971	63.230	0.4%	83%	10
LE TWL, Canary	35	60.0%	159,373	24.401	24.401	87.631	0.1%	83%	3
OA, Shelf	1,265	24.5%	556,667	36.463	36.463	124.093	0.5%	84%	7
OA TWL, Oth, >50% GF	43	32.6%	172,602	83.618	83.618	207.711	0.2%	84%	1
LE TWL, Slope RF	212	75.0%	1,325,816	128.314	128.314	336.025	1.2%	85%	5
LE TWL, Oth RF	165	80.6%	1,393,426	212.939	212.939	548.964	1.2%	86%	3
LE TWL, Arrowtooth	257	81.7%	3,574,020	395.761	346.988	895.952	3.2%	90%	5
LE TWL, Whiting	1,326	67.3%	5,399,567	368.152	368.152	1,264.104	4.8%	94%	7
LE TWL, Widow	144	100.0%	1,583,364	665.161	665.161	1,929.265	1.4%	96%	1
LE TWL, Midwater	255	91.4%	1,461,986	952.043	952.043	2,881.309	1.3%	97%	1
Total	37,630		111,519,070	3,377.909	2,881.309		100.0%		18

Table 5.3-7. Catch and/or landed catch of widow rockfish and exvessel revenue by trip target type (1998 & 2002).[a/] (Page 2 of 4)

Primary Target for Trip	Trips	Percent of Primary Target Trips with Widow in Landing	Total Exvessel Revenue	Widow Landed (mt)	Widow Landed or Estimated Catch (mt)	Cumulative Widow (Mt)	Total Exvessel Revenue for Area: Percent of Total	Total Exvessel Revenue for Area: Cumulative Percent	Exves Rev/Lb Widow (Landed & Bycatch)
1998									
South of Mendocino									
LE Fxd Gr SF, Slope	690	0.1%	669,160	0.003	0.003	0.003	0.8%	1%	111,527
LE Fxd Gr, Oth GF, Nearshore	169	0.6%	160,641	0.003	0.003	0.006	0.2%	1%	22,949
Gillnet Complex	2,272	0.0%	1,167,329	0.005	0.005	0.010	1.3%	2%	116,733
LE Fxd Gr SF, Shelf	27	3.7%	23,517	0.017	0.017	0.027	0.0%	2%	636
Oth Species	3,114	0.0%	3,211,706	0.017	0.017	0.044	3.6%	6%	84,519
Salmon	7,526	0.0%	3,004,940	0.019	0.019	0.063	3.4%	9%	73,291
OA TWL, Prawn, >50% GF	38	2.6%	85,181	0.026	0.026	0.089	0.1%	9%	1,469
LE TWL, Yellowtail	3	33.3%	11,596	0.091	0.091	0.181	0.0%	9%	58
OA, Nearshore	6,201	0.0%	2,559,930	0.103	0.103	0.283	2.9%	12%	11,327
LE TWL, Petrale Sole	41	9.8%	115,007	0.098	0.136	0.419	0.1%	13%	383
LE TWL, Leftover	12	41.7%	38,218	0.099	0.151	0.570	0.0%	13%	115
LE Fxd Gr, Oth GF, Slope	830	1.0%	648,550	0.224	0.224	0.794	0.7%	13%	1,316
California Halibut	3,194	0.1%	1,829,470	0.226	0.226	1.020	2.1%	15%	3,674
OA TWL, Oth, >50% GF	129	0.8%	28,139	0.409	0.409	1.429	0.0%	15%	31
Pink Shrimp	70	5.7%	323,932	0.925	0.925	2.354	0.4%	16%	159
LE TWL, DTS	548	19.3%	3,415,746	60.116	1.315	3.669	3.9%	20%	1,179
Oth GF (plurality but <50%)	333	0.9%	243,485	1.834	1.834	5.503	0.3%	20%	60
LE TWL, Canary	5	100.0%	28,778	4.120	4.120	9.623	0.0%	20%	3
LE TWL, Flatfish	386	18.1%	1,151,322	25.853	5.449	15.072	1.3%	21%	96
LE Fxd Gr, Oth GF, Shelf	312	10.6%	352,549	5.820	5.820	20.892	0.4%	22%	27
LE TWL, Chilipepper	111	36.0%	747,542	43.536	43.536	64.428	0.8%	23%	8
LE TWL, Midwater	16	100.0%	87,598	62.149	62.149	126.577	0.1%	23%	1
LE TWL, Slope RF	316	28.5%	1,791,897	63.077	63.077	189.654	2.0%	25%	13
LE TWL, Oth RF	141	54.6%	854,102	71.714	71.714	261.368	1.0%	26%	5
LE TWL, Widow	29	100.0%	265,582	113.831	113.831	375.199	0.3%	26%	1
OA, Shelf	2,441	16.1%	1,655,175	121.588	121.588	496.787	1.9%	28%	6
Total	63,298		88,009,673	575.902	496.787		100.0%		80

Table 5.3-7. Catch and/or landed catch of widow rockfish and exvessel revenue by trip target type (1998 & 2002).[a/] (Page 3 of 4)

Primary Target for Trip	Trips	Percent of Primary Target Trips with Widow in Landing	Total Exvessel Revenue	Widow Landed (mt)	Widow Landed or Estimated Catch (mt)	Cumulative Widow (Mt)	Total Exvessel Revenue for Area: Percent of Total	Total Exvessel Revenue for Area: Cumulative Percent	Exves Rev/Lb Widow (Landed & Bycatch)
2002									
North of Mendocino									
Oth GF (plurality but <50%)	336	0.3%	791,167	0.001	0.001	0.001	0.6%	1%	395,584
OA, SF, Shelf	128	0.8%	311,694	0.001	0.001	0.002	0.2%	1%	103,898
LE Fxd Gr, Oth GF, Shelf	52	1.9%	225,343	0.002	0.002	0.004	0.2%	1%	56,336
LE Fxd Gr, Oth GF, Nearshore	185	0.5%	174,051	0.005	0.005	0.010	0.1%	1%	14,504
LE TWL, Lingcod	8	12.5%	3,899	0.005	0.005	0.015	0.0%	1%	325
LE Fxd Gr SF, Shelf	105	1.0%	905,116	0.015	0.015	0.030	0.7%	2%	26,621
Salmon	8,390	0.1%	7,139,761	0.021	0.021	0.052	5.4%	7%	151,910
LE TWL, Slope RF	19	10.5%	108,415	0.050	0.050	0.102	0.1%	7%	977
OA, Shelf	381	0.5%	96,087	0.057	0.057	0.159	0.1%	7%	769
Oth Species	3,880	0.1%	7,786,606	0.069	0.069	0.228	5.9%	13%	50,893
OA, Nearshore	4,229	0.2%	1,501,444	0.129	0.129	0.357	1.1%	15%	5,287
Pink Shrimp	1,963	1.3%	15,093,298	0.174	0.174	0.531	11.5%	26%	39,305
LE TWL, Petrale Sole	229	2.6%	1,570,707	0.574	1.208	1.740	1.2%	27%	590
LE TWL, Leftover	158	3.8%	491,678	0.011	1.493	3.233	0.4%	28%	149
LE TWL, Whiting	632	18.8%	4,824,800	5.318	5.318	8.551	3.7%	31%	411
LE TWL, DTS	1,020	3.1%	7,477,358	1.213	7.045	15.596	5.7%	37%	481
LE TWL, Flatfish	1,275	7.2%	4,975,044	2.285	8.187	23.783	3.8%	41%	276
OA TWL, Oth, >50% GF	135	29.6%	510,025	12.687	12.687	36.469	0.4%	41%	18
LE TWL, Arrowtooth	184	33.2%	2,345,701	18.777	18.991	55.461	1.8%	43%	56
LE TWL, Midwater	63	96.8%	601,804	223.765	223.765	279.225	0.5%	43%	1
Total	43,556		131,046,019	265.162	279.225		100.0%		213

Table 5.3-7. Catch and/or landed catch of widow rockfish and exvessel revenue by trip target type (1998 & 2002).[a/] (Page 4 of 4)

Primary Target for Trip	Trips	Percent of Primary Target Trips with Widow in Landing	Total Exvessel Revenue	Widow Landed (mt)	Widow Landed or Estimated Catch (mt)	Cumulative Widow (Mt)	Total Exvessel Revenue for Area: Percent of Total	Total Exvessel Revenue for Area: Cumulative Percent	Exves Rev/Lb Widow (Landed & Bycatch)
2002									
South of Mendocino									
Gillnet Complex	2,767	0.0%	1,495,473	0.000	0.000	0.000	1.7%	2%	1,495,473
OA TWL, Oth, >50% GF	29	3.4%	29,406	0.001	0.001	0.001	0.0%	2%	14,703
LE Fxd Gr, Oth GF, Shelf	32	3.1%	29,006	0.010	0.010	0.012	0.0%	2%	1,261
LE TWL, Leftover	3	33.3%	10,750	0.133	0.100	0.112	0.0%	2%	49
California Halibut	4,326	0.1%	1,805,186	0.135	0.135	0.247	2.0%	4%	6,078
OA, Shelf	928	2.3%	250,132	0.268	0.268	0.514	0.3%	4%	424
LE TWL, Petrale Sole	53	5.7%	287,972	0.108	0.301	0.815	0.3%	4%	434
LE TWL, Slope RF	53	9.4%	250,821	0.426	0.426	1.241	0.3%	5%	267
LE TWL, Oth RF	28	14.3%	193,986	0.583	0.583	1.824	0.2%	5%	151
LE TWL, Midwater	2	100.0%	1,277	0.749	0.749	2.573	0.0%	5%	1
LE TWL, Chilipepper	54	33.3%	137,730	0.894	0.894	3.467	0.2%	5%	70
LE TWL, Widow	1	100.0%	3,728	1.264	1.264	4.731	0.0%	5%	1
LE TWL, DTS	625	6.2%	4,279,277	1.290	1.662	6.392	4.8%	10%	1,168
LE TWL, Flatfish	369	9.8%	1,025,588	1.093	3.307	9.699	1.2%	11%	141
Total	61,427		88,511,363	6.953	9.699		100.0%		4,139

a/ See Sections 3.4.2.1 and 4.4.2 for important caveats and assumptions.

Table 5.3-8. Catch and/or landed catch of bocaccio and exvessel revenue by trip target type (1998 & 2002).[a/] (Page 1 of 3)

Primary Target for Trip	Trips	Percent of Primary Target Trips with Bocaccio in Landing	Total Exvessel Revenue	Bocaccio Landed (mt)	Bocaccio Landed or Estimated Catch (mt)	Cumulative Bocaccio (mt)	Total Exvessel Revenue for Area: Percent of Total	Total Exvessel Revenue for Area: Cumulative Percent	Exves Rev/Lb Bocaccio (Landed & Bycatch)
1998									
North of Mendocino									
LE TWL, Canary	35	2.9%	159,373	0.004	0.004	0.004	0.1%	0%	17,708
Pink Shrimp	1,105	0.2%	4,960,814	0.005	0.005	0.010	4.4%	5%	413,401
LE Fxd Gr SF, Shelf	182	0.5%	710,550	0.006	0.006	0.016	0.6%	5%	50,754
LE Fxd Gr, Oth GF, Nearshore	215	0.5%	119,541	0.010	0.010	0.026	0.1%	5%	5,197
OA, Nearshore	2,201	0.2%	498,681	0.032	0.032	0.058	0.4%	6%	7,124
OA TWL, Oth, >50% GF	43	2.3%	172,602	0.036	0.036	0.094	0.2%	6%	2,185
LE TWL, Yellowtail	93	2.2%	399,104	0.044	0.044	0.138	0.4%	6%	4,114
LE TWL, Leftover	106	2.8%	330,150	0.117	0.117	0.254	0.3%	7%	1,285
LE TWL, Midwater	255	3.1%	1,461,986	0.140	0.140	0.395	1.3%	8%	4,731
OA, Shelf	1,265	2.4%	556,667	0.533	0.533	0.927	0.5%	8%	474
Oth GF (plurality but <50%)	179	3.4%	241,047	0.611	0.611	1.538	0.2%	9%	179
Oth Species	1,428	1.1%	9,261,628	0.672	0.672	2.209	8.3%	17%	6,254
LE TWL, Flatfish	957	2.3%	4,000,469	0.720	0.720	2.929	3.6%	21%	2,521
LE Fxd Gr, Oth GF, Shelf	313	2.9%	295,262	0.762	0.762	3.691	0.3%	21%	176
LE TWL, Slope RF	212	7.5%	1,325,816	2.182	2.182	5.873	1.2%	22%	276
LE TWL, DTS	1,627	5.0%	10,067,097	2.613	2.613	8.486	9.0%	31%	1,748
LE TWL, Widow	144	12.5%	1,583,364	3.196	3.196	11.681	1.4%	32%	225
LE TWL, Oth RF	165	9.7%	1,393,426	3.678	3.678	15.359	1.2%	34%	172
Total	37,630		111,519,070	15.359	15.359		100.0%		3,293

Table 5.3-8. Catch and/or landed catch of bocaccio and exvessel revenue by trip target type (1998 & 2002).[a/] (Page 2 of 3)

Primary Target for Trip	Trips	Percent of Primary Target Trips with Bocaccio in Landing	Total Exvessel Revenue	Bocaccio Landed (mt)	Bocaccio Landed or Estimated Catch (mt)	Cumulative Bocaccio (mt)	Total Exvessel Revenue for Area: Percent of Total	Total Exvessel Revenue for Area: Cumulative Percent	Exves Rev/Lb Bocaccio (Landed & Bycatch)
South of Mendocino									
Oth Crustaceans	9,856	0.0%	7,214,809	0.000	0.000	0.000	8.2%	8%	7,214,809
OA, SF, Slope	58	1.7%	13,780	0.001	0.001	0.002	0.0%	8%	4,593
HMS Plan Species	2,783	0.0%	24,316,147	0.003	0.003	0.005	27.6%	36%	3,473,735
LE Fxd Gr SF, Slope	690	0.1%	669,160	0.003	0.003	0.008	0.8%	37%	95,594
Sea Cuc	947	0.1%	465,629	0.005	0.005	0.014	0.5%	37%	38,802
Pink Shrimp	70	2.9%	323,932	0.006	0.006	0.020	0.4%	37%	24,918
CPS Plan Species	2,768	0.1%	6,693,748	0.011	0.011	0.030	7.6%	45%	278,906
California Sheephead	860	0.2%	695,882	0.014	0.014	0.044	0.8%	46%	23,196
OA TWL, Halibut, >50% GF	284	1.4%	95,758	0.015	0.015	0.059	0.1%	46%	2,902
LE Fxd Gr SF, Shelf	27	7.4%	23,517	0.022	0.022	0.081	0.0%	46%	490
California Halibut	3,194	0.1%	1,829,470	0.023	0.023	0.103	2.1%	48%	36,589
No landing wt or 2 equal wts	605	0.3%	235,323	0.032	0.032	0.135	0.3%	48%	3,362
LE TWL, Leftover	12	58.3%	38,218	0.467	0.066	0.201	0.0%	48%	262
LE Fxd Gr, Oth GF, Slope	830	0.4%	648,550	0.079	0.079	0.281	0.7%	49%	3,706
Salmon	7,526	0.2%	3,004,940	0.131	0.131	0.412	3.4%	53%	10,398
Oth Species	3,114	0.4%	3,211,706	0.166	0.166	0.578	3.6%	56%	8,751
OA TWL, Oth, >50% GF	129	5.4%	28,139	0.173	0.173	0.752	0.0%	56%	74
LE TWL, Petrale Sole	41	22.0%	115,007	0.217	0.183	0.934	0.1%	56%	285
OA, Nearshore	6,201	0.2%	2,559,930	0.269	0.269	1.203	2.9%	59%	4,317
Gillnet Complex	2,272	0.5%	1,167,329	0.309	0.309	1.512	1.3%	61%	1,714
LE TWL, Yellowtail	3	33.3%	11,596	0.348	0.348	1.860	0.0%	61%	15
LE TWL, Canary	5	80.0%	28,778	0.577	0.577	2.437	0.0%	61%	23
LE TWL, Midwater	16	31.3%	87,598	0.827	0.827	3.265	0.1%	61%	48
Oth GF (plurality but <50%)	333	4.5%	243,485	0.934	0.934	4.198	0.3%	61%	118
OA TWL, Prawn, >50% GF	38	39.5%	85,181	1.452	1.452	5.651	0.1%	61%	27
LE TWL, Widow	29	55.2%	265,582	2.177	2.177	7.828	0.3%	61%	55
LE TWL, DTS	548	24.8%	3,415,746	10.999	2.276	10.104	3.9%	65%	681
Prawns	3,132	1.8%	6,235,599	2.360	2.360	12.464	7.1%	72%	1,199
OA, Slope	166	7.2%	86,129	2.375	2.375	14.839	0.1%	73%	16
LE Fxd Gr, Oth GF, Shelf	312	37.2%	352,549	6.661	6.661	21.500	0.4%	73%	24
LE TWL, Slope RF	316	30.4%	1,791,897	7.902	7.902	29.402	2.0%	75%	103
LE TWL, Oth RF	141	49.6%	854,102	7.902	7.902	37.305	1.0%	76%	49
LE TWL, Chilipepper	111	45.9%	747,542	9.121	9.121	46.426	0.8%	77%	37
LE TWL, Flatfish	386	24.1%	1,151,322	7.137	19.412	65.839	1.3%	78%	27
OA, Shelf	2,441	27.3%	1,655,175	56.781	56.781	122.620	1.9%	80%	13
Total	63,298		88,009,673	119.502	122.620		100.0%		326

Table 5.3-8. Catch and/or landed catch of bocaccio and exvessel revenue by trip target type (1998 & 2002).[a/] (Page 3 of 3)

Primary Target for Trip		Trips	Percent of Primary Target Trips with Bocaccio in Landing	Total Exvessel Revenue	Bocaccio Landed (mt)	Bocaccio Landed or Estimated Catch (mt)	Cumulative Bocaccio (mt)	Total Exvessel Revenue for Area: Percent of Total	Total Exvessel Revenue for Area: Cumulative Percent	Exves Rev/Lb Bocaccio (Landed & Bycatch)
2002										
North of Mendocino										
Pink Shrimp		1,963	0.1%	15,093,298	0.004	0.004	0.004	11.5%	12%	1,886,662
LE TWL, Whiting		632	0.2%	4,824,800	0.004	0.004	0.007	3.7%	15%	603,100
LE TWL, DTS		1,020	0.1%	7,477,358	0.010	0.010	0.018	5.7%	21%	325,103
LE TWL, Slope RF		19	5.3%	108,415	0.029	0.029	0.046	0.1%	21%	1,721
LE TWL, Flatfish		1,275	0.9%	4,975,044	0.154	0.154	0.200	3.8%	25%	14,632
	Total	43,556		131,046,019	0.200	0.200		100.0%		296,484
South of Mendocino										
Oth Crustaceans		8,526	0.0%	6,399,995	0.002	0.002	0.002	7.2%	7%	1,599,999
CPS Plan Species		2,969	0.0%	7,175,550	0.002	0.002	0.004	8.1%	15%	1,435,110
OA, Nearshore		3,838	0.1%	1,760,441	0.003	0.003	0.007	2.0%	17%	293,407
California Sheephead		387	0.3%	378,451	0.005	0.005	0.011	0.4%	18%	37,845
Gillnet Complex		2,767	0.1%	1,495,473	0.007	0.007	0.018	1.7%	19%	99,698
Salmon		8,117	0.0%	7,058,263	0.008	0.008	0.026	8.0%	27%	415,192
No landing wt or 2 equal wts		143	2.1%	701,249	0.014	0.014	0.040	0.8%	28%	22,621
Oth Species		3,651	0.1%	3,028,537	0.016	0.016	0.056	3.4%	32%	84,126
LE TWL, Leftover		3	66.7%	10,750	0.066	0.020	0.076	0.0%	32%	244
LE TWL, Slope RF		53	5.7%	250,821	0.023	0.023	0.099	0.3%	32%	4,918
Prawns		2,083	0.2%	3,990,047	0.025	0.025	0.124	4.5%	36%	72,546
OA, Slope		269	0.7%	185,765	0.027	0.027	0.151	0.2%	37%	3,149
California Halibut		4,326	0.0%	1,805,186	0.034	0.034	0.185	2.0%	39%	24,394
OA, SF, Slope		281	0.4%	180,345	0.041	0.041	0.226	0.2%	39%	1,982
LE Fxd Gr, Oth GF, Slope		746	0.3%	740,909	0.057	0.057	0.283	0.8%	40%	5,927
OA TWL, Oth, >50% GF		29	10.3%	29,406	0.065	0.065	0.348	0.0%	40%	204
LE TWL, Petrale Sole		53	13.2%	287,972	2.300	0.150	0.498	0.3%	40%	870
LE Fxd Gr, Oth GF, Shelf		32	31.3%	29,006	0.168	0.168	0.666	0.0%	40%	78
LE TWL, Lingcod		6	33.3%	3,680	0.310	0.310	0.976	0.0%	40%	5
Oth GF (plurality but <50%)		180	10.6%	170,145	0.388	0.388	1.364	0.2%	40%	199
LE TWL, Oth RF		28	17.9%	193,986	1.330	1.330	2.693	0.2%	41%	66
LE TWL, Chilipepper		54	35.2%	137,730	2.122	2.122	4.815	0.2%	41%	29
OA, Shelf		928	15.3%	250,132	2.609	2.609	7.424	0.3%	41%	43
LE TWL, DTS		625	11.7%	4,279,277	6.318	2.905	10.329	4.8%	46%	668
LE TWL, Flatfish		369	19.0%	1,025,588	4.777	18.255	28.584	1.2%	47%	25
	Total	61,427		88,511,363	20.715	28.584		100.0%		1,405

a/ See Sections 3.4.2.1 and 4.4.2 for important caveats and assumptions.

Table 5.3-9. Catch and/or landed catch of cowcod and exvessel revenue by trip target type (1998 & 2002).[a/] (Page 1 of 1)

Primary Target for Trip		Trips	Percent of Primary Target Trips with Cowcod in Landing	Total Exvessel Revenue	Cowcod Landed (mt)	Cowcod Landed or Estimated Catch (mt)	Cumulative Cowcod (mt)	Total Exvessel Revenue for Area: Percent of Total	Cumulative Percent	Exves Rev/Lb Cowcod (Landed & Bycatch)
1998										
North of Mendocino										
LE TWL, Flatfish		957	0.2%	4,000,469	0.021	0.021	0.021	3.6%	4%	85,116
	Total	37,630	0.2%	111,519,070	0.021	0.021		100.0%		2,372,746
South of Mendocino										
Gillnet Complex		2,272	0.0%	1,167,329	0.001	0.001	0.001	1.3%	1%	583,665
LE Fxd Gr SF, Slope		690	0.1%	669,160	0.001	0.001	0.002	0.8%	2%	223,053
California Sheephead		860	0.1%	695,882	0.002	0.002	0.005	0.8%	3%	139,176
LE Fxd Gr, Oth GF, Slope		830	0.1%	648,550	0.006	0.006	0.011	0.7%	4%	46,325
LE TWL, Widow		29	3.4%	265,582	0.014	0.014	0.024	0.3%	4%	8,853
OA TWL, Prawn, >50% GF		38	2.6%	85,181	0.016	0.016	0.041	0.1%	4%	2,366
Oth Species		3,114	0.1%	3,211,706	0.035	0.035	0.076	3.6%	8%	41,176
LE TWL, Midwater		16	12.5%	87,598	0.053	0.053	0.129	0.1%	8%	755
OA, Nearshore		6,201	0.0%	2,559,930	0.086	0.086	0.215	2.9%	11%	13,473
LE TWL, DTS		548	1.5%	3,415,746	0.105	0.105	0.320	3.9%	15%	14,787
LE TWL, Oth RF		141	2.8%	854,102	0.161	0.161	0.481	1.0%	16%	2,406
OA, Slope		166	3.6%	86,129	0.172	0.172	0.653	0.1%	16%	227
OA TWL, Oth, >50% GF		129	4.7%	28,139	0.190	0.190	0.843	0.0%	16%	67
Oth GF (plurality but <50%)		333	2.7%	243,485	0.257	0.257	1.100	0.3%	16%	430
LE TWL, Slope RF		316	3.5%	1,791,897	0.376	0.376	1.476	2.0%	18%	2,159
LE TWL, Chilipepper		111	9.9%	747,542	0.459	0.459	1.935	0.8%	19%	739
Prawns		3,132	0.6%	6,235,599	0.552	0.552	2.487	7.1%	26%	5,124
LE Fxd Gr, Oth GF, Shelf		312	9.9%	352,549	1.480	1.480	3.967	0.4%	26%	108
OA, Shelf		2,441	3.2%	1,655,175	7.702	7.702	11.668	1.9%	28%	97
	Total	63,298	61.5%	88,009,673	11.668	11.668		100.0%		3,421
2002										
North of Mendocino										
	Total	43,556	0	131,046,019	0.000	0.000	0.000	-	-	-
South of Mendocino										
LE TWL, Chilipepper		54	1.9%	137,730	0.000	0.000	0.000	0.2%	0%	137,730
LE TWL, DTS		625	0.2%	4,279,277	0.009	0.009	0.009	4.8%	5%	225,225
LE Fxd Gr SF, Slope		695	0.1%	613,422	0.018	0.018	0.027	0.7%	6%	15,336
LE TWL, Flatfish		369	0.8%	1,025,588	0.024	0.024	0.051	1.2%	7%	19,351
	Total	61,427	3.0%	88,511,363	0.051	0.051		100.0%		783,286

a/ See Sections 3.4.2.1 and 4.4.2 for important caveats and assumptions.

Table 5.3-10. Catch and/or landed catch of yelloweye rockfish and exvessel revenue by trip target type (1998 & 2002).[a/] (Page 1 of 2)

Primary Target for Trip	Trips	Percent of Primary Target Trips with Yelloweye in Landing	Total Exvessel Revenue	Yelloweye Landed (mt)	Yelloweye Landed or Estimated Catch (mt)	Cumulative Yelloweye (mt)	Total Exvessel Revenue for Area: Percent of Total	Total Exvessel Revenue for Area: Cumulative Percent	Exves Rev/Lb Yelloweye (Landed & Bycatch)
1998									
North of Mendocino									
LE Fxd Gr SF, Shelf	182	0.5%	710,550	0.001	0.001	0.001	0.6%	1%	355,275
OA, Slope	11	9.1%	1,768	0.014	0.014	0.015	0.0%	1%	57
LE TWL, Widow	144	1.4%	1,583,364	0.043	0.043	0.058	1.4%	2%	16,844
Oth GF (plurality but <50%)	179	4.5%	241,047	0.054	0.054	0.112	0.2%	2%	2,009
LE TWL, Oth RF	165	2.4%	1,393,426	0.103	0.103	0.215	1.2%	4%	6,112
LE TWL, DTS	1,627	0.7%	10,067,097	0.324	0.324	0.540	9.0%	13%	14,080
LE Fxd Gr, Oth GF, Nearshore	215	9.3%	119,541	0.554	0.554	1.094	0.1%	13%	98
OA, Nearshore	2,201	3.7%	498,681	0.991	0.991	2.085	0.4%	13%	228
OA, Shelf	1,265	6.1%	556,667	1.574	1.574	3.659	0.5%	14%	160
LE Fxd Gr, Oth GF, Shelf	313	6.4%	295,262	1.676	1.676	5.334	0.3%	14%	80
Total	37,630		111,519,070	5.334	5.334				9,483
1998									
South of Mendocino									
Salmon	7,526	0.0%	3,004,940	0.000	0.000	0.000	3.4%	3%	3,004,940
LE TWL, Flatfish	386	0.3%	1,151,322	0.002	0.002	0.003	1.3%	5%	230,264
No landing wt or 2 equal wts	605	0.2%	235,323	0.002	0.002	0.005	0.3%	5%	47,065
LE Fxd Gr SF, Slope	690	0.3%	669,160	0.005	0.005	0.010	0.8%	6%	66,916
OA TWL, Halibut, >50% GF	284	0.4%	95,758	0.012	0.012	0.022	0.1%	6%	3,547
LE TWL, Midwater	16	6.3%	87,598	0.015	0.015	0.037	0.1%	6%	2,576
OA, SF, Shelf	22	9.1%	10,482	0.017	0.017	0.054	0.0%	6%	283
LE TWL, Yellowtail	3	66.7%	11,596	0.046	0.046	0.100	0.0%	6%	114
Prawns	3,132	0.0%	6,235,599	0.052	0.052	0.152	7.1%	13%	54,223
LE TWL, Slope RF	316	2.8%	1,791,897	0.092	0.092	0.244	2.0%	15%	8,827
LE TWL, DTS	548	1.3%	3,415,746	0.100	0.100	0.345	3.9%	19%	15,456
LE TWL, Widow	29	13.8%	265,582	0.112	0.112	0.457	0.3%	19%	1,071
LE TWL, Chilipepper	111	6.3%	747,542	0.138	0.138	0.596	0.8%	20%	2,451
Oth GF (plurality but <50%)	333	1.2%	243,485	0.145	0.145	0.740	0.3%	20%	763
OA, Nearshore	6,201	0.3%	2,559,930	0.207	0.207	0.947	2.9%	23%	5,614
LE Fxd Gr, Oth GF, Nearshore	169	5.3%	160,641	0.263	0.263	1.210	0.2%	24%	277
LE Fxd Gr SF, Shelf	27	18.5%	23,517	0.380	0.380	1.590	0.0%	24%	28
LE TWL, Oth RF	141	10.6%	854,102	0.919	0.919	2.509	1.0%	25%	422
LE Fxd Gr, Oth GF, Shelf	312	13.8%	352,549	3.477	3.477	5.986	0.4%	25%	46
OA, Shelf	2,441	4.8%	1,655,175	6.014	6.014	12.000	1.9%	27%	125
Total	63,298		88,009,673	12.000	12.000				3,327

Table 5.3-10. Catch and/or landed catch of yelloweye rockfish and exvessel revenue by trip target type (1998 & 2002).[a/] (Page 2 of 2)

Primary Target for Trip		Trips	Percent of Primary Target Trips with Yelloweye in Landing	Total Exvessel Revenue	Yelloweye Landed (mt)	Yelloweye Landed or Estimated Catch (mt)	Cumulative Yelloweye (mt)	Total Exvessel Revenue for Area: Percent of Total	Total Exvessel Revenue for Area: Cumulative Percent	Exves Rev/Lb Yelloweye (Landed & Bycatch)
2002										
North of Mendocino										
OA, Shelf		381	0.3%	96,087	0.000	0.000	0.000	0.1%	0%	96,087
OA, Nearshore		4,229	0.0%	1,501,444	0.002	0.002	0.002	1.1%	1%	375,361
LE Fxd Gr SF, Slope		316	0.6%	2,068,272	0.002	0.002	0.005	1.6%	3%	413,654
LE TWL, Arrowtooth		184	0.5%	2,345,701	0.005	0.005	0.009	1.8%	5%	234,570
Pink Shrimp		1,963	0.1%	15,093,298	0.005	0.005	0.015	11.5%	16%	1,257,775
OA, SF, Slope		216	0.5%	1,100,262	0.011	0.011	0.026	0.8%	17%	44,010
LE TWL, Petrale Sole		229	0.9%	1,570,707	0.027	0.027	0.053	1.2%	18%	26,178
LE TWL, DTS		1,020	1.3%	7,477,358	0.094	0.094	0.147	5.7%	24%	35,949
Pacific Halibut		379	0.5%	1,564,532	0.202	0.202	0.350	1.2%	25%	3,508
LE TWL, Flatfish		1,275	1.7%	4,975,044	0.215	0.215	0.565	3.8%	29%	10,474
	Total	43,556		131,046,019	0.565	0.565				105,173
2002										
South of Mendocino										
LE TWL, DTS		625	0.2%	4,279,277	0.002	0.002	0.002	4.8%	5%	1,069,819
LE TWL, Petrale Sole		53	1.9%	287,972	0.002	0.002	0.004	0.3%	5%	71,993
LE TWL, Slope RF		53	1.9%	250,821	0.009	0.009	0.013	0.3%	5%	12,541
LE TWL, Flatfish		369	0.8%	1,025,588	0.019	0.019	0.032	1.2%	7%	24,419
OA, Nearshore		3,838	0.1%	1,760,441	0.032	0.032	0.064	2.0%	9%	25,149
	Total	61,427		88,511,363	0.064	0.064				632,224

a/ See Sections 3.4.2.1 and 4.4.2 for important caveats and assumptions.

Table 5.3-11. Catch and/or landed catch of shoreside whiting and exvessel revenue by trip target type (1998 & 2002).[a/] (Page 1 of 2)

Primary Target for Trip		Trips	Percent of Primary Target Trips with Shoreside Whiting in Landing	Total Exvessel Revenue	Shoreside Whiting Landed (mt)	Shoreside Whiting Landed or Estimated Catch (mt)	Cumulative Shoreside Whiting (mt)	Total Exvessel Revenue for Area: Percent of Total	Total Exvessel Revenue for Area: Cumulative Percent	Exves Rev/Lb Shoreside Whiting (Landed & Bycatch)
1998										
North of Mendocino										
LE TWL, Petrale Sole		115	0.9%	630,545	0.227	0.227	0.227	0.6%	1%	1,261
LE TWL, Midwater		255	1.2%	1,461,986	0.858	0.858	1.085	1.3%	2%	773
LE TWL, Canary		35	2.9%	159,373	0.982	0.982	2.067	0.1%	2%	74
Oth Species		1,428	0.7%	9,261,628	1.647	1.647	3.714	8.3%	10%	2,551
LE TWL, Slope RF		212	0.9%	1,325,816	1.676	1.676	5.390	1.2%	12%	359
Pink Shrimp		1,105	0.1%	4,960,814	1.875	1.875	7.265	4.4%	16%	1,200
LE TWL, Widow		144	2.8%	1,583,364	3.591	3.591	10.856	1.4%	17%	200
LE TWL, Arrowtooth		257	1.6%	3,574,020	4.746	4.746	15.602	3.2%	21%	342
LE TWL, DTS		1,627	0.7%	10,067,097	17.490	17.490	33.092	9.0%	30%	261
LE TWL, Flatfish		957	3.6%	4,000,469	23.755	23.755	56.847	3.6%	33%	76
Oth GF (plurality but <50%)		179	0.6%	241,047	27.382	27.382	84.229	0.2%	33%	4
LE TWL, Leftover		106	30.2%	330,150	88.213	88.213	172.442	0.3%	34%	2
LE TWL, Whiting		1,326	100.0%	5,399,567	87,681.897	87,681.897	87,854.339	4.8%	39%	0
	Total	37,630		111,519,070	87,854.543	87,854.543				1
South of Mendocino										
Gillnet Complex		2,272	0.0%	1,167,329	0.002	0.002	0.002	1.3%	1%	291,832
Oth Species		3,114	0.0%	3,211,706	0.005	0.005	0.007	3.6%	5%	291,973
OA, Shelf		2,441	0.3%	1,655,175	0.020	0.020	0.027	1.9%	7%	37,618
Prawns		3,132	0.2%	6,235,599	0.030	0.030	0.057	7.1%	14%	93,069
LE Fxd Gr SF, No Strata		223	1.8%	98,173	0.037	0.037	0.094	0.1%	14%	1,212
LE TWL, DTS		548	0.2%	3,415,746	0.054	0.054	0.148	3.9%	18%	28,704
LE Fxd Gr SF, Slope		690	0.9%	669,160	0.075	0.075	0.223	0.8%	19%	4,056
LE Fxd Gr, Whiting		7	100.0%	1,916	0.251	0.251	0.474	0.0%	19%	3
LE Fxd Gr, Oth GF, Slope		830	2.5%	648,550	0.282	0.282	0.756	0.7%	19%	1,043
LE TWL, Slope RF		316	0.3%	1,791,897	0.919	0.919	1.675	2.0%	21%	885
	Total	63,298		88,009,673	1.675	1.675				23,838

Table 5.3-11. Catch and/or landed catch of shoreside whiting and exvessel revenue by trip target type (1998 & 2002).[a/] (Page 2 of 2)

Primary Target for Trip	Trips	Percent of Primary Target Trips with Shoreside Whiting in Landing	Total Exvessel Revenue	Shoreside Whiting Landed (mt)	Shoreside Whiting Landed or Estimated Catch (mt)	Cumulative Shoreside Whiting (mt)	Total Exvessel Revenue for Area: Percent of Total	Total Exvessel Revenue for Area: Cumulative Percent	Exves Rev/Lb Shoreside Whiting (Landed & Bycatch)
2002									
North of Mendocino									
LE TWL, Midwater	63	1.6%	601,804	0.086	0.086	0.086	0.5%	0%	3,184
LE TWL, Petrale Sole	229	0.4%	1,570,707	0.259	0.259	0.345	1.2%	2%	2,746
LE TWL, DTS	1,020	0.7%	7,477,358	3.577	3.577	3.923	5.7%	7%	948
LE TWL, Flatfish	1,275	1.2%	4,975,044	24.789	24.789	28.712	3.8%	11%	91
LE TWL, Leftover	158	3.8%	491,678	36.683	36.683	65.395	0.4%	12%	6
Oth Species	3,880	0.9%	7,786,606	182.932	182.932	248.327	5.9%	17%	19
LE TWL, Whiting	632	100.0%	4,824,800	45,458.931	45,458.931	45,707.257	3.7%	21%	0
Total	43,556		131,046,019	45,707.257	45,707.257				1
South of Mendocino									
LE TWL, Midwater	63	1.6%	601,804	0.086	0.086				
LE TWL, Petrale Sole	229	0.4%	1,570,707	0.259	0.259				
LE TWL, DTS	1,020	0.7%	7,477,358	3.577	3.577				
LE TWL, Flatfish	1,275	1.2%	4,975,044	24.789	24.789				
LE TWL, Leftover	158	3.8%	491,678	36.683	36.683				
Oth Species	3,880	0.9%	7,786,606	182.932	182.932				
LE TWL, Whiting	632	100.0%	4,824,800	45,458.931	45,458.931				
Total	43,556		131,046,019	45,707.257	45,707.257				

a/ See Sections 3.4.2.1 and 4.4.2 for important caveats and assumptions.

Exhibit B.13
Situation Summary
June 2003

FINAL ADOPTION OF FMP AMENDMENT 16-1 AND AMENDMENT 16-2

Situation: There are nine overfished groundfish species on the West Coast managed under Council interim rebuilding measures adopted at previous meetings as either rebuilding plans or rebuilding strategies for yet-to-be completed rebuilding plans. As a result of litigation, the Federal District Court for the Northern District of California ruled in August 2001 that rebuilding plans for all nine species are required to be formally adopted as either fishery management plan (FMP) amendments or regulatory amendments, not as the policy documents the Council had adopted. Additionally, the court ruled the process of adopting the framework for rebuilding plans was inadequate under the National Environmental Policy Act (NEPA). This effectively means there are no approved rebuilding plans in place at this time.

The Council began developing a FMP amendment last year to: (1) framework the process and standards for incorporating rebuilding plans into the FMP or into regulations, and (2) incorporate species specific rebuilding plans into the FMP or into regulations. The Process and Standards for Rebuilding component (Amendment 16-1) was considered by the Council in June 2002, and a motion was passed restructuring the alternatives in the Process and Standards section. In November 2002, the Council chose preferred alternatives for all process and standards issues, except a part of Issue 1: the form and required elements of rebuilding plans. Although the Council recommended adopting rebuilding plan elements as regulations, the Council did not decide which elements should be adopted. At the April 2003 meeting the Council approved release of a Draft Environmental Assessment (EA) of Amendment 16-1, Process and Standards for Rebuilding Plans for public review. This was done between the April and June Council meetings to allow the public an opportunity to review the EA and comment to the Council at the June meeting. The Council task at this meeting is to consider final adoption of preferred alternatives for Amendment 16-1 before the EA is submitted to NMFS for approval.

The Council also began development of individual species' rebuilding plans as part of the Amendment 16 package last year. A preliminary draft of the Draft Environmental Impact Statement (DEIS) with analyses of rebuilding plans for four of the nine overfished West Coast groundfish species (darkblotched rockfish, Pacific ocean perch, canary rockfish, and lingcod) was presented to the Council as Amendment 16-2 in April 2003. The Council took comment on the structure of the DEIS and rebuilding plan alternatives, provided guidance on developing the DEIS, and directed Council staff to release the preliminary draft of the Amendment 16-2 DEIS for public review in advance of the June meeting. The Council task at this meeting is to consider final adoption of preferred alternatives for Amendment 16-2 before the DEIS is submitted to NMFS and the Environmental Protection Agency (EPA). A 45-day public comment period will ensue after EPA publishes a Notice of Availability of the DEIS later this summer. Final implementation of Amendment 16-2 by NMFS is anticipated for early next year. The remaining five overfished species' rebuilding plans will be analyzed in subsequent Amendment 16 packages. The next Amendment 16 EIS (Amendment 16-3) is tentatively scheduled for initial Council review in November.

Council Action:

1. **Adopt Preferred Alternatives for Amendment 16-1 for Implementation by NMFS.**
2. **Adopt Preferred Alternatives for Amendment 16-2 for EPA Notice and Comment and Implementation by NMFS.**

Reference Materials:

1. Draft Amendment 16-1 to the Pacific Coast Groundfish Fishery Management Plan; Process and Standards for Rebuilding Plans; Including Environmental Assessment and Regulatory Analyses (Exhibit B.13, Attachment 1).
2. Draft Amendment 16-2 to the Pacific Coast Groundfish Fishery Management Plan; Rebuilding Plans For Darkblotched Rockfish, Pacific Ocean Perch, Canary Rockfish, And Lingcod; Including Preliminary Draft Environmental Impact Statement and Regulatory Analyses (Exhibit B.13, Attachment 2).

3. Cumulative Effects Section (Chapter 5) for the Amendment 16-2 DEIS (Exhibit B.13, Attachment 3).
4. Public Scoping Comment Letter from the U.S. Environmental Protection Agency (Exhibit B.13.c, Attachment 4).

Agenda Order:

a. Agendum Overview — John DeVore
b. Reports and Comments of Advisory Bodies
c. Public Comments
d. **Council Action:** Adopt FMP Amendments 16-1 and 16-2 for Implementation by NMFS

PFMC
06/02/03

Species	ACCEPTABLE BIOLOGICAL CATCH (ABC)						OY (Total catch)	Commercial OY (Total Catch	Allocations total catch			
	Vancouver	Columbia	Eureka	Monterey	Conception	Total Catch			Limited Entry		Open Access	
									Mt	%	Mt	%
ROCKFISH:												
Pacific Ocean Perch j/	689			--		689	377	374	--	--	--	--
Shortbelly k/	13,900					13,900	13,900	13,900	--	--	--	--
Widow l/	3,871					3,871	832	781	757	97.0	23	3.0
Canary m/	272					272	44	23	20	87.7	2.8	12.3
Chilipepper n/	c/			2,700		2,700	2,000	1,985	1,106	55.7	879	44.3
Bocaccio o/	c/			198		198	≤20	14	8	52.7	6	44.3
Splitnose p/	c/			615		615	461	461	--	--	--	--
Yellowtail q/	3,146			c/		3,146	3,146	2,717	2,492	91.7	226	8.3
Shortspine thornyhead r/ north of 34°27'	1,004					1,004	955	941	939	99.7	3	0.27
Longspine thornyhead s/ north of 36°	2,461				--	2,461	2,461	2,434	--	--	--	--
south of 36° t/	--				390	390	195	195	--	--	--	--
Cowcod u/	c/			19	--	19	2.4	0	--	--	--	--
	c/			--	5	5	2.4	0	--	--	--	--
Darkblotched v/	205					205	172	170		--	170	-
Yelloweye w/	52					52	22	9.5	--	--	--	-

Table 1a. 2003 Specifications of Acceptable Biological Catch (ABC), Optimum Yields (Oys), and Limited Entry and Open Access Allocations, by International North Pacific Fisheries Commission (INPFC) Areas (weights in metric tons).

Species	ACCEPTABLE BIOLOGICAL CATCH (ABC)						OY (Total catch)	Commercial OY (Total Catch)	Allocations total catch			
	Vancouver a/	Columbia	Eureka	Monterey	Conception	Total Catch			Limited Entry		Open Access	
									Mt	%	Mt	%
ROUNDFISH												
Lingcod b/	841					841	651	284	230	81.0	54	19.0
Pacific Cod	3,200		c/			3,200	3,200	3,200	--	--	--	--
Pacific Whiting d/	188,000					188,000	148,200	121,200	--	--	--	--
Sablefish e/ (north of 36°)	8,209				--	8,209	6,500	5,767	5,225	90.6	542	9.4
Sablefish f/ (south of 36°)	--				441	441	294	294	--	--	--	--
FLATFISH												
Dover sole g/	8,510					8,510	7,440	7,318	--	--	--	--
English sole	2,000		1,100			3,100	na	-	-	-	-	-
Petrale sole h/	1,262		500	800	200	2,762	na	-	-	-	-	-
Arrowtooth flounder	5,800					5,800	na	-	-	-	-	-
Other flatfish i/	700	3,000	1,700	1,800	500	7,700	na	-	-	-	-	-

	ACCEPTABLE BIOLOGICAL CATCH (ABC)						OY (Total catch)	Comme r-cial OY (Total Catch	Allocations total catch			
Species	Vancou- ver	Colum- bia	Eureka	Mont- erey	Concep- tion	Total Catch			Limited Entry		Open Access	
									Mt	%	Mt	%
Minor Rockfish North x/	4,795			--		4,795	3,056	2,292	2,102	91.7	190	8.3
Minor Rockfish South y/	--			3,506		3,506	1,894	1,401	780	55.7	621	44.3
Remaining Rockfish	2,727			854		--	--	--	--	-	-	--
bank z/	c/			350		350	--	--	--	--	--	--
black aa/	615		500			1,115	--	--	--	--	--	--
blackgill bb/	c/			75	268	343	--	--	--	--	--	--
bocaccio - north	8					318	--	--	--	--	--	--
chilipepper- north	32					32	--	--	--	--	--	--
redstripe	576			c/		576	--	--	--	--	--	--
sharpchin	307			45		352	--	--	--	--	--	--
silvergrey	38			c/		38	--	--	--	--	--	--
splitnose	242			c/		242	--	--	--	--	--	--
yellowmouth	99			c/		99	--	--	--	--	--	--
yellowtail- south				116		116	--	--	--	--	--	--
Other rockfish cc/	2,068			2,652		--	--	--	--	--	--	--
OTHER FISH dd/	2,500	7,000	1,200	2,000	2,000	14,700	na	-	--	--	--	-

Table 1b. 2003 OYs for minor rockfish by depth sub-groups (weights in metric tons).

Species	Total Catch ABC	OY (Total Catch)			Harvest Guidelines (total catch)			
		Total Catch OY	Recrea-tional Estimate	Commercial OY for minor rockfish and HG for depth sub-groups	Limited Entry		Open Access	
					Mt	%	Mt	%
Minor Rockfish North x/	4,794	3,056	750	2,292	2,102	91.7	190	8.3
Nearshore		928	740	188				
Shelf		968	10	954				
Slope		1,160	0	1,156				
Minor Rockfish South y/	3,506	1,894	493	1,401	780	55.7	621	44.3
Nearshore		541	433	108				
Shelf		714	60	654				
Slope		639	0	639				

a/ ABC applies to the U.S. portion of the Vancouver area, except as noted under individual species.

b/ Lingcod was declared overfished on March 3, 1999. A stock assessment that included parts of Canadian waters was done in 2000 and updated for 2001. Following the assessment, lingcod was believed to be at 15 percent of its unfished biomass coastwide. The U.S. portion of the ABC for the Vancouver area was set at 44 percent of the total biomass for that area. The ABC of 841 mt was calculated using an Fmsy proxy of F45%. The total catch OY of 651 mt is based on a rebuilding plan with a 60 percent probability of rebuilding the stock to Bmsy by the year 2009 (Tmax). The total catch OY is reduced by 355 mt for the amount that is estimated to be taken by the recreational fishery, 3 mt for the amount estimated to be taken during research fishing, 4.3 mt for the amount estimated to be taken in non-groundfish fisheries, and by 5.2 mt for the amount estimated to be taken in the tribal fishery, resulting in a commercial OY of 284 mt. The open access total catch allocation is 54 mt (19 percent of the commercial OY) and the open access landed catch value is 43 mt. The limited entry total catch allocation is 230 mt and the landed catch value is 184 mt. The landed catch value is based on a discard mortality rate of 20 percent. Tribal vessels are estimated to land about 5.2 mt of lingcod in 2003, but do not have a specific allocation at this time.

c/ "Other species", these are neither common nor important to the commercial and recreational fisheries in the areas footnoted. Accordingly, Pacific cod is included in the non-commercial OY of "other fish" and rockfish species are included in either "other rockfish" or "remaining rockfish" for the areas footnoted.

d/ Pacific whiting - The most recent stock assessment was prepared in 2002, at which time the whiting stock was believed to be below 25 percent of its unfished biomass. Whiting was declared overfished on April 15, 2002 (67 FR 18117). The U.S.-Canada ABC of 235,000 mt is based on the 2002 assessment results with the application of an Fmsy proxy harvest rate of 45%. In estimating the current biomass, NMFS used a medium level recruitment assumption of a recent (1999) large year class. The U.S. ABC of 188,000 mt is 80 percent of the coastwide ABC. The U.S. whiting OY is 148,200 mt which is 80 percent of the coastwide OY (185,325 mt) and is based on the application of the 40-10 harvest rate policy. The total catch OY is further reduced by 25,000 mt for the tribal allocation, 200 mt for the amount estimated to be taken during research fishing, and 1,800 mt for the estimated catch in non-groundfish fisheries, resulting in a commercial OY of 121,200 mt. The commercial OY is allocated between the sectors with 42 percent (50,904 mt) going to the shore-based sector, 34 percent (41,288 mt) going to the catcher/processor sector, and 24 percent (29,080 mt) going to the mothership sector. Discards of whiting are estimated from the observer data and counted towards the OY inseason.

e/ Sablefish north of 36° N. lat. - NMFS did a new sablefish assessment in 2001 for the area north of Point Conception (34°27'N lat.) and updated it for 2002. Following the assessment update, sablefish north of 34° 27'N lat. was believed to be between 31 percent and 38 percent of its unfished biomass. The ABC for the surveyed area (8,459 mt) is based on environmentally driven projections with the Fmsy proxy of F45%. The ABC for the management area north of 36° N. lat. is 8,209 mt (97.04 percent of the ABC from the surveyed area). The total catch OY for the area north of 36° N. lat.is 6,500 mt and is 97.04 percent of the OY from the surveyed area with a risk averse precautionary adjustment. The total catch OY is reduced by 10 percent (650 mt) for the tribal set aside, by 11.1 mt for compensation to vessels that conducted resource surveys, 53.0 mt for the amount estimated to be taken as research catch, and 18.5 mt for the amount estimated to be taken in non-groundfish fisheries. The remainder (5,767 mt) is the commercial total catch OY. The open access allocation is 9.4 percent of the commercial OY, resulting in an open access total catch OY of 542 mt. The limited entry total catch OY is 5,225 mt. The limited entry total catch OY is further divided with 58 percent (3,031 mt) allocated to the trawl fishery and 42 percent (2,194 mt) allocated to the non-trawl fishery. To provide for bycatch in the at-sea whiting fishery 15 mt of the limited entry trawl allocation will be set aside. Discard rates will be applied as follows: 21 percent for limited entry trawl, 8 percent for limited entry fixed gear and open access, and 3 percent for the tribal fisheries. Landed catch OYs are 2,364 mt for limited entry trawl, excluding the at-sea whiting fishery, 2,019 mt for limited entry fixed gear, 499 mt for open access, and 631 mt for the tribal fisheries.

f/ Sablefish south of 36° N. lat. - The ABC of 441 mt is the sum of 250 mt (2.96 percent of the ABC from the 2002 survey based assessment update) and 191 mt (based on historical landings). The total catch OY (294 mt) is the sum of 198 mt (2.96 percent of the OY from the 2002 update of the survey based assessment with a risk averse precautionary adjustment) and 96 mt (that portion of the ABC based on historical landings which was reduced by 50 percent to address uncertainty, due to limited information). There are no limited entry or open access allocations in the Conception area at this time. The assumed discard value is 8 percent, resulting in a landed catch value of 271 mt.

g/ Dover sole north of 34° 27'N lat. was assessed in 2001 and was believed to be at 29 percent of its unfished biomass. The ABC (8,510 mt) is based on an Fmsy proxy of F40%. Because the biomass is estimated to be in the precautionary zone, the total catch OY of 7,440 mt is based on the application of the 40-10 harvest rate policy. The OY is reduced by 62.4 mt for compensation to vessels that conducted resource surveys, 58 mt for the amount estimated to be taken as research catch, and 2 mt for estimated catch in non-groundfish fisheries resulting in commercial OY of 7,318 mt. Discards are assumed to be 5 percent, resulting in a landed catch OY of 7,006 mt.

h/ Petrale Sole was believed to be at 42 percent of its unfished biomass following a 1999 assessment. For 2002, the ABC for the Vancouver-Columbia area (1,262 mt) is based on a F40% Fmsy proxy. The ABCs for the Eureka, Monterey, and Conception areas (1,500 mt) continue at the same level as 2001.

i/ Other flatfish are those species that do not have individual ABC/OYs and include butter sole, curlfin sole, flathead sole, Pacific sand dab, rex sole, rock sole, sand sole, and starry flounder. The ABC is based on historical catch levels.

j/ Pacfic ocean perch (POP) was declared overfished on March 3, 1999. The ABC (689 mt) was projected from the 2000 assessment which was updated for 2001 and is based on an Fmsy proxy of F50%. The OY (377 mt) is based on a 70 percent probability of rebuilding the stock to Bmsy by the year 2041 (Tmax). The OY is reduced by 3 mt for the amount estimated to be taken during research fishing, resulting in a commercial OY of 374 mt. The landed catch value is 314 mt, and is based on a discard rate of 16 percent.

k/ Shortbelly rockfish remains as an unexploited stock and is difficult to assess quantitatively. The 1989 assessment provided 2 alternative yield calculations of 13,900 mt and 47,000 mt. NMFS surveys have shown poor recruitment in most years since 1989, indicating low recent productivity and a naturally declining population in spite of low fishing pressure. The ABC and OY therefore are set at 13,900 mt, the low end of the range in the assessment.

l/ Widow rockfish was assessed in 2000 and was believed to be at 24 percent of its unfished biomass. Widow rockfish was declared overfished on January 11, 2001 (66 FR 2338). The ABC (3,871 mt) is based on a F50% Fmsy proxy. The OY (832 mt) is based on a 60 percent probability of rebuilding the stock to Bmsy by the year 2039 (Tmax). The OY is reduced by 5 mt for the amount estimated to be taken as recreational catch, 1.5 mt for the amount estimated to be taken during research fishing, 0.4 mt for the amount estimated to be taken in non-groundfish fisheries, and 45 mt for the amount estimated to be taken in the tribal fisheries, resulting in a commercial OY of 781 mt. The commercial OY is divided with open access receiving 3 percent (23 mt) and limited entry receiving 97 percent (757 mt). The limited entry landed catch equivalent for the open access fishery is 20 mt. The limited entry allocation is reduced by 182 mt for anticipated bycatch in the at-sea whiting fishery and an additional 30 mt for anticipated bycatch in the shore-based sector of the whiting fishery. The remainder of the limited entry allocation is reduced by 16 percent to account for discards in the trip limit fisheries. The landed catch equivalent, excluding the at-sea whiting fishery, is 488 mt. Tribal vessels are estimated to land about 45 mt of widow rockfish in 2003, but do not have a specific allocation at this time.

m/ Canary rockfish was declared overfished on January 4, 2000 (65 FR 221). A new assessment was completed in 2002 for canary rockfish and the stock is believed to be at 8 percent of its unfished biomass coastwide. The coastwide ABC of 272 mt is based on a Fmsy proxy of F50%. The coastwide OY of 44 mt is based on the rebuilding plan, which has a 60 percent probability of rebuilding the stock to Bmsy by the year 2076 (Tmax). The OY is reduced by 15 mt for the amount estimated to be taken in the recreational fishery, 1 mt for the amount estimated to be taken during research fishing, 2.3 mt for the amount estimated to be taken during the tribal fisheries, and 2.5 for the amount estimated to be taken in non-groundfish fisheries, resulting in a commercial OY of 23 mt. For 2003, the total catch OY has been divided with 61 percent going to the commercial fisheries and 39 percent going to the recreational fisheries. The commercial OY is divided with open access receiving 12.3 percent (2.8 mt) and limited entry receiving 87.7 percent (20 mt). The landed catch value for the open access fishery is 2.3 mt. The limited entry allocation is further reduced by 3 mt for anticipated bycatch in the offshore whiting fishery. The limited entry landed catch value is 14 mt, which is based on a discard rate of 16 percent. Specific open access/limited entry allocations have been suspended during the rebuilding period as necessary to meet the overall rebuilding target while allowing harvest of healthy stocks. Tribal vessels are estimated to land about 2.3 mt of canary rockfish in 2003, but do not have a specific allocation at this time.

n/ Chilipepper rockfish - the ABC (2,700 mt) for the Monterey-Conception area is based on the 1998 stock assessment with the application of F50% Fmsy proxy. Because the unfished biomass is believed to be above 40 percent, the default OY could be set equal the ABC. However, the OY is set at 2,000 mt to discourage effort on chilipepper, which co-occur with bocaccio rockfish. The OY is reduced by 15 mt for the amount estimated to be taken in the recreational fishery, resulting in a commercial OY of 1,985 mt. Open access is allocated 44.3 percent (879 mt) of the commercial OY and limited entry is allocated 55.7 percent (1,106 mt) of the commercial OY. The assumed discard is 16 percent, resulting in a open access landed catch value of 739 mt and a limited entry landed catch value of 929 mt.

o/ Bocaccio rockfish was assessed in 2002 and is believed to be at 3.6 percent of its unfished biomass. Bocaccio rockfish was declared overfished on March 3, 1999. The ABC of 198 mt is based on a F50% Fmsy proxy. The OY of ≤20 mt is based on a sustainabitiy analysis with >80 percent probability of no further decline in spawning biomass. The OY is reduced by 0.2 mt for the amount estimated to be taken during research fishing, and 5 mt for the amount estimated to be taken in the recreational fishery, resulting in a 14 mt commercial OY. Open access is allocated 44.3 percent (6 mt) of the commercial OY and limited entry is allocated 55.7 percent (8 mt) of the commercial OY. Boccacio retention will not be permitted in 2003. The OY will be used to accommodate discards of bocaccio rockfish resulting from incidental take in fisheries for co-occurring species.

p/ Splitnose rockfish - The 2001 ABC is 615 mt in the southern area (Monterey-Conception). The 461 mt OY for the southern area reflects a 25 percent precautionary adjustment because of the less rigorous assessment for this stock. In the north, splitnose is included in the minor slope rockfish OY. The assumed discard is 16 percent for a landed catch value of 387 mt.

q/ Yellowtail rockfish - Following the 2000 stock assessment, yellowtail rockfish was believed to be at 63 percent of its unfished biomass. The ABC of 3,146 mt is based on a 2000 stock assessment for the Vancouver-Columbia-Eureka areas with the Fmsy Proxy of F50%. The OY (3,146 mt) was set equal to the ABC. The OY is reduced by 15 mt for the amount estimated to be taken in the recreational fishery, 8 mt for the amount estimated to be taken during research fishing, 5.8 mt for the amount taken in non-groundfish fisheries, and 400 mt for the amount estimated to be taken in the tribal fisheries, resulting in a commercial OY of 2,717 mt. The open access allocation (226 mt) is 8.3 percent of the commercial OY. The limited entry allocation (2,492 mt) is 91.7 percent the commercial OY. For anticipated bycatch in the at-sea whiting fishery, 300 mt is subtracted from the limited entry landed catch allocation. An additional 100 mt is deducted for the shore-based whiting fishery. The remainder (2,092 mt) is further reduced by 16 percent for assumed discard. The limited entry landed catch equivalent, excluding the at-sea whiting fishery, is 1,773 mt. The open access landed catch equivalent is 189 mt. Tribal vessels are estimated to land about 400 mt of yellowtail rockfish in 2003, but do not have a specific allocation at this time.

r/ Shortspine thornyhead was last assessed in 2001 and the stock was believed to be between 25 and 50 percent of its unfished biomass. The ABC (1,004 mt) for the area north of Pt. Conception (34° 27'N lat.) is based on a F50% Fmsy proxy. The OY of 955 mt is based on the new survey with the application of the 40-10 harvest policy. The OY is reduced by 9 mt for the amount estimated to be taken during research fishing, by 1.6 mt for compensation to vessels that conducted resource surveys, and 3.0 mt for the amount estimated to be taken in the tribal fisheries, resulting in commercial OY of 941 mt. Open access is allocated 0.27 percent (3 mt) of the commercial OY and limited entry is allocated 99.73 percent (939 mt) of the commercial OY. A 20 percent rate of discard is applied to obtain a limited entry landed catch value (751 mt). There is no ABC or OY for the southern Conception area. Tribal vessels are estimated to land about 3 mt of shortspine thornyhead in 2003, but do not have a specific allocation at this time.

s/ Longspine thornyhead is believed to be above 40 percent of its unfished biomass. The ABC (2,461 mt) in the north (Vancouver-Columbia-Eureka-Monterey) is based on the average of the 3-year individual ABCs at a F50%. The total catch OY (2,461 mt) is set equal to the ABC. The OY is further reduced by 8.9 mt for compensation to vessels that conducted resource surveys, by 18 mt for the amount estimated to be taken during research fishing, resulting in a commercial OY of 2,434 mt. To derive the landed catch equivalent of 2,020 mt, the limited entry allocation is reduced by 17 percent for estimated discards.

t/ Longspine thornyhead - A separate ABC (390 mt) is established for the Conception area and is based on historical catch for the portion of the Conception area north of 34° 27' N. lat. (Point Conception). To address uncertainty in the stock assessment due to limited information, the ABC was reduced by 50 percent to obtain the OY, (195 mt). There is no ABC or OY for the southern Conception Area.

u/ Cowcod in the Conception area was assessed in 1999 and was believed to be less than 10 percent of its unfished biomass. Cowcod was declared overfished on January 4, 2000 (65 FR 221). The ABC in the Conception area (5 mt) is based on the 1999 assessment, while the ABC for the Monterey (19 mt) is based on average landings from 1993-1997. An OY of 4.8 mt (2.4 mt in each area) is based on the rebuilding plan which has a 55 percent probability of rebuilding the stock to Bmsy by the year 2099 (Tmax). Cowcod retention will not be permitted in 2003. The OY will be used to accommodate discards of cowcod rockfish resulting from incidental take.

v/ Darkblotched rockfish was assessed in 2000 and was believed to be at 22 percent of its unfished biomass. The darkblotched rockfish stock was declared overfished on January 11, 2001 (66 FR 2338). The ABC is projected to be 205 mt and is based on an Fmsy proxy of F50%. The OY of 172 mt is based on the rebuilding plan, which has a 80 percent probability of rebuilding the stock to Bmsy by the year 2047 (Tmax). For anticipated bycatch in the at-sea whiting fishery, 5 mt is subtracted from the limited entry landed catch OY. The landed catch value for the remaining limited entry fisheries is 132 mt. The landed catch values are based on a discard rate of 20 percent.

w/ Yelloweye rockfish was assessed in 2001 and updated for 2002. On January 11, 2002 yelloweye rockfish was declared overfished (67 FR 1555). In 2002 following the assessment update, yelloweye rockfish was believed to be at 24.1 percent of its unfished biomass coastwide. The 52 mt coastwide ABC is based on an Fmsy proxy of F50%. The OY of 22 mt is based on a revised rebuilding analysis (August 2002) with a 50 percent probability of rebuilding to Bmsy by the year 2050 (Tmid). The OY is reduced by 7.7 mt for the amount estimated to be taken in the recreational fishery, 0.6 mt for the amount estimated to be taken during research fishing, 0.8 mt for the amount taken in non-groundfish fisheries, and 3 mt for the amount estimated to be taken in the tribal fisheries, resulting in a commercial OY of 9.5 mt. Tribal vessels are estimated to land about 3 mt of yelloweye rockfish in 2003, but do not have a specific allocation at this time.

x/ Minor rockfish north includes the "remaining rockfish" and "other rockfish" categories in the Vancouver, Columbia, and Eureka areas combined. These species include "remaining rockfish" which generally includes species that have been assessed by less rigorous methods than stock assessment, and "other rockfish" which includes species that do not have quantifiable assessments. The ABC is the sum of the individual "remaining rockfish" ABCs plus the "other rockfish" ABCs. The remaining rockfish ABCs continue to be reduced by 25 percent (F=0.75M) as a precautionary adjustment. To obtain the total catch OY (3,056 mt) the remaining rockfish ABCs are further reduced by 25 percent with the exception of black rockfish; other rockfish ABCs were reduced by 50 percent. These deductions were a precautionary measures due to limited stock assessment information. The OY is reduced by 750 mt for the amount estimated to be taken in the recreational fishery, resulting in a commercial OY of 2,292 mt. Open access is allocated 8.3 percent (190 mt) of the commercial OY and limited entry is allocated 91.7 percent (2,102 mt) of the commercial OY. The discard is assumed to be 5 percent for nearshore rockfish, 16 percent for shelf rockfish, and 20 percent for slope rockfish. Tribal vessels are estimated to land about 14 mt of minor rockfish (10 mt of shelf rockfish, and 4 mt of slope rockfish) in 2003, but do not have a specific allocation at this time.

y/ Minor rockfish south includes the "remaining rockfish" and "other rockfish" categories in the Monterey and Conception areas combined. These species include "remaining rockfish", which generally includes species that have been assessed by less rigorous methods than stock assessment, and "other rockfish", which includes species that do not have quantifiable assessments. The ABC (3,556 mt) is the sum of the individual "remaining rockfish" ABCs plus the "other rockfish" ABCs. The remaining rockfish ABCs continue to be reduced by 25 percent (F=0.75M) as a precautionary adjustment. To obtain total catch OY (2,015 mt), the remaining rockfish ABCs are further reduced by 25 percent, with the exception of blackgill rockfish, and the other rockfish ABCs were reduced by 50 percent. These deductions were a precautionary measures due to limited stock assessment information. The OY is reduced by 493 mt for the amount estimated to be taken in the recreational fishery, resulting in a commercial OY of 1,401 mt. Open access is allocated 44.3 percent (621 mt) of the commercial OY and limited entry is allocated 55.7 percent (780 mt) of the commercial OY. The discard is assumed to be 5 percent for nearshore rockfish, 16 percent for shelf rockfish, and 20 percent for slope rockfish.

z/ Bank rockfish -- The ABC is 350 mt which is based on a 2000 assessment for the Monterey and Conception areas. This stock contributes 263 mt towards the minor rockfish OY in the south.

aa/ Black rockfish -- the ABC (1,115 mt) is based on a 2000 assessment, and is the sum of the assessment area (615 mt) plus the average catch in the unassessed area (500 mt). To obtain the OY for the southern portion of this area, the ABC has been reduced by 50 percent as a precautionary measures due to limited information. For the assessed area the OY was set equal to the ABC. This stock contributes 865 mt towards the minor rockfish OY in the north.

bb/ Blackgill rockfish is believed to be at 51 percent of its unfished biomass. The ABC of 343 mt is the sum of the Conception area ABC of 268 mt, based on the 1998 assessment with an Fmsy proxy of F50%, and the Monterey area ABC of 75 mt. This stock contributes 306 mt towards minor rockfish south (268 mt for the Conception area ABC and 38 mt for the Monterey area). The OY for the Monterey area is the ABC reduced by 50 percent for precautionary measures because of lack of information.

cc/ "Other rockfish" includes rockfish species listed in 50 CFR 660.302 and California scorpionfish. The ABC is based on the 1996 review of commercial Sebastes landings and includes an estimate of recreational landings. These species have never been assessed quantitatively.

dd/ "Other fish" includes sharks, skates, rays, ratfish, morids, grenadiers, and other groundfish species noted above in footnote c/.

II. Commercial and Recreational Fisheries

Since 1994, the non-tribal commercial groundfish fishery has been divided into limited entry and open access sectors, each with its own set of allocations and management measures. Species or species group allocations between the two sectors are based on the relative amounts of a species or species group taken by each component of the fishery during the 1984–1988 limited entry permit qualification period (50 CFR 660.332). The FMP allows suspension of this allocation formula for overfished species when changes to the traditional allocation formula are needed to better protect overfished species (FMP, section 5.3.2).

Historically, groundfish species and/ or species groups have not been allocated between the commercial and recreational fisheries. Fishery managers instead estimated the amount that would be taken in the recreational fisheries and set that amount aside before determining the allowable harvest for the non-tribal commercial sectors. For 2003, the Council has recommended adopting nearshore groundfish allocations between the recreational and commercial fisheries. These allocations were proposed by the States of Oregon and California for waters off their coasts north and south of 40°10′ N. lat. and are intended to maintain the ratio between recreational and commercial landings 2000. Most of the fish subject to the allocation will be taken in state waters, but state-Federal management of these nearshore species is coordinated through the Council. Commercial groundfish fishing is prohibited in Washington State waters.

Groundfish species or species group allocations and set asides for the tribal and non-tribal sectors, and between the different non-tribal commercial and recreational sectors, are detailed in Tables 1a and 1b. All OYs, allocations and set asides are expressed in terms of total catch. The limited entry/open access allocations for bocaccio, canary, darkblotched, yelloweye rockfish, and the nearshore rockfish species group would be suspended to allow the Council to better develop management measures that provide harvest opportunity for more abundant stocks while protecting overfished stocks. Estimates of trip-limit induced discards are taken "off the top" and in accordance with the bycatch and discard analysis described in the proposed rule for this action at 68 FR 953 (January 7, 2003) before setting the non-tribal sector allocations, except for estimates of sablefish discards as explained in the footnotes to Table 1a. Landed catch equivalents are the harvest goals used when adjusting trip limits and other management measures during the season. Estimated bycatch of yellowtail, widow, canary, and darkblotched rockfish in the offshore whiting fishery is also deducted from the limited entry allocations before determining the landed catch equivalents for the target fisheries for widow and yellowtail rockfish.

III. 2003 Management Measures

Management measures for the limited entry fishery are found in Section IV. Boundary line coordinates for the RCAs are designated at paragraph IV.A.(19). Most cumulative trip limits, size limits, and seasons for the limited entry fishery are set out in Tables 3 and 4. However, the limited entry nontrawl sablefish fishery, the midwater trawl fishery for whiting, and the hook-and-line fishery for black rockfish off Washington are managed separately from the majority of the groundfish species and are not fully addressed in the tables. The management structure for these fisheries has not changed since 2002, except for the level of trip limits for sablefish and whiting, which are described in paragraphs IV.B.(2) through (4). Similarly, management measures for the open access exempted trawl fisheries (California halibut, sea cucumber, pink shrimp, spot and ridgeback prawns) are described in paragraph IV.C.(2), separately from the open access fisheries trip limits set out in Table 5.

IV. NMFS Actions

For the reasons stated above, the Assistant Administrator for Fisheries, NOAA (Assistant Administrator), concurs with the Council's recommendations and announces the following management actions for 2003, including measures that are unchanged from 2002 and new measures.

A. General Definitions and Provisions

The following definitions and provisions apply to the 2003 management measures, unless otherwise specified in a subsequent Federal Register document:

(1) *Trip limits.* Trip limits are used in the commercial fishery to specify the amount of fish that may legally be taken and retained, possessed, or landed, per vessel, per fishing trip, or cumulatively per unit of time, or the number of landings that may be made from a vessel in a given period of time, as follows:

(a) A per trip limit is the total allowable amount of a groundfish species or species group, by weight, or by percentage of weight of legal fish on board, that may be taken and retained, possessed, or landed per vessel from a single fishing trip.

(b) A daily trip limit is the maximum amount that may be taken and retained, possessed, or landed per vessel in 24 consecutive hours, starting at 0001 hours local time (l.t). Only one landing of groundfish may be made in that 24-hour period. Daily trip limits may not be accumulated during multiple day trips.

(c) A weekly trip limit is the maximum amount that may be taken and retained, possessed, or landed per

SCOPING INFORMATION DOCUMENT
Acceptable Biological Catch and Optimum Yield Specification and Management Measures for the 2004 Pacific Coast Groundfish Fishery
Draft Environmental Impact Statement

This narrative outline provides a basis for public scoping on the Draft EIS. It describes the overall organization of the document and essential elements of the analysis, as proposed by Council staff. Preliminary alternatives will be developed during the June Council meeting, which occurs during the public scoping period. The outline describes the types of potential environmental impacts Council staff have identified for evaluation in the EIS. Comments on the alternatives, as they are developed, and on potential environmental impacts, are especially encouraged.

Front Material:

Cover sheet
Reader's Guide
Executive Summary
Table of Contents (and list of tables, figures)
Acronyms and Glossary

1.0 INTRODUCTION

This chapter describes the purpose and need for proposed action, scoping comments, and impacts that will be evaluated based on scoping input.

The proposed action is to implement management measures consistent with the requirements of the Magnuson-Stevens Fishery Conservation and Management Act (Magnuson-Stevens Act) that constrain total fishing mortality during 2004 within limits that maintain fish stocks at, or rebuild them to, a level capable of producing maximum sustained yield (MSY), or to a stock size less than this if such stock size results in long-term net benefit to the nation.

The purpose of this action is to ensure Pacific Coast groundfish subject to federal management are harvested at OY during 2004 and in a manner consistent with the Groundfish FMP and National Standards Guidelines (50 CFR 600 Subpart D).

The proposed action is needed to constrain commercial and recreational harvests in 2004 to levels that will ensure groundfish stocks are maintained at, or restored to, sizes and structures that will produce the highest net benefit to the nation, while balancing environmental and social values.

Two public scoping meetings will occur at the June 16-20, 2003, Pacific Council meeting as part of the Council's regular agenda. The first public scoping opportunity will occur on Tuesday, June 17, 2003, as part of agendum B.4, Preliminary Range of Harvest Levels for 2004. The second opportunity will occur on Friday, June 20, 2003, as part of agendum B.14, Adoption of Proposed Range for 2004 Groundfish Management Measures. A public comment period is scheduled for each agendum and comments on the scope of the DEIS are encouraged during these comment periods. At the close of the scoping period a scoping summary will be prepared and made available to the public.

2.0 ALTERNATIVES INCLUDING THE PROPOSED ACTION

This chapter describes the range of alternatives that will be considered to implement the proposed action. The range must encompass all reasonable alternatives. If alternatives are eliminated from detailed study, they should be briefly described along with reasons for eliminating them. The range of alternatives must include the alternative of no action. In this case, the no action alternative would be the re-application of harvest limits and management measures implemented in 2003. (Management measures proposed at the beginning of the year can be modified through inseason management actions. Because this EIS will be prepared during 2003, management measures proposed at the beginning of the year will be used in the analysis. This also offers a like comparison to the action alternatives, or proposals for 2004, since these are also the unadjusted measures.)

A preliminary set of alternatives will be developed during the June 16-20, 2003 meeting of the Pacific Fishery Management Council. Alternatives will be structured around a range of ABCs/OYs for assessed groundfish species. This range of ABCs/OYs is based on stock assessments, including seven new assessments completed since 2003 harvest specification were established, rebuilding analyses for overfished species based on these assessments, and a stock assessment of cabezon due to be completed before the end of 2003. This last assessment, although it will not be completed and peer-reviewed early in the decision process, will be used to identify different management measures for nearshore fisheries. For some species OY/ABC ranges that would be used to develop alternatives may be based on consultations by the Council with state and federal agencies, Indian tribes, and the affected public on the allocation of harvest opportunity between sectors. Allocation decisions can affect OYs, because different sectors may catch fish of different ages, allowing different sustainable harvest levels

For each set of ABCs/OYs used in a given alternative, a set of management measures will be identified that will constrain total harvest mortality (across all fisheries intercepting groundfish). Restrictive management measures intended to rebuild overfished species have been adopted and implemented over the past several years for most commercial and recreational fishing sectors. Management measures intended to control the rate at which different groundfish species or species groups are taken in the fisheries include trip limits, bag limits, size limits, time/area closures, and gear restrictions. Large area closures, intended to reduce bycatch of overfished species and referred to as Rockfish Conservation Areas were first implemented in late 2002. These closed areas will continue to be a key feature of alternatives considered in the EIS to manage groundfish fisheries in 2004.

3.0 AFFECTED ENVIRONMENT
4.0 ENVIRONMENTAL CONSEQUENCES

Chapters 3 and 4 have a parallel structure. Both are organized around different components of the human environment that may be significantly affected by the proposed action. Chapter 3 describes the baseline. The baseline describes the affected human environment at a point in time before the proposed action is implemented. Because of the time lag in obtaining and processing stock assessment, harvest, and economic data, the baseline will likely be a time period ending before 2003.

For each human environment component a set of evaluation criteria must be developed to characterize the type and intensity of impacts. Thus the major headings in Chapter 3 and 4 are affected environmental components, while the analysis in Chapter 4 under each of these headings is organized around the kinds of impacts to these components. For the different human environment components direct, indirect, and cumulative impacts will be evaluated. Direct impacts occur at the same time and in the same place as the proposed action. Indirect impacts are reasonably foreseeable effects of the proposed action that occur at a later time or in a place removed from the area where the proposed action occurs. Cumulative impacts result from the incremental impacts of the proposed action when combined with other past, present, and reasonably foreseeable future actions, regardless of what agency or person undertakes them.

Council staff have identified the following human environment components that could be significantly affected by one or more of the alternatives:

- Habitat and ecosystem. There is limited information about habitat and ecosystem impacts. The alternatives will be evaluated based on the inferred level of fishing effort that would occur. Increased effort would correlate with more impacts to habitat. Ecosystem effects result from changes in the relative abundance of species that are either predators or prey of other species.

- Overfished groundfish stocks, target groundfish stocks, and other groundfish stocks. The direct effect of the alternatives can be defined as the total fishing mortality, including bycatch, resulting from a particular set of harvest specifications and management measures. The degree to which the management measures in an alternative cause fishers to discard fish, producing bycatch, is a particular concern. This concern is due to potentially unaccounted for fishing mortality and the physical waste of resources. Another evaluation criterion with particular relevance to overfished species is the risk and uncertainty of achieving MSY, including the effect of model assumptions used in stock assessments and rebuilding analyses on proposed OYs and stock rebuilding. Effects on biodiversity also may be considered in terms of the extinction risk of overfished species posed by different alternatives.

- Nongroundfish stocks. Vessels targeting groundfish stocks catch nongroundfish species incidentally. If other, directed fisheries for these species are near or at their harvest limits, incidental catches by groundfish vessels could have a significant impact in terms of total fishing mortality.

- Protected species. A range of fish and nonfish species potentially taken by groundfish vessels are protected under the Endangered Species Act, Marine Mammal Protection Act, and Migratory Bird Treaty Act. Aside from ESA-listed salmon stocks, primarily taken in the whiting fishery, there is limited information on the effects of groundfish fisheries on these species. Similar to the approach taken in evaluating habitat and ecosystem impacts, the imputed level of fishing effort will be used to compare the potential effects of the alternatives.

- The public sector: enforcement. The nature and complexity of management measures affects enforcement agencies in terms of the institutional resources needed to effectively monitor fishing activities.

- The public sector: data collection and analysis. Stock assessments rely on *fishery dependent data*, which is derived from the fisheries themselves. Alternatives that sharply curtail fishing or redistribute fishing effort (through the use of closed areas, for example) can reduce the amount of these data available over time, making stock assessments more difficult. As a result, management agencies may have to gather more *fishery independent data*, for example by using submersibles to census fish populations. New, potentially more expensive methods may have to be developed, with impacts to management agency resources.

- Commercial fisheries. Many different types of fisheries are affected by groundfish management measures. Fisheries can be categorized by broad regulatory categories and these form major sub-components that will be analyzed. These are: *limited entry trawl fisheries*, *limited entry fixed gear fisheries* (which includes both longline and pot gear types), *directed open access fisheries*, and *nongroundfish fisheries* (some of which may catch groundfish as bycatch). The last two categories can be difficult to distinguish; the proportions of nongroundfish and groundfish species in landings are used to identify directed open access fisheries. A mix of qualitative and quantitative measures will be used to assess impacts, including exvessel revenue. These regulatory categories will be further subdivided, based on economic data, to probe for differential effects on vessels or fleets. Vessels will be categorized by the species composition of their catches, size, and gross revenue. Vessel dependence on and involvement in groundfish fisheries are additional subcategories that will be used to evaluate differential impacts. Dependence is measured by the percent of revenue a given vessel derives from groundfish. Involvement is measured by the proportion of total groundfish landings made by a given vessel. It is likely some of the categories used in the EIS for 2003 harvest specifications will be used in this EIS.

- Recreational fisheries. Generally, less data are available on recreational fishing activity than for commercial fisheries, making analysis more difficult. Recreational fishing can be subdivided into individuals fishing recreationally (using private vessels or fishing from shore) and commercial ventures that take on recreational fishers (charter vessels). Fish caught in recreational fisheries usually are not marketed; the "product" that may be sold or consumed is the recreational experience. Alternatives can be evaluated in terms of the availability of this product and associated economic activity.

- Tribal fisheries. Northwest Indian Tribes receive allocations of the available groundfish harvest based on treaty rights. Alternatives can be evaluated in terms of the change in the amount of fish allocated to Indian fisheries in comparison to baseline and/or 2003 conditions.

- Adjacent council-managed fisheries. The Magnuson-Stevens Act requires fishery management actions be evaluated in terms of their impacts to fisheries managed by other, adjacent councils. Although there are linkages between the West Coast and the area covered by the Western Pacific Council (Hawaii and the U.S.-affiliated Pacific Islands), they do not bear directly on groundfish fisheries. In terms of groundfish fisheries, only the North Pacific Council is relevant. Many vessels participate in both West Coast fisheries managed by the Pacific Council and Alaska fisheries managed by the North Pacific Council. Groundfish management measures affecting participation on the West Coast could affect participation rates in Alaska fisheries.

- Buyers and processors. For many buyers and processors impacts correlate with changes in landings and associated exvessel revenue. (Exvessel revenue is derived from purchases by this sector.) Lower harvest limits would reduce the amount of fish that could be purchased relative to higher harvest limits. Impacts of the alternatives on markets, such as retail outlets and restaurants, can be qualitatively evaluated in terms of the substitutability of other fish products for those that might become unavailable as a result of harvest limits. Some groundfish products might be easily substituted while others—such as live fish sales—may not be. It is likely the same buyer/processor categories used in the EIS for 2003 harvest specifications will be used in this EIS.

- Fishing communities. Fishing community impacts represent the aggregate of the socioeconomic impacts described above. Alternatives can be qualitatively evaluated by comparing changes in personal income resulting from changes in groundfish landings. Given the range of these species and how vessels, landings, and processors are distributed by port, there will be geographic differences in community impacts. Fishing communities are identified based on ports and "port groups" for which groundfish landings data are available. It is likely the same groupings used in the EIS for 2003 groundfish harvest specifications will be used in this EIS.

In addition to the evaluation of impacts to the human environment components listed above, Chapter 4 will include a socioeconomic cost-benefit analysis. This analysis will show how producer and consumer surplus may vary under the alternatives. Chapter 4 will also identify measures that could be used to mitigate any unavoidable adverse impacts identified in the impact analysis.

5.0 CONSISTENCY WITH THE GROUNDFISH FMP AND MAGNUSON-STEVENS ACT NATIONAL STANDARDS

This chapter describes how the proposed action (preferred alternative) is consistent with the Groundfish FMP and the ten National Standards for fishery conservation and management listed in the Magnuson-Stevens Act.

6.0 CROSS-CUTTING MANDATES

In addition to being prepared in accordance with the requirements of the Magnuson-Stevens Act and the National Environmental Policy Act, the EIS document must also address requirements of other applicable federal laws and Executive Orders. This chapter describes the following mandates and the way in which their requirements will be met in implementing the proposed action:

- Coastal Zone Management Act
- Endangered Species Act
- Marine Mammal Protection Act
- Migratory Bird Treaty Act
- Paperwork Reduction Act
- Regulatory Flexibility Act
- EO 12866 (Regulatory Impact Review)
- EO 12898 (Environmental Justice)
- EO 13132 (Federalism)
- EO 13175 (Consultation and Coordination With Indian Tribal Government)
- EO 13186 (Responsibilities of Federal Agencies to Protect Migratory Birds)

7.0 LIST OF PREPARERS

8.0 AGENCIES, ORGANIZATIONS, AND PERSONS TO WHOM COPIES OF THIS STATEMENT WERE SENT

9.0 BIBLIOGRAPHY

The final chapters provide required information. With respect to Chapter 8, NMFS distributes copies of the DEIS to federal and state agencies that may be affected by the action. The Council distributes copies to individuals who specifically request a copy of the document and those who submitted substantive comments on the draft environmental impact statement. (The DEIS and FEIS will be made available for download from the Council website or on request from the Council office.)

ADOPTION OF A PROPOSED RANGE OF 2004 GROUNDFISH MANAGEMENT MEASURES

Situation: Management measures adopted during the Council process are designed to implement new and existing rebuilding programs, achieve bycatch reduction mandates, keep total catch within the proposed harvest levels, and achieve optimum benefits to the various user groups and fishing communities. The harvest levels and allocations adopted for 2003 are attached to provide a reference when the Council deliberates management alternatives for 2004 (Exhibit B.14, Attachment 1).

In the last four years the Council has implemented a substantial restructuring of the groundfish fishery that includes gear restrictions, seasons, dramatically lower harvest levels consistent with previously-approved rebuilding programs for overfished species, and depth-based restrictions that shift the fishery out of the areas where the most depleted groundfish species reside. The management implications of new groundfish stock assessments and rebuilding analyses, as well as the advent of new observer data require consideration of different management measures than implemented in 2003.

The Ad Hoc Allocation Committee (Committee) is scheduled to meet on June 10 and 11 (Exhibit B.14.b, Supplemental Ad Hoc Allocation Committee Report) to begin formulating recommended management and allocation alternatives that are responsive to new assessments and rebuilding analyses. Additionally, the Groundfish Management Team, Groundfish Advisory Subpanel, and interested public are expected to provide recommendations and alternatives for 2004 management.

The Council should develop a range of specific management options at this meeting to help focus public attention on the extent of changes that may be necessary and to provide the basis for adopting final 2004 management measures at the September Council meeting. Allocation alternatives or specifications consistent with proposed management measures should also be considered and adopted by the Council at this time. A preliminary draft 2004 Annual Specifications Environmental Impact Statement (EIS) will be prepared for Council consideration at the September Council meeting. The outline of a draft 2004 Annual Specifications EIS is provided as Exhibit B.14, Attachment 2. It will be important that the Council and its advisors carefully deliberate the potential effectiveness of alternative management measures to stay within the alternative harvest levels adopted under agendum B.4. Otherwise, the quality of the 2004 Annual Specifications EIS may be compromised if alternatives are not properly structured and analyzed with as much scientific rigor as possible.

To aid the Council adoption of management measure alternatives, the public comment period under this agendum also serves as a scoping meeting under the National Environmental Policy Act (NEPA), as previously announced in the *Federal Register*. Pursuant to the NEPA, the Council, in cooperation with NMFS, seeks public comment on the scope of the EIS that will be prepared for the 2004 groundfish harvest specifications and management measures. The scope consists of the range of actions, alternatives, and impacts to be considered in the EIS. At the end of the public scoping period, Council and NMFS staff will prepare and make available a scoping summary describing the oral and written comments on the scope of the analysis, including those made at this meeting and, as appropriate, how they will be addressed in the EIS. Comments are most helpful if they bear directly on the range of alternatives that should be considered and the specific impacts to the natural and human environment the commenter believes the proposed action will cause.

Council Action:

1. **Adopt a proposed range of 2004 management measures for public review.**

Reference Materials:

1. 2003 Specifications of Acceptable Biological Catch (ABC), Optimum Yields (OYs), and Limited Entry and Open Access Allocations, by International North Pacific Fisheries Commission (INPFC) Areas (weights in metric tons) (Exhibit B.14, Attachment 1).

2. Scoping Information Document: Acceptable Biological Catch and Optimum Yield Specifications and Management Measures for the 2004 Pacific Coast Groundfish Fishery Draft Environmental Impact Statement outline (Exhibit B.14, Attachment 2).
3. Public comment (Exhibit B.14.e).
4. Draft minutes of the June 10 and 11 Ad Hoc Allocation Committee meeting (Exhibit B.14.b, Supplemental Ad Hoc Allocation Committee Report).

Agenda Order:

a.	Agendum Overview	John DeVore
b.	Reports and Comments of Advisory Bodies	
c.	Tribal Comments and Recommendations	Jim Harp
d.	Agency Comments and Recommendations	Phil Anderson/Neal Coenen/Marija Vojkovich
e.	Public Comments	
f.	**Council Action:** Adopt a Proposed Range of 2004 Management Measures for Public Review	

PFMC
06/03/03

OCEANA
2501 M Street, NW
Suite 300
Washington, D.C. 20037

NRDC
71 Stevenson St,
Ste. 1825
San Francisco, CA 94105

The Ocean Conservancy
116 New Montgomery St.,
Ste 810
San Francisco, CA 94105

Pacific Marine Conservation Council
P.O. Box 59
Astoria, OR 97103

May 27, 2003

Dr. Hans Radtke
Chair
Pacific Fishery Management Council
7700 NE Ambassador Place
Suite 200
Portland, OR 97220

RECEIVED
MAY 28 2003
PFMC

Dear Dr. Radtke:

Please accept for consideration by the Pacific Fishery Management Council at its June 2003 meeting the enclosed proposal to institute hard bycatch caps in the west coast groundfish fisheries for the 2004 fishing season.

As you know, bycatch of groundfish contributes to the overfishing of many species and results in waste and destruction of marine resources. Establishing a system of caps whereby each sector of the fishery is held accountable for the bycatch it creates would be an important first step in our efforts to count, cap and control bycatch on the west coast. We hope that the enclosed proposal will begin the discussion of how we can reach our bycatch reduction goals.

Thank you for the opportunity to submit this proposal for the Council's consideration, and we look forward to participating in the upcoming meeting.

Very truly yours,

Phil Kline
Fisheries Policy and Programs
Oceana

Chris Dorsett
Pacific Fish Conservation Manager
The Ocean Conservancy

Karen Garrison
Senior Policy Analyst
Natural Resources Defense Council

Peter Huhtala
Acting Executive Director
Pacific Marine Conservation Council

cc: Dr. Donald McIsaac, Executive Director

Hard Bycatch Caps: Proposal for the
Pacific Fishery Management Council
May 13, 2003

Summary

Beginning in the 2004 fishing season, the PFMC should establish a system of hard bycatch caps, using the sector bycatch allocations from the Pacific Fishery Management Council's (PFMC) "bycatch scorecard."

The scorecard was developed by the PFMC to allocate bycatch amounts to all fishing gear sectors for the year. The bycatch scorecard contains estimates of the bycatch mortality of various species in the different West coast groundfish fisheries.

This proposal expands upon the current use of the bycatch scorecard by using the projected bycatch mortality as a hard cap (limit). Fishing would stop in an individual sector when these limits or "hard caps" are reached. The Federal observer program would be responsible for monitoring bycatch mortality through the season.

In this proposal, the total bycatch for the year would be allocated to each fishing gear sector and the projected bycatch mortality for these different sectors would become their bycatch cap. The bycatch caps should only be adjusted annually, based on new scientific information, with no reallocation from one sector to another during the fishing year. When any sector reaches its allotted bycatch level, that sector would be closed to any further fishing even if the target optimum yield had not been reached.

Additionally, the PFMC needs to continue its push for real time data collection and full accountability in our fisheries. The creation of hard bycatch caps, by fishing sector, will insure that no overfishing occurs and excessive mortalities caused by one fishing sector would not cause the closure of other sector's fishing opportunities.

Purpose/Benefits

Helps ensure fairness between sectors by preventing any one sector from "using up" the total year's catch for a species.

Provides greater incentives for clean-fishing, since as bycatch is "counted" against the specific sector and can result in shutting down a fishery.

Builds upon existing management practices by simply extending the current application of the scorecard.

Insures that the total mortality for a species does not exceed the annual limit set by the PFMC.

OUTER BANKS

253 Highland Drive
Channel Islands Beach
California 93035
Tim Athens, Owner

Commercial Fisheries
(805) 984-5338
Fax: (805) 985-JAWS
email: NeptuneOBS@aol.com

RECEIVED
JUN 2 2003
PFMC

Members of the PFMC and GMT

2 JUNE 2003

RE: CCA / RCA boundaries; groundfish allocation; restricted access; LE fleet trip limits

It has come to my attention that the Council may consider easing restrictions on shelf rockfish fishing in the second half of 2003 in light of new information concerning the status of the bocaccio resource. First, I'd like to take the opportunity to commend those involved in making revisions to some of the fundamental variables in the scientific population model this year by their use of the most up-to-date biological information. These modifications have produced a much-more realistic estimate of the current population size.

That being said, I would like you to know that I have been commercially fishing various shelf rockfish species off the coast of southern California for nearly 30 years, am a 'federal A fixed gear permittee', and serve on the PFMC's Habitat Technical Review Committee.

The PFMC and GMT now have some difficult decisions ahead on how best to handle the need to ease these restrictions, respecting the need to maintain existing protection for other overfished rockfish species. Furthermore, the situation now prompts the question of how to allocate 'the shelf' between fishery sectors. I would like to make a few recommendations on these matters.

1. For offshore southern California waters, the Cowcod Conservation Area (CCA) goals, objectives, and boundaries need immediate re-examination relative to the Rockfish Conservation Area (RCA). When we were first faced with the giant swath of closed area in the CCA, we were told that this much area needed to be placed off-limits to ensure adequate protection for 50 percent of the cowcod population. While cowcod have specific depth ranges, it was decided, for enforcement purposes, that only big square or rectangular dimensions would be enforceable, causing the loss of many hundreds of square miles of deeper fishable habitat for minor slope rockfish, blackcod and thornyheads. Yet in 2001, the PFMC moved to the use of closure areas defined by depth contours, and has continued with this strategy ever since. No management action has been taken to reduce the CCA boundaries to compensate for this additional protection which came on-line with the RCA. Clearly, it is arbitrary, redundant, and not in the spirit of sound scientific management to leave the current boundaries of the CCA status quo while enforcing the current RCA boundaries. Without question, the current CCA boundaries are antiquated. Now, with requirements looming for VMS to address enforcement concerns, the limited entry commercial fishery should be given additional access to deeper waters needlessly closed in the CCA. Moving the 'outward line' in to 180 fathoms would be a good start.

2. On the matter of allocation of the bocaccio OY between sectors, it seems most sensible, fair, and equitable to return to the 56/44 percent split between recreational and commercial resources that was in place in 2002. Loss of access to shelf resources was imposed equally between sectors for 2003, and thus the return of access should be dealt with in the same manner.

3. However, in the case of the commercial allocation of bocaccio, it is imperative that the PFMC and GMT be cautious in how this catch is subdivided between the limited entry and open-access fleet. Percentages and splits aside, management MUST take into account that we need to do everything possible to PROHIBIT NEW FISHING EFFORT ON THE SHELF by establishing shelf trip limits for open-access that allow for incidental landings, but serve to deter new involvement. The West Coast groundfish crisis is not over, and we need to remember that there is still a substantial open-access component to this fishery. It does not need to increase in size. Inexplicably, to this day, if the shelf were opened, vessel owners who have never landed a rockfish can still register their vessel commercially, buy a commercial license and go out on the shelf and fish for rockfish. Given California's recent actions restricting access to the nearshore, we need to prevent effort shift onto the shelf. If the PFMC believes in their policies regarding the value of the use of restricted access as a mechanism to reduce effort in a fishery, setting these trip limits for open access should be of utmost importance.

4. Set appropriate trip limits that allow us to more fully utilize the minor shelf OY. Efforts to protect bocaccio have resulted in a loss of access for everybody to this OY. As you are aware, the level at which our minor shelf trip limits are set is far more important than the volume of bocaccio we will be authorized to take, as other shelf species are more important to our markets. In the past, the PFMC has provided a 200-pound monthly trip limit, which was paired with a 1,000 pound per month shelf trip limit. Given our ability to more purely target species such as vermilion, and chilipepper rockfish etc. I'd suggest, for the COMMERCIAL LIMITTED ENTRY FLEET ONLY, that ratio perhaps be loosened so that we can target the shelf species which are not overfished by implementing higher shelf limits. Such a strategy would still accomplish the goal of prohibiting discard of bocaccio, yet would authorize the take of this resource by the component of the commercial fishery that the PFMC has identified as having priority.

Thank you for your consideration,

Tim Athens

Tim Athens

CC: PFMC GMT F&G Commission Voikovich Wolf Barnes

Subject: Fwd: Re: Fwd: Yahoo! News Story - Study Finds Large Drop in PredatoryFish
From: "PFMC Comments" <pfmc.comments@noaa.gov>
Date: Wed, 21 May 2003 15:59:17 -0700
To: John.DeVore@noaa.gov

X-Mozilla-Status: 0001
X-Mozilla-Status2: 00000000
>From - Wed May 21 15: 56:18 2003
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Pacific Fishery Management Council
7700 NE Ambassador Place, Suite 200
Portland, Oregon 97220-1384
Phone: 503-820-2280
Fax: 503-820-2299
On the web at: http://www.pcouncil.org

Subject: Re: Fwd: Yahoo! News Story - Study Finds Large Drop in PredatoryFish
From: John Coon <john.coon@noaa.gov>
Date: Tue, 20 May 2003 11:16:32 -0700
To: PFMC Comments <pfmc.comments@noaa.gov>

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Message-ID: <16c8eb16c36c.16c36c16c8eb@mercury.akctr.noaa.gov>
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MIME-Version: 1.0
Content-Language: en
X-Accept-Language: en
Content-Type: multipart/mixed; boundary="--38803328836742f"

Sandy, forward to JDD--JC

PFMC Comments wrote:

> Pacific Fishery Management Council
> 7700 NE Ambassador Place, Suite 200
> Portland, Oregon 97220-1384
> Phone: 503-820-2280
> Fax: 503-820-2299
> On the web at: http://www.pcouncil.org
>
> --
>
> Subject: Fwd: Yahoo! News Story - Study Finds Large Drop in Predatory Fish
> Date: Sun, 18 May 2003 11:32:22 -0700 (PDT)
> From: jean public <jeanpublic@yahoo.com>
> To: info.wpcouncil@noaa.gov
> CC: pfmc.comments@noaa.gov
>
> Please consider this as my public comments at the next ccouncil meeting. This fishing councilis controlled by fishermen who set quotas much too high so that the ffish can never recover. They also seek to avoid setting any refuges, which should be set, to allow fish stocks to recover. It is time that the fishermen fforget about their deep pockets filled with money at the expense of all of us in this world who want our children and grandchildren to have some fish in the ocean. It is clear that research shows the predatory fishing that has taken place courtesy of the fishing industry.
> b. sashaw
> 15 elm st

florham park nj 07932
--- Yahoo! News <refertofriend@reply.yahoo.com> wrote:
> Date: Sat, 17 May 2003 14:50:26 PDT
> From: Yahoo! News <refertofriend@reply.yahoo.com>
> To: mtrollan@mafmc.org
> CC: jeanpublic@yahoo.com
> Subject: Yahoo! News Story - Study Finds Large Drop
> in Predatory Fish
>

(jeanpublic@yahoo.com) has sent you a news article.
(Email address has not been verified.)
Personal message:
it is interesting what scientists who are not under the thumb of commercial fishermen can find. Of course, when commercial fishermen control scientists and tell them what to say and find, they can catch all the fish they want - and that is what is going on with our fish councils right now. It is a shame.
Study Finds Large Drop in Predatory Fish
http://story.news.yahoo.com/news?tmpl=story&u=/ap/20030514/ap_on_sc/fewer_fish
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for
[input]
[input] Advanced Science - APStudy Finds Large Drop in Predatory Fish
Wed May 14, 6:14 PM ET
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By JOHN HEILPRIN, Associated Press Writer
WASHINGTON - Scientists reported a 90 percent decline in large predatory fish in the world's oceans since a half century ago, a dire assessment that drew immediate skepticism from commercial fishermen.
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Analyzing nearly 50 years of data, two marine scientists at Dalhousie University in Canada say in Thursday's issue of Nature that commercial fishing killed off all but 10 percent of populations of large prized tuna, swordfish, marlin and other fish species.

Average weights of those remaining also have declined sharply, they say.

"Although it is now widely accepted that single populations can be fished to low levels, this is the first analysis to show general, pronounced declines of entire communities across widely varying ecosystems," scientists Ransom A. Myers and Boris Worm report in Thursday's issue of Nature magazine.

Nelson Beideman, who directs the Blue Water Fishermen's Association in Barnegat Light, N.J., said the report seemed aimed at developing "Chicken Little-type scenarios" to please the Pew Charitable Trusts, which helped finance the study. Pew backs a number of environmental groups.

"Fishermen are not seeing the whole ocean down at 10 percent," said Beideman, whose trade group represents Atlantic longline fishermen.

Myers, a marine biology professor, and Worm, a research fellow, also found giant commercial fishing operations generally take less than 15 years to kill off 80 percent of a new fishing ground's abundance. But they said marine life can recover if smaller, fast-growing species are given a chance to fill in for the large, overfished predators.

Myers began work on the report a decade ago, collecting data only for commercial fish that could be canned. He covered Japanese longline fishing between 1952 and 1999. Longlines, the most widespread fishing gear used on open oceans, catch tuna, marlin and swordfish by floating for miles with baited hooks dangling vertically below.

No marine fish stocks were known to be overfished when large-scale fishing fleets began spreading globally just after World War II and the Japanese were catching 10 fish per 100 hooks.

Now, they are lucky to catch one per 100, Myers said. The report uses other research to verify the results and expand them to other species.

The trends outlined in the report echo a 1994 estimate by the U.N. Food and Agriculture Organization (news - web sites) that almost 70 percent of marine fish stocks were overfished or fully exploited. A U.N.-sponsored world summit in South Africa called for restoration of global fisheries by 2015.

Myers and Worm hope their work helps guide those efforts.

David Burney, who directs the U.S. Tuna Foundation in San Diego, said the report raises legitimate concerns about overfishing but probably overstates the problem.

"It just highlights what we've been saying for the last five years #151; there's way too much fishing capacity out on the open seas. It's a combination of more, bigger boats and technology advances that are allowing you to find the fish so much easier than before," he said.

Michael Sissenwine, head of fisheries science at the National Oceanic and Atmospheric Administration, agreed with the report that fishing can cause big reductions in populations quickly but cautioned against drawing larger conclusions.

"There's nothing that assures us that the data they are using is representative of all populations in the world," he said, adding that fishing typically reduces a species' population by at least 50 percent.

Barbara Block, a Stanford University marine biologist and one of the world's leading tuna researchers, said the report's findings are solid.
#160;

"What the paper is doing is bringing to the public the reality of what's happening in our seas," she said. "We're systematically removing the large carnivores from the seas."
Block said "some of the most magnificent creatures on Earth" are being eliminated before researchers fully understand them.
"Do we want a world without white sharks and giant tunas?" she asked. "Do we want a world without mako sharks? Industrial large-scale fishing is making that choice for all of humankind."
Daniel Pauly, a leading fisheries expert based in Canada, also praised the report for its unusually comprehensive data illustrating the shortcomings of fisheries management.
"We always regulate the closing of barns after the horses have already left," he said. "What it means is that the high seas fisheries that are opened up in the deep seas, they are a completely law-free environment like the Old West."

—
On the Net:
Nature: http://www.nature.com/nature

PFMC Comments <pfmc.comments@noaa.gov>
Pacific Fishery Management Council

PFMC Comments
Pacific Fishery Management Council <pfmc.comments@noaa.gov>
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Portland Work: 503-820-2280
OR
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USA
Additional Information:
Last Name Comments
First Name PFMC
Version 2.1

Subject: Fwd: Tougher Groundfish Regulations Needed
From: "PFMC Comments" <pfmc.comments@noaa.gov>
Date: Mon, 03 Mar 2003 08:03:18 -0800
To: John.DeVore@noaa.gov
CC: Mike.Burner@noaa.gov

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>From - Mon Mar 03 08: 21:13 2003
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Phone: 503-820-2280
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On the web at: http://www.pcouncil.org

Subject: Tougher Groundfish Regulations Needed
From: (Branden Leach) branden@leach.net
Date: Sat, 1 Mar 2003 08:09:08 -0800
To: rhight@dfg.ca.gov
CC: rtreanor@dfg.ca.gov, mvojkovi@dfg2.ca.gov, governor@governor.ca.gov, Assemblymember.Wayne@assembly.ca.gov, Assemblymember.Hollingsworth@assembly.ca.gov, carol.wallisch@sen.ca.gov, Senator.Oller@sen.ca.gov, pfmc.comments@noaa.gov

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I have been fishing the California coast for more than 30 years. In the last ten years I have seen the average size of rockfish decline steadily. At the same time I have seen the size and frequency of lingcod decline as well. I stongly support the draconian measures described above to preserve and restore these fish stocks. I believe the burden of a fishing moratorium should fall on all of us, sport and commercial angelers as well, though primarily on commerical fishermen since there are fewer of them and they take a greater number of fish. Furthermore, if enforcement required raising taxes I would support this provided the burden was progressive and the funds went directly to the DFG instead of into the State's general fund. Thank you.

I, as a California recreational angler, find the increasing body of evidence indicating the severe depletion of California's groundfish stocks alarming. I believe the interim CDFG regulations will prove inadequate to stop further deterioration of the stocks and urge the department to implement the following measures.

Immediately end the use of traps for catching fish.

Restrict commercial fishing to the use of rod-and-reel gear in waters less than 60 fathoms, and limit the number of fish caught per day per vessel. We are in agreement with, and support the United Anglers proposed limit of 20 fish per day per commercial fishing vessel.

Require all rockfish catches be landed at designated landing sites where DFG employees are present to monitor and sample the catch.
Documentation of the catch by CDFG would be provided. Charging commercial vessels would fund the program.

Require all merchants to document purchases and sales of rockfish so they could be tracked back to the fisherman.

Seasonal closures should be timed when the majority of species in an area are spawning, such as banning ling cod fishing in water less than 20 fathoms in December and January.

Begin recruitment and training of an enforcement staff large enough to make the regulations effective.

Dramatically increase penalties for any violation of Fish & Game regulations associated with groundfish; including poaching and possession of undocumented catch, to include seizure of assets.

Begin moving to a computer based licensing system such as in use by the State of Oregon. This would allow limiting the amount of days the recreational anglers could target rockfish through the use of stamps affixed to the license.

These emergency measures, if enacted and enforced, may allow us to save this valuable public resource while the while the long-term solutions and regulations required to create a sustainable fishery are established.

Sincerely,
Branden Leach
oceano

ARTICLE:
Tougher Interim Regulations Needed to Protect Rockfish Stocks

By: Richard Alves 2-12-01
Fishsniffer.com

"The West Coast groundfish fishery cannot ever reach sustainable levels, either biologically or economically, if it continues as is," wrote the Pacific Marine Conservation Council in their newsletter last summer. The PMCC is a non-profit group based in Astoria Oregon.

Government agencies, commercial fishermen and sport anglers agree the California groundfish fishery is in trouble. After years of inaction, and many species of rockfish being on the verge of collapse, the California Department of Fish and Game, at the insistence of the Pacific Fishery Management Council Commission have enacted interim regulations aimed at protecting the fishery while the long-term solutions are to be determined over the course of the year.

The caveat being, the regulations have been formulated without any accurate data regarding the fishery or the fishery harvest. I can't tell you how hard it has been to find any data on the fishery, and the information published by CDFG, http://www.dfg.ca.gov/mrd/mlma/reports/ (Only the Acrobat Files have the numbers), is unbelievable if given more than a cursory reading.

The problem with the Interim Regulations, http://www.fishsniffer.com/steelhead/020201rockfishregs.html, is they fail to address the most serious threats to the fishery, highly efficient commercial gear, blanket harvest (http://www.fishsniffer.com/steelhead/021201bgrockfish.html#fishtrap), and illegal catch, while at the same time create economic havoc for the sportfishing and coastal tourism industry.

Regulations enacted without effective enforcement and severe penalties will prove futile. Unfortunately the history of CDFG enforcement is not encouraging. They are simply understaffed for the challenges they are facing. Unless manpower is increased and the agency is better organized, whatever regulations are adopted, are doomed to failure.

For Example:

An interim rockfish species quota has been adopted by the California Fish And Game Commission, however, the CDFG has yet to establish verification methods or obtain the funding to pay for them.

Meanwhile, the commercial livefish boats are systematically cleaning out the nearshore fishery. "On Friday, October 27, 2000, five commercial livefish boats were working 50 traps in a kelp bed the size of a football field inside Noyo Cove. The traps were set five or ten yards apart," a Fish Sniffer Reader reported.

A 1996 NMFS study showed that most of the live fish sold in their sample of San Francisco fish markets and restaurants were sub legal and/or undocumented.

At this moment we are heading into another season where the documentation of the commercial catch will be spotty at best, while the unreported illegal catch goes completely undocumented. Current lack of enforcing reporting statutes for commercial passenger fishing vessels, party boats, also brings into question the validity of that source of data, http://www.fishsniffer.com/steelhead/021201bgrockfish.html#available.

But rest assured, the fishery will be hammered for another year while we attend endless hearings to develop another set of temporary regulations, which the State can't enforce. Unless California can find the courage and determination to make meaningful change stick, the future of the groundfish species in California is bleak.

Where do we go from here?

Immediately end the use of traps for catching fish.

Restrict commercial fishing to the use of rod-and-reel gear in waters less than 60 fathoms, and limit the number of fish caught per day per vessel. We are in agreement with, and support the United Anglers proposed limit of 20 fish per day per commercial fishing vessel.

Require all rockfish catches be landed at designated landing sites where DFG employees are present to monitor and sample the catch.
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PFMC Comments
<pfmc.comments@noaa.gov>
Pacific Fishery Management Council

Subject: Fwd: comment on fixed gearfor Sablefish
From: "PFMC Comments" <pfmc.comments@noaa.gov>
Date: Tue, 21 Jan 2003 08:21:56 -0800
To: john.devore@noaa.gov
CC: mike.burner@noaa.gov

X-Mozilla-Status: 0001
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>From - Tue Jan 21 08: 18:35 2003
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Portland, Oregon 97220-1384
Phone: 503-820-2280
Fax: 503-820-2299
On the web at: http://www.pcouncil.org

Subject: comment on fixed gearfor Sablefish
From: "Larry Demmert" <larrynbrenda@earthlink.net>
Date: Sat, 18 Jan 2003 18:39:01 -0800
To: <pfmc.comments@noaa.gov>

X-Mozilla-Status: 0001
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Content-Language: en
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Content-Type: multipart/mixed; boundary="--f9e4e0277ff4fcf"

I believe that the fixed gear permits should be allowed to do either pot or longline regardless of the endorsement, as they are both fixed gears. With the current groundfish bycatch problems, I think it only makes sense that pot fishing should be encouraged because of the lower by-catch rates and less Sperm whale interaction. Off of the Nitnat this year we were stripped of most of our Sablefish and whales were waiting by our buoys before we even hauled. There also would be zero sea-bird problems.

Thank you

Larry Demmert
206-484-4749

PFMC Comments
<pfmc.comments@noaa.gov>
Pacific Fishery Management Council

Subject: Fwd: Permit Stacking
From: "PFMC Comments" <pfmc.comments@noaa.gov>
Date: Mon, 12 May 2003 15:20:14 -0700
To: John.DeVore@noaa.gov
CC: Mike.Burner@noaa.gov

Pacific Fishery Management Council
7700 NE Ambassador Place, Suite 200
Portland, Oregon 97220-1384
Phone: 503-820-2280
Fax: 503-820-2299
On the web at: http://www.pcouncil.org

Subject: Permit Stacking
From: "Sharon Demmert" <demmsha@aptalaska.net>
Date: Fri, 9 May 2003 19:52:58 -0800
To: <pfmc.comments@noaa.gov>

Dear Council,
I would like to see an increase in the number of permits allowed on a vessel to 6 permits so that 2 permit owners with a full license limit of three each may consolidate on one boat to cut expenses i.e.insurance , fuel and gear costs. It is far cheaper to insure 1 boat and change crews than to insure 2 different boats crews etc. My Insurance rates have increased nearly 50% over last year and is the Council aware of the insurance crisis, that many boats are unable to get coverage at all. I was dropped by my insurer of 8 years for a small claim(13,000) and have too pay considerably more . Please seriously consider this!!!!

Larry Demmert

PFMC Comments <pfmc.comments@noaa.gov>
Pacific Fishery Management Council

Subject: Fwd: Pineapple Trawl
From: "PFMC Comments" <pfmc.comments@noaa.gov>
Date: Fri, 02 May 2003 09:43:31 -0700
To: John.DeVore@noaa.gov
CC: Mike.Burner@noaa.gov

X-Mozilla-Status: 0001
X-Mozilla-Status2: 00000000
>**From - Fri May 02 09:** 41:52 2003
X-Mozilla-Status: 0001
X-Mozilla-Status2: 00000000
Return-Path: <pfmc.comments@noaa.gov>
Received: from mercury.akctr.noaa.gov ([127.0.0.1]) by mercury.akctr.noaa.gov (Netscape Messaging Server 4.15 mercury Jun 21 2001 23:53:48) with ESMTP id HE9QGJ00.U5B; Fri, 2 May 2003 09:43:31 -0700
Message-ID: <3f74041962.419623f740@mercury.akctr.noaa.gov>
X-Mailer: Netscape Webmail
MIME-Version: 1.0
Content-Language: en
X-Accept-Language: en
Content-Type: multipart/mixed; boundary="--763a3995668433f0"

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7700 NE Ambassador Place, Suite 200
Portland, Oregon 97220-1384
Phone: 503-820-2280
Fax: 503-820-2299
On the web at: http://www.pcouncil.org

Subject: Pineapple Trawl
From: "sl" <fwtrawl@newportnet.com>
Date: Thu, 1 May 2003 16:47:10 -0700
To: "PFMC" <pfmc.comments@noaa.gov>

X-Mozilla-Status: 0001
X-Mozilla-Status2: 00000000
>**From - Fri May 02 09:** 41:52 2003
X-Mozilla-Status: 0001
X-Mozilla-Status2: 00000000
Return-Path: <pfmc.comments@noaa.gov>
Received: from mercury.akctr.noaa.gov ([127.0.0.1]) by mercury.akctr.noaa.gov (Netscape Messaging Server 4.15 mercury Jun 21 2001 23:53:48) with ESMTP id HE9QGJ00.U5B; Fri, 2 May 2003 09:43:31 -0700
Message-ID: <3f74041962.419623f740@mercury.akctr.noaa.gov>
X-Mailer: Netscape Webmail
MIME-Version: 1.0
Content-Language: en
X-Accept-Language: en
Content-Type: multipart/mixed; boundary="--763a3995668433f0"

Dear council members,

My name is Sara Skamser. My husband John and myself own Foulweather Trawl here in Newport, Oregon. We are the last survivng net shop in Oregon that has a crew (8 to 14 people) to build, manufacture and repair commercial fishing trawls.

We designed and built the original Pineapple trawl for an ODF&W study started in 2001 to study the concept of a cut back "topless" bottom trawl for use on the shelf fishery here in Oregon. The concept was theirs, but the actual design was ours, and the two years of their study with this trawl was a great collaborative success. Steve Parker, Bob Hannah and Keith Matteson were excellent to work with as they knew what they were looking for in a design, and they knew how to run the research and quantify results.Our company was thrilled to have won that contract and to have been a part of something so groundbreaking.

After the depth closures in the fall of 2002, we were contacted by four vessels here in Newport and one brave soldier in Coos Bay to either build the original Pineapple trawl for them, or to redesign the net for the smaller horsepowered vessels. We did both, and four vessels ordered the nets and started fishing them about three weeks ago on the shelf.

We recieved phone calls from all the skippers of these vessels while they were still at sea (a rare occurance for us) on their first trips with these nets to tell us how absolutely unbelievable it was. They were plowing through all kinds of sign (a lot of whiting) of fish and bringing up just flats and some true cod. Virtually no canaries, yellow eye or hake or any other "bad" fish. The nets also tow easier and it looks like fuel savings will prove to be significant in the long run, even in the short run. The crew members even love us because the time for picking fish and putting them down in the hold is much less of a chore.

I have been hired by ODF&W on a small contract to trouble shoot some of the net designs submitted by fishermen from all ports in Oregon for the upcoming Exempted Fishing program hopefully starting soon, to allow 8 vessels to fish in the closed Zone with Pineapple trawls to start quantifying performance of these trawls on the grounds. Unlike my usual, extremely territorial self, I have signed off any intellectual property rights to the work I do for ODF&W and that includes design work. At this point I don't care where the Pineapple's come from, as long as everybody is trying. It could very well be that some other design or innovation proves to be an even better way to go, but from looking at the designs that were submitted there may be some mixed results.We are hoping that everyone keeps an open mind when this program begins.

John and I also plead the case here for expanding some fishing grounds or quota's to the draggers deploying this gear, as the value of the fish the quota's allow right now, would force our net shop out of business, much less a drag boat. A year from now, if these quota's and closed zones stay in effect, we will be having to turn fishermen away for fears of not being paid. Inventories at shoreside services are dwindling and the entire market infrastructure seems ready to collapse. We hear rumors that the "buy back" program is slowly falling off the table because it is obvious that these fishermen can just be choked to death instead. We hope that is a rumor, but when we see what happened at the April Council meeting we think the worst.

I know your job as council members is thankless and long suffering, but we think this net brings a ray of hope and might encourage the will to continue to fight for good mangement of the Pacific Ocean commercial fisheries. We also know that the drag fishermen have been slow in changing their fishing practices, but again, this net might encourage the fleet to do the right thing.

Sincerely, Sara Skamser

PFMC Comments
<pfmc.comments@noaa.gov>
Pacific Fishery Management Council

Subject: Fwd: The experimental "Pineapple Trawl"
From: "PFMC Comments" <pfmc.comments@noaa.gov>
Date: Fri, 25 Apr 2003 08:50:49 -0700
To: John.DeVore@noaa.gov
CC: Mike.Burner@noaa.gov

X-Mozilla-Status: 0001
X-Mozilla-Status2: 00000000
>From - Fri Apr 25 09: 35:02 2003
X-Mozilla-Status: 0001
X-Mozilla-Status2: 00000000
Return-Path: <pfmc.comments@noaa.gov>
Received: from mercury.akctr.noaa.gov ([127.0.0.1]) by mercury.akctr.noaa.gov (Netscape Messaging Server 4.15 mercury Jun 21 2001 23:53:48) with ESMTP id HDWPCP00.Q4P; Fri, 25 Apr 2003 08:50:49 -0700
Message-ID: <d1ee9611.9611d1ee@mercury.akctr.noaa.gov>
X-Mailer: Netscape Webmail
MIME-Version: 1.0
Content-Language: en
X-Accept-Language: en
Content-Type: multipart/mixed; boundary="--2e1b1800f9d79cb"

Pacific Fishery Management Council
7700 NE Ambassador Place, Suite 200
Portland, Oregon 97220-1384
Phone: 503-820-2280
Fax: 503-820-2299
On the web at: http://www.pcouncil.org

Subject: The experimental "Pineapple Trawl"
From: "Ken Yada" <kenyada@actionnet.net>
Date: Thu, 24 Apr 2003 11:02:16 -0700
To: <pfmc.comments@noaa.gov>

X-Mozilla-Status: 0001
X-Mozilla-Status2: 00000000
>From - Fri Apr 25 09: 35:02 2003
X-Mozilla-Status: 0001
X-Mozilla-Status2: 00000000
Return-Path: <pfmc.comments@noaa.gov>
Received: from mercury.akctr.noaa.gov ([127.0.0.1]) by mercury.akctr.noaa.gov (Netscape Messaging Server 4.15 mercury Jun 21 2001 23:53:48) with ESMTP id HDWPCP00.Q4P; Fri, 25 Apr 2003 08:50:49 -0700
Message-ID: <d1ee9611.9611d1ee@mercury.akctr.noaa.gov>
X-Mailer: Netscape Webmail
MIME-Version: 1.0
Content-Language: en
X-Accept-Language: en
Content-Type: multipart/mixed; boundary="--2e1b1800f9d79cb"

Hopefully to someone that cares,

We made our first trip with the experimental net, and I am really impressed. We delivered approximately twenty-six thousand pounds of an assortment of petrale, skates, and other fish caught between seventy-five and eighty-five fathoms. In five days I saw two Canary Rockfish and maybe One hundred pounds of some juvenile rock- fish. At times there was such heavy hake sign that I would have expected to be chased out of the area, but we never had more than a basket of hake in any of our tows. Our tows ranged from fifteen hundred to seven thousand pounds. Other boats with conventional nets reported big tows of hake.

I have been trawling for twenty seven years and from what I observed last trip I have no doubts that the new trawl has the potential to solve our rockfish dilemma. I believe it is worth concentrating most of your time and energy to find a workable solution to the problem of by-catch. I am pleading that you look into this trawl and it's potential in a manner that will take a minimum amount of time. If we do not get back some grounds or quotas in the next couple of catch periods, I am sure there will be some fisherman dangerously close to losing their ability to survive. Look at the value of the fish that you have left us and go through the economics of running a trawler. It does not add up to viable business.

Sincerely, Ken Yada F/V AJA

PFMC Comments
<pfmc.comments@noaa.gov>
Pacific Fishery Management Council

Subject: Fwd: an amendment
From: "PFMC Comments" <pfmc.comments@noaa.gov>
Date: Thu, 17 Apr 2003 08:02:25 -0700
To: John.DeVore@noaa.gov
CC: Mike.Burner@noaa.gov

X-Mozilla-Status: 0001
X-Mozilla-Status2: 00000000
Return-Path: <pfmc.comments@noaa.gov>
Received: from mercury.akctr.noaa.gov ([127.0.0.1]) by mercury.akctr.noaa.gov (Netscape Messaging Server 4.15 mercury Jun 21 2001 23:53:48) with ESMTP id HDHTS100.LHN; Thu, 17 Apr 2003 08:02:25 -0700
Message-ID: <de92ada429.da429de92a@mercury.akctr.noaa.gov>
X-Mailer: Netscape Webmail
MIME-Version: 1.0
Content-Language: en
X-Accept-Language: en
Content-Type: multipart/mixed; boundary="--4e8a41a221f4be8"

Pacific Fishery Management Council
7700 NE Ambassador Place, Suite 200
Portland, Oregon 97220-1384
Phone: 503-820-2280
Fax: 503-820-2299
On the web at: http://www.pcouncil.org

Subject: an amendment
From: "Ken Yada" <kenyada@actionnet.net>
Date: Thu, 17 Apr 2003 06:29:30 -0700
To: <pfmc.comments@noaa.gov>

X-Mozilla-Status: 0001
X-Mozilla-Status2: 00000000
Return-Path: <pfmc.comments@noaa.gov>
Received: from mercury.akctr.noaa.gov ([127.0.0.1]) by mercury.akctr.noaa.gov (Netscape Messaging Server 4.15 mercury Jun 21 2001 23:53:48) with ESMTP id HDHTS100.LHN; Thu, 17 Apr 2003 08:02:25 -0700
Message-ID: <de92ada429.da429de92a@mercury.akctr.noaa.gov>
X-Mailer: Netscape Webmail
MIME-Version: 1.0
Content-Language: en
X-Accept-Language: en
Content-Type: multipart/mixed; boundary="--4e8a41a221f4be8"

Dear Sirs,

I was going over my first letter to you and thought the word "highliner was inappropriate. I think that fisherman who have spent decades learning the whereabouts of certain fish and looking at the types of grounds where they live, should be used in stock assesments. If the use of some "grid" type sampling is done on species of fish that live in tight schools over a very specific type bottom , I would think there would be a high risk of large errors in the data. The time of day and the time of year that the samples a taken are so critical for fish that have life histories like many of the rock fish. Why not try to assess the stocks when and where the fish congregate? Isn't salmon managed that way?

Well I hope I hear from somebody who can help me understand why you can't work harder trying to improve your methods of stock assessment , especially when so much is at stake.

Well I need to go fishing so that's all for now.

Ken Yada

PFMC Comments
<pfmc.comments@noaa.gov>
Pacific Fishery Management Council

Subject: Fwd: Please enlighten me!
From: "PFMC Comments" <pfmc.comments@noaa.gov>
Date: Thu, 17 Apr 2003 08:01:52 -0700
To: John.DeVore@noaa.gov
CC: Mike.Burner@noaa.gov

X-Mozilla-Status: 0001
X-Mozilla-Status2: 00000000
Return-Path: <pfmc.comments@noaa.gov>
Received: from mercury.akctr.noaa.gov ([127.0.0.1]) by mercury.akctr.noaa.gov (Netscape Messaging Server 4.15 mercury Jun 21 2001 23:53:48) with ESMTP id HDHTR400.7KC; Thu, 17 Apr 2003 08:01:52 -0700
Message-ID: <dd4dcd8a49.d8a49dd4dc@mercury.akctr.noaa.gov>
X-Mailer: Netscape Webmail
MIME-Version: 1.0
Content-Language: en
X-Accept-Language: en
Content-Type: multipart/mixed; boundary="--f354807e8672e7"

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7700 NE Ambassador Place, Suite 200
Portland, Oregon 97220-1384
Phone: 503-820-2280
Fax: 503-820-2299
On the web at: http://www.pcouncil.org

Subject: Please enlighten me!
From: "Ken Yada" <kenyada@actionnet.net>
Date: Thu, 17 Apr 2003 03:16:13 -0700
To: <pfmc.comments@noaa.gov>

X-Mozilla-Status: 0001
X-Mozilla-Status2: 00000000
Return-Path: <pfmc.comments@noaa.gov>
Received: from mercury.akctr.noaa.gov ([127.0.0.1]) by mercury.akctr.noaa.gov (Netscape Messaging Server 4.15 mercury Jun 21 2001 23:53:48) with ESMTP id HDHTR400.7KC; Thu, 17 Apr 2003 08:01:52 -0700
Message-ID: <dd4dcd8a49.d8a49dd4dc@mercury.akctr.noaa.gov>
X-Mailer: Netscape Webmail
MIME-Version: 1.0
Content-Language: en
X-Accept-Language: en
Content-Type: multipart/mixed; boundary="--f354807e8672e7"

Anybody and everybody,

I am requesting somebody to convince that the methods of stock assements are the best that are available. I've been fishing since I was thirteen. I started trawling with Barry Fisher. I wish he was still alive because I believed in him so much that if I had any questions about anything I would just ask him and take his answer as the absolute truth. (I am very biased though, because I loved him)

My biggest problem in understanding the assesment technique, aside from not even knowing what it is, is how the method that is used can account for the dispersion of some of the species of fish we are concerned with.

I really believe there is a way to make stock assesments of rock fish species that are dispersed in "clumped clumps" with the help of some of the "highliners" by direct observation. The technology is there.

I always wonder if the people who determine the methods of stock assesments are so sure of themselves that they would risk their livelyhood on their conclusions.

This is the first time I've ever voiced my opinion about the management plan, despite Barry's encouragement to do so thirty years ago.

I realize that I am totally ignorant on this subject, so would someone try and expain to a dummy how the assesments work.

I'[ve got one other question. How long has present method been used?

Sincerely,
Ken Yada

PFMC Comments
<pfmc.comments@noaa.gov>
Pacific Fishery Management Council

Subject: Re: Reply from PFMC Regarding Directed Sablefish Fishery
From: "Larry Demmert" <larrynbrenda@earthlink.net>
Date: Tue, 25 Feb 2003 16:52:27 -0800
To: "Jim Seger" <Jim.Seger@noaa.gov>

Jim,
Since my original comment something more pressing has come to light, I would like to see a longer season more than anything so that we can defend our place in the market against Farmed sablefish. I recently read a story on it on how it came up at the IPHC meeting and I was alarmed that NMFS is promoting this. With all the disasterous things that have happend to the salmon Industry (tremendous devaluation,runs that are wiped out by disease, displacement in spawning habitat on Vancouver Isl, all the streams in Norway sterilized because of farmed fish disease and infestations,Pollution, diseased fish carcasses dumped irresponsibaly by Canadien gov. etc.) I believe that a longer season would combat any farmed fish.Biologically there is no reason not to and enforcement wise it shouldn't add any cost either .
Please consider this proposal thank you
Larry Demmert
----- Original Message -----
From: "Jim Seger" <Jim.Seger@noaa.gov>
To: <larrynbrenda@earthlink.net>
Sent: Tuesday, February 11, 2003 2:04 PM
Subject: Reply from PFMC Regarding Directed Sablefish Fishery

Dear Mr. Demmert:

We received your email comment requesting a plan amendment to allow vessels participating in the directed sablefish fishery the option of using pot or longline gear, regardless of the fixed gear endorsement on their limited entry permit. We also apologize for our delayed response to your comment. You mention you are both a longline and pot fisherman, and you have stacked permits. Current regulations allow a vessel to catch all of its sablefish with any fixed gear for which it holds at least one limited entry permit. Thus, if at least one of your stacked permits is endorsed for pot gear, you may use pot gear for all of your fixed gear limited entry directed sablefish harvest. If none of your stacked permits is endorsed for pot gear, then you are correct; a plan amendment would be required to allow longline vessels to use pot gear. If you wish to pursue a plan amendment, please let us know, and we will circulate your email to Council members.

Please be aware that the Council is currently addressing a number of issues for groundfish and other fisheries off the West Coast. Progress on many of these issues is currently stalled, because of the need to address the highest priority items first. If the Council decides to pursue development of the plan amendment option you are suggesting, it will need to be prioritized along with other items under consideration by the Council.

Regards,
Jim Seger

Southern California Trawlers Association

February 11, 2003

RECEIVED

FEB 1 8 2003

PFMC

Mr. Hans Radke, Chairman
Pacific Fishery Management Council
7700 NE Ambassador Place, Suite 200
Portland, OR 97220-1384
June 20, 2002

RE: PROPOSED CHANGES TO SOUTHERN CALIFORNIA COWCOD CONSERVATION CLOSURE AREAS

Dear Mr. Radke:

The Southern California Trawler's Association is a group of eighteen small trawlers (80% from 32 feet to 45 feet, largest is 60 feet in length) fishing out of the ports of Morro Bay, Santa Barbara, Ventura, and San Pedro, principally in the Santa Barbara Channel. We fish for ridgeback shrimp, spot prawns, sea cucumbers and (mostly live) halibut. A few of our members also fish for pink shrimp.

A proposal is now being circulated among Council Committees that may make changes to the Southern California Cowcod Conservation Area established over the last couple of years to rebuild cowcod stocks. Our Association members are concerned that these proposed changed to the boundary lines of the Cowcod Conservation Area will significantly impact our members without adding measurable conservation benefits to cowcod stocks.

After the closure was initiated, Association members who used to trawl for spot prawns in the area started fishing deeper, outside the closed area, and found a few areas that hold spot prawns, enough, at least, to keep the boats working. The current boundaries approximate the 150 fathom depth contours. The proposed boundaries in most places would close fishing to our members out to 200 fathoms, a depth beyond which spot prawns do not inhabit in commercial quantities. Further, our small boats don't carry enough cable or horsepower to fish the net in that deep of water.

We feel that by staying outside of 150 fathoms, we have complied with both the spirit and the letter of the PFMC Groundfish Amendments to conserve cowcod. To our knowledge, none of our members have caught a cowcod while trawling for spot prawns outside 150 fathoms since the closure of the Cowcod Conservation Area. From our perspective, we have done everything asked of us to conserve cowcod. The Council set 150 fathoms as the maximum depth at which cowcod are normally found, and our spot prawn fishing outside the Conservation Area is bearing out this wisdom.

6 Harbor Way, Box 101 — Santa Barbara, California 93109

We urge the Council not to adopt this change to the Cowcod Conservation Area boundaries in light of the questionable additional conservation benefits it provides cowcod, especially when the effects of this kind of change under the Magnuson Act must be looked at in a balanced view considering also the social and economic impacts to members of our Association, all of whom are individual family fishermen.

This proposed regulation must also be viewed in context of the other Groundfish Plan amendments that have essentially closed most of the Continental Shelf south of Point Conception to trawling between 100 and 150 fathoms. These depth zones are predominantly where we traditionally have fished for spot prawns. Therefore, most of our spot prawn grounds have already been prohibited. We have been eking out market orders by adhering to all of the groundfish conservation measures, but barely. Now, with the proposed changes to the Cowcod Conservation Area, our last few spot prawn areas would be halved again, since the Island side of the Santa Barbara Channel was also restricted for our exempted trawl fisheries south of Point Conception.

For these reasons, we urge the Council not to make further changes to the boundaries of the Cowcod Conservation Area. The idea that improved enforcement will result from these proposed changes isn't consistent with modern navigational technology. Our members have been able to avoid entering the existing CCA without difficulty using modern GPS and fathometers. The new Department of Fish and Game enforcement vessels are even better equipped than ours. They, too, should have no problem detecting the existing boundary and water depths.

Our Association members support Council measures that promote long-term sustainability of our fisheries. The proposed changes, however, offer no demonstrable conservation benefits to cowcod while significantly impacting what little spot prawn trawl grounds that remain to us, given all the other conservation measures we are now in compliance with.

Thank you for the opportunity to comment on these proposed changes to the Southern California Cowcod Conservation Area. If you have any questions or comments for our members, please do not hesitate to contact me at (805) 566-1400 or fish4u1@msn.com.

Sincerely, Mike McCorkle

Mike McCorkle, President
Southern California Trawler's Association

Cc: Dr. Don McIsaac, Executive Director, PFMC
Mr. John DeVore, Groundfish Staff Officer, PFMC
Mr. Jim Seger, Fisheries Economics Staff Officer, PFMC
Mr. Rod Moore, Groundfish Advisory Subpanel
Dr. Alec McCall, Scientific and Statistical Committee
Dr.. Steve Ralston, Scientific and Statistical Committee
Dr. Cindy Thompson, Scientific and Statistical Committee
Mr. L.B. Boydston, Ad-Hoc Allocation Committee
Ms. Marija Vojkovich, Department of Fish and Game
Mr. Brian Culver, Groundfish Management Team
Dr. James Hastie, Groundfish Management Team
Mr. Zeke Grader, Pacific Coast Federation of Fishermen's Associations

Subject: Fwd: Sportfishing
From: "PFMC Comments" <pfmc.comments@noaa.gov>
Date: Thu, 20 Feb 2003 13:03:22 -0800
To: John.DeVore@noaa.gov
CC: Mike.Burner@noaa.gov

Pacific Fishery Management Council
7700 NE Ambassador Place, Suite 200
Portland, Oregon 97220-1384
Phone: 503-820-2280
Fax: 503-820-2299
On the web at: http://www.pcouncil.org

Subject: Sportfishing
From: <JimTinto@aol.com>
Date: Thu, 20 Feb 2003 15:22:50 EST
To: pfmc.comments@noaa.gov

Please read the following concerning the frustrations of the Sportfishing of near shore groundfish.
jimtinto@aol.com

Editorial
Rockfish? No we don't have no stinking rockfish reports. Cal Fish and Game shut the sport season down last November and aside from commercial boats no one has been fishing the past few months. Yes! That's right! Sport anglers have been forced off the water while commercial boats continue to fish. What's wrong with this picture? Plenty! Pound for pound sportfishing pumps billions into the California economy while commercial fishing supports far fewer jobs and generates far fewer dollars for the same fish landed. (in a 1990s study the average sport caught salmon generated $85 while that same commercial caught fish was worth an average of a $1.50 per pound or about $15). In turn we are already seeing several party boat operations being sold or forced out of business after losing the past November though next June's rockfish & Ling cod fishery. Many boats and supporting businesses (tackle shops, fuel docks, hotels ect.) depend on rockfish for winter their income. It's not a large part of their annual total but enough to pay their employees, insurance and berthing fees until the more lucrative salmon season opens.

We are literally one bad salmon season away from losing most of the party boat operations along the Central coast. In a good salmon season these small businesses can scratch out a living but if the salmon don't show the cost of running a boat and paying it's crew becomes impossible. Most at risk are boats and businesses in the smaller ports. Two of the largest party boat operations in Bodega Bay are currently selling out or closing down and more are sure to follow from Ft Bragg to Morro Bay. While boats out of Monterey and the Golden Gate have their respective albacore and striped bass and halibut fisheries to keep them going during a slow salmon year most other ports don't have this luxury. A blown motor or other major break down can cost upwards of $40,000 and quickly force the owner to sell out or into bankruptcy.

Sold out is exactly what Cal Fish and Game did to California sport anglers. Relying on incomplete data they followed the Feds lead and closed the cod fishery. Now granted, many rockfish species are in decline but most of these live in the deeper waters where their decline was due to commercial fishing, (drag boats, long liners and gillnets) NOT sportfishing. There are solutions but Fish and Game management just doesn't seem to see the big picture. Keep the nearshore complex in state waters (where few of the threatened rockfish species live) open longer and open the deep water complex when the salmon season is closed. Under the current regulations the rockfish season reopens in July, the peak of the salmon season and a time of year that rockfishing doesn't garner much interest. A fall and winter rock cod fishery would make much more sense. This would not only keep a sustainable rockfish management plan in place but would help the many small businesses that rely on our fisheries open and generate millions of tax dollars the state so desperately needs. After all, our fisheries should be managed with the fish, the fisher's and the jobs they create in mind.

Mike Aughney

Subject: Fwd: current injustice
From: "PFMC Comments" <pfmc.comments@noaa.gov>
Date: Thu, 06 Feb 2003 10:35:32 -0800
To: John.DeVore@noaa.gov
CC: Mike.Burner@noaa.gov

Pacific Fishery Management Council
7700 NE Ambassador Place, Suite 200
Portland, Oregon 97220-1384
Phone: 503-820-2280
Fax: 503-820-2299
On the web at: http://www.pcouncil.org

Subject: current injustice
From: <HITCHFISH@aol.com>
Date: Wed, 5 Feb 2003 12:20:14 EST
To: TOMBARNES@NOAA.gov, WILL_daspit@psmfc.org, pfmc.comments@NOAA.gov, JDUFFY@dfg.ca.gov, AVEJAR@dfg.ca.gov

DEAR SIR: PLEASE READ AND DISTRIBUTE TO CONCERNED PARTIES: YOUR HONOR: OR TO WHOM IT MAY CONCERN; PLEASE READ THE ENCLOSED LETTER TO FISH AND GAME. IT IS MY LATEST. FROM: MARK HITCHCOCK / OPEN ACCESS FISHERIES PARTICIPANT **TO: ALL FISH AND GAME CONCERNS** CHINEESE NEW YEAR IS THE APEX OF THE MARKET PRICE FOR LIVE FISH. THE MAXIMUM BENEFIT IS DERIVED BY ATTAINING THE HIGHEST PRICE AND THE HIGHEST DEMAND OF THE YEAR IS REALIZED. ALL HOOK AND LINE OPEN ACCESS FISHERMEN ARE WONDERING HOW WE CAN BE DISCRIMINATED AGAINST SO AT THIS TIME OF YEAR. THIS YEAR IN PARTICULAR, WITH RECORD NUMBERS OF SCULPIN AND LINGCOD FOR THE SPORTFISHERMEN- (COMMERCIALLY LICENSED SPORTFISHERMEN) NO COMMERCIAL HOOK AND LINE FISHERMAN COULD POSSIBLY COMPREHEND THE BIAS OF THE FISH AND GAME CURRENT REGULATIONS. I AND OTHERS HAD BEEN ABLE TO MAINTAIN A SUSTAINABLE FISHERY AS WELL AS KEEP A SUCCESSFUL BUSINESS- WITH EMPLOYEES! THAT WAS WHEN WE WERE ALLOWED TO FISH ALL YEAR(WITH QUOTAS) AND TARGET MORE THAN ONE SPECIES. NOW, WE HAVE BEEN REGULATED TO FISH ONLY FOUR(4) MONTHS OF THE YEAR! AND THE LICENSE FEES ARE GOING UP! WITH MORE LICENSES! (DEEPER NEARSHORE ROCKFISH- A CRUEL SLAP IN THE FACE TO NEARSHORE FISHERMEN NOT LEVIED ON THE SPORTFISHING FLEET) THIS SITUATION IS UNACCEPTABLE TO THIS OPEN ACCESS PARTICIPANT. THE TERM OPEN ACCESS IS ANTIQUATED. BARELY OPEN ACCESS IS MORE LIKE IT. HOW CAN HIGHER FEES BE JUSTIFIED? ISN'T THE FISH AND GAME FUNDED BY LAW? YOU CANNOT POSSIBLY EXPECT 200 TO 400 COMMERCIAL FISHERMEN PAY THE SALARY OF THE ENTIRE STAFF OF THE DEPARTMENT, AND PAY FOR EQUIPMENT TOO! I AM WRITING TO YOU ON MY OWN, BUT MY VOICE SPEAKS FOR ALL WHO WOULD SEE FAIR AND EQUAL TREATMENT OF OUR NATION'S FISHERMEN, ONE OF THE RESOURCES THAT FOUNDED THIS GREATEST COUNTRY OF ALL CONTRIES. PLEASE CONSIDER EMERGENCY ACTION TO ALLOW THE TAKE OF SCULPIN AND LINGCOD IN THE SOUTHERN REGION BY ROD AND REEL GEAR. QUOTAS ARE A GIVEN, BUT THE SPORTBOATS ARE AVERAGING 400 TO A THOUSAND(400 LB.S- 1,000 LB.S) POUNDS A WEEK(80% SCULPIN/20% LINGCOD) AND, I WOULD ASSUME THAT A QUOTA IS A QUOTA, NO MATTER HOW FAST IT'S REACHED. I WOULD BE AGHAST TO HEAR THAT THE

SPORTFISHERMEN OVER-FISHED THEIR QUOTA AND NOW THE COMMERCIAL QUOTA WOULD BE MADE TO BEAR THE DIFFERENCE. PLEASE MAINTAIN YOU DILLIGENCE IN THIS MATTER. AGAIN, I WOULD ASK YOU TO CONSIDER AN EMERGENCY OPENING ON THE COMMERCIAL TAKE OF SCULPIN AND LINGCOD. JUST ROD AND REEL WOULD BE GREAT(ELIMINATES TRAPS AND SET LINES, AS THEY HAVE TARGETS ALREADY IN SHEEPHEAD, CABEZON, ETC.). I AM POSITIVE THE LOGBOOKS OF THE COMMERCIALLY LICENSED SPORTFISHERS WILL SHOW SUFFICIENT DATA TO EFFECT THIS RECOMENDATION.
THANK YOU FOR YOUR TIME AND INTEREST IN FISH AND GAME MATTERS. SINCERELY, MARK HITCHCOCK
OWNER/OPERATOR F/V- "NEXT SHOT" 1677 QUIVIRA WAY S.D., CA. 92109 PH- 619.222.6275
THE REGULATIONS ARE PUTTING ME OUT OF BUSINESS, BY A CONSPIRACY OF ANTI-FISHING MANAGEMENT STAFFING. WHILE I SUFFER THE EXTINCTION OF THE COMMERCIAL FISHERMAN IN THE GREATEST COUNTRY IN THE WORLD, IMPORTS OF ENDANGERED SPECIES ARE ALLOWED TO RISE FROM COUNTRIES WITH NO REGULATIONS AT ALL! SOMETHING MUST BE DONE TO PUT THE COMMERCIAL FISHING INDUSTRY BACK TO A COMMON SENSE, PROFITABLE STATE. HUNDREDS OF MILLIONS OF MUCH NEEDED DOLLARS ARE LEFT UNTAPPED ON GROSSLY EXAGGERATED FEARS AND CLAIMS OF DECLINING FISH STOCKS. PLEASE TAKE AN INTEREST IN FISH AND GAME MATTERS. THANK YOU FOR YOUR TIME AND YOUR INTEREST IN FISH AND GAME MATTERS. SINCERELY, MARK HITCHCOCK

PFMC Comments <pfmc.comments@noaa.gov>
Pacific Fishery Management Council

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May 20, 2003

Dr. William Hogarth
Director, National Marine Fisheries
1315 E. West Highway
Silver Springs, MD 20910

RECEIVED
MAY 22 2003
PFMC

Dear Mr. Hogarth:

Thank you for the time you've afforded me to briefly discuss the situation the Sportfishing fleet is experiencing in southern California pertaining to seasonal and geographic closures of various groundfish species.

As I indicated, these current species, area and seasonal limitations will, in a relatively short time, cause the ultimate demise of the Sportfishing industry. We have already realized a significant decline in our passenger loads and revenue since the most current and stringent closure went into effect, i.e. Sculpin closure (March 1). This closure, in conjunction with the on-going Whitefish restriction, the "non-opening" for any species of Rockfish and the 20 fathom (120 feet) depth limitation have all contributed to what can only be described as a catastrophic situation for the sportfishing industry in southern California. A lack of catchable species is now being recognized by our attending and prospective customers and their interest and participation is at an all-time low for this time of the year.

It is our understanding that the severe limitations that have been imposed are part of an effort to protect, primarily, Bocaccio, a species of rockfish (groundfish). The closures, it seems, were implemented as a "panic reaction" with very little, if any, meaningful stock assessments as to the Bocaccio's abundance in southern California. Now, subsequent to the declaration of the closures, surveys of various types have been conducted with the preliminary results indicating that the closures were premature, unwarranted and certainly not scientifically based. These preliminary results show significantly more available stock of Bocaccio than anyone imagined. So the net result, consequently, of the closures has been that the sportfishing industry is now crippled by the limitations of allowable catch which has had a devastating effect on our potential customers' participation in the fishing activity. In other words, PEOPLE ARE NOT GOING FISHING BECAUSE THEY CAN KEEP <u>NEXT TO NOTHING</u> THAT THEY CATCH ! To pay to go fishing is not money well spent since the trips result in something more akin to simply a "boat ride".

The major fallacy of the closures is that anyone who fishes in southern California with any regularity (notwithstanding sportboat Captains and crews) knows that there are innumerable areas that can be fished for Whitefish and/or Sculpin without any possibility of catching a Bocaccio. This is true in most areas of less than 120 feet (20 fathoms). Another fallacy is that these closures are in effect to protect Bocaccio, a species that doesn't appear to require the level of protection that has been instituted.

Over the past 50 years of recreational sportfishing, we have been able to offer our customers a variety of species in the winter and spring months. Since migratory species, such as Tuna, Yellowtail, Barracuda, etc. are not in our area during these months we have relied on Whitefish, Sculpin and Rockfish (Groundfish) as the mainstay of our trips. Needless to say both the Winter and Spring seasons have been disastrous in terms of participation and "catch" due to the fact that we are unable to fish for any type of groundfish other than Sheephead.

Additionally, the proposal by the State Department of Fish and Game to eliminate 1-day fishing licenses and replace with a 2-day license is yet another fatal situation for sportfishing. This change will increase the price of fishing excursion for our casual fisherpersons (40-50 percent of our passengers) by as much as 19%, which will decrease participation even further, when coupled with the closures.

The demise of recreational sportfishing will also have a severe economic impact on those who derive their livelihood from sportfishing. Those who will be affected directly include boat and landing owners, captains, crewmembers, bait haulers, landing office personnel, etc. The businesses indirectly impacted would be tackle providers, fuel docks, boat maintenance and repair facilities (shipyards), manufacturers of fishing electronic equipment, vessel food and beverage vendors, and the list goes on.

We are asking that any and all of the personnel and regulatory organizations involved with the study, evaluation, and decision-making process pertaining to groundfish issues work with maximum expediency to affect the relaxation of the current regulations. If the restrictions for Whitefish, Sculpin and Nearshore Groundfish are not changed, recreational sportfishing will not survive another year here in southern California.

We are pleading that a more scientific, defined and reasonable approach be taken in determining and implementing any closures. We are also demanding, for the sake of the future of this industry, the present closures be re-evaluated and reversed as soon as possible.

Mr. Hogarth, any assistance that you could provide by recommending to or contributing input for the regional or state regulatory organizations that make these closure (or reopening) decisions would be appreciated. So far, the voices of the sportfishing industry have been fully ignored by the majority of the individuals who occupy positions in the organizations.

Both the future of the sportfishing industry and the recreational opportunity enjoyed by millions of participants in California are in jeopardy without someone's positive intervention.

Respectfully submitted,

Norris Tapp
Manager, Davey's Locker Sportfishing
Coast Guard Licensed Captain

COPY: Mr. Robert C. Hight, Director - California Department of Fish and Game
Mr. Randy Fisher, Executive Director – Pac States Marine Fisheries Comm.
Dr. Hans Radtke, Chairman Pacific Fishery Management Council
Mr. Mike Flores, President - California Fish and Game Commission
Gov. Gray Davis, Governor – State of California

Subject: Fwd: Rockfish
From: "PFMC Comments" <pfmc.comments@noaa.gov>
Date: Sat, 22 Feb 2003 07:58:51 -0800
To: John.DeVore@noaa.gov
CC: Mike.Burner@noaa.gov

Pacific Fishery Management Council
7700 NE Ambassador Place, Suite 200
Portland, Oregon 97220-1384
Phone: 503-820-2280
Fax: 503-820-2299
On the web at: http://www.pcouncil.org

Subject: Rockfish
From: Rob Domrese <rmdomrese@yahoo.com>
Date: Mon, 07 Mar 1904 01:19:00 -0600
To: pfmc.comments@noaa.gov

I feel disheartened with the response that your organization has taken regarding the decline in numbers of groundfish of the west coast. If we are truely facing stock decline of less than 10% of original biomas, why is your organization allowing commercial fishing on ANY scale? If your organization were truely interested in saving the resource, why not shut down all fishing, both recreational and commercial. After the stocks rebound, then re-open recreational ONLY. If stocks later abound, then, and only then, open commercial. I wonder how long ANY of our lakes in CA would fare if the DFG decided to open them up to commercial fishing? Probably not good. The ocean is just a larger body of water.

Rob Domrese
rmdomrese@yahoo.com

PFMC Comments <pfmc.comments@noaa.gov>
Pacific Fishery Management Council

B-1

Exhibit B.1
Supplemental Public Comment
June 2003

BRIEF ECONOMIC SURVEY OF BUSINESSES DEPENDENT UPON RECREATIONAL FISHING IN NORTHERN LOS ANGLES, VENTURA, AND SANTA BARBARA COUNTIES

THE PROBLEM

Rockfishing regulations over the recent past has been dramatically affecting recreational fishing opportunities in Northern Los Angeles, Ventura, and Santa Barbara counties.

SYNOPSIS

On the following pages are some results Dan Fink, United Anglers of Southern California, obtained from interviews with owners of tackle shops, fishing vessels, and landings operating in the Channel Islands area.

Note that half the landings that existed 3 years ago either left the business or had a business failure. This includes Channel Islands Sportfishing Company that recently was taken over by the County of Ventura because of failure to pay rent.

The situation in this area is critical for the future of sportfishing in Northern Los Angeles, Ventura, and Santa Barbara counties.

REQUEST FOR RELIEF

United Anglers of Southern California respectfully requests that the PFMC take emergency action to provide immediate relief for businesses dependent upon recreational fishing.

Survey of Landing Operators

Santa Barbara Harbor – Santa Barbara County

In 1999, two landings, Hornet Sportfishing and Sea Landing operated here. Since then, the former has closed with no subsequent information available. Sea Landing had 3 sportfishing vessels available throughout the year. Now, it has one with a second available in October and November for offshore fishing.

Sea Landing – 301 West Cabrillo Boulevard, Santa Barbara, CA 93101 – (805) 963-3564

	Year	Year	Diff.	%	Year	Diff	%	Year	Diff	%
Jan.	2000	2001			2002			2003		
Trips	N/A	15			24	+9		13	-11	
Passengers	N/A	142			245	+103		204	-41	
Average Pass. p/boat	N/A	9.46			10.20			15.69		
Days Fished	N/A	12			16	+4		11	-5	
Oct./Trips	34	42	+8		34	-8				
Passengers	663	725	+62		553	-172				
Average Pass. p/boat	19.5	17.26			16.26					
Days Fished	22	29	+7		27	-2				
Nov./Trips	29	36	+7		19	-17				
Passengers	472	631	+159		245	-386				
Average Pass. p/boat	16.2	17.52			12.89					
Days Fished	21	20	-1		14	-6				
Dec./Trips	25	20	-5		10	-10				
Passengers	468	245	-223		121	-124				
Average Pass. p/boat	18.7	12.25			12.1					
Days Fished	16	15	-1		8	-7				
Total Passengers	**1603**	**1601**	**-2**		**1164**	**-437**				

Essentially, Sea Landing had 437 fewer passengers in 2002 than 2001 for the 3 corresponding months.

Ventura County

Ventura Harbor – The one landing here that had 3 vessels operating from it has closed its doors and no records are available.

Channel Islands Harbor

Cisco's Sportfishing Landing – 4151 South Victoria Avenue, Oxnard, CA 93035 – (805) 985-8511
Eleven partyboats operate from here, two of them leaving to summer in San Diego.

	Year	Year	Diff.	%	Year	Diff	%	Year	Diff	%
Jan.	2000	2001			2002			2003		
Trips	N/A	22			21	-1		30	+9	
Passengers	N/A	509			448	-61		485	+37	
Average Pass. p/boat	N/A	23.13			21.33			16.16		
Days Fished	N/A	17			15	-2		19	+4	
Oct./Trips	165	153	-12		148	-10				
Passengers	3241	3134	-107		2531	-603	19¼%			
Average Pass. p/boat	19.64	20.48			17.10					
Days Fished	28	29	+1		30	+1				
Nov./Trips	116	93	-23		71	-22				
Passengers	1907	1615	-292		1388	-227	14%			
Average Pass. p/boat	16.43	17.36			19.54					
Days Fished	26	24	-2		23	-1				
Dec./Trips	94	52	-42		33	-20				
Passengers	2041	995	-1046		562	-433	43½%			
Average Pass. p/boat	21.71	19.13			17.03					
Days Fished	28	20	-8		18	-2				
Total Passengers	**7189**	**5744**			**4481**					

October, November and December 2002 compared to 2001 – Down overall 25½%

Ciscos's Sportfishing Landing has been in business and open 24 per day since 1964. It is the largest landing in the region.

February 1, 2003 – The following are points from a conversation with Marlene Wilcox; Owner of Cisco's Landing

- Lack of passengers most apparent on open party boats.
- Overnight boats not getting out at all.
- ½ day and ¾ day boats going light.
- Running a 2 for 1 program, i.e. 2 go for the price of one during the week so passenger loads betray amount of money generated.
- Marlene guestimates business is off a minimum of 25%.
- Overall charger bookings are also way down for the forthcoming season.
- "The regulations in place take away any chance of making any money"
- Is reducing everything to stay alive.
- Payroll has been cut in half – now operating office with 1 full time employee and 4 part time employees. Formerly had 14 full time employees.
- Used to stay open 24 hours per day – now only 8 to 12 hours, which is the minimum necessary to stay in business.
- Has cut all corners and still just falling further and further behind.
- Can't pay bills.
- "I don't know what else to do".

Channel Islands Harbor (cont.)

Captain Hooks Sportfishing – 3600 South Harbor Boulevard, Oxnard, CA 93035
(805) 382-6233
5 boats operate from here

	2000		**2001**		**2002**		**2003**
January	N/A		N/A		60		91
February	N/A		N/A		59		
March	N/A		629		759		
April	N/A		734		829		
May	N/A		1074		1068		
June	N/A		1515		1254		
July	781		1617		1273		
August	886		1327		1306		
September	767		1237		723		
October	921		968		577		
November	386		400		225		
December	492		156		69		
Totals	**4233**		**5705**		**4173**		

This spreadsheet only shows passengers carried on a per month basis. Captain Hooks opened in 1998 with a ½ million-dollar investment by owners Ken and Debbie Kohr. They enjoyed a 15% growth in 1999 and 2000. The downturn started in 2001, and Debbie reports that financially, her business is down 21% and between 45% - 55% behind on her original business model for the same time frame. As evidenced in the chart above, there's been a steady decline in business since May 2002. If this pattern continues or some form of relief isn't forthcoming, they'll be forced into bankruptcy. They never would have invested in the business if they had known this would happen.

Port Hueneme Sportfishing – P.O. Box 1039, Port Hueneme, CA 93044 – (805) 488-2212
Owner: Bruce Williams
4 boats operate from here

	2000		**2001**		**2002**
July	1916		2164		1675
December	772		332		248

Port Hueneme Sportfishing reflects the same downturn in business that the others in the area show. Bruce Williams (owner) reports his November and December 2002, and January 2003, were 50% of what he did the previous year. He also reports that he experienced 50% cancellation of charters for the same 3 months that had been previously booked and bookings for 2003 are running 75% behind last year. He can't make his monthly lease payments to the Harbor Department. He used to employ 2 part time and 2 full time employees. He has now laid everyone off.

*All the above numbers were secured on the Internet at www.sportfishingreports.com. Estimated percentages were procured via interviews both in person and via telephone with the people listed.

Comments from Commercial Passenger Fishing Vessels (CPFV's)

Capt. Bruce Dexter – Owner/Operator
F.V. Pacific Clipper – Cisco's Landing
"Booking of charters for upcoming year over 20% off from last year and last year was poor".

Capt. Steve Kelly – Owner/Operator
F.V. Island Tak – Cisco's Landing
"New business substantially curtailed".

Capt. Frank Urcetti – Owner/Operator
F.V. Ranger 85 and Coral Sea
"Between the 20 fathom closure and island closures, where am I supposed to fish? Give us out to 30 or 40 fathoms or buy me out. Give me a long-term, low interest loan to fund my boats' transition to eco-tourism and I'll never fish again. Right now I'm in the middle of a county sponsored engines, generator re-power that's costing me $200,000.00, so I can be eco-emission compliant. I'm doing this because they want me to; it's not required. While I'm doing thism other parts of government are putting me out of business.

<u>**Comments from Tackle Suppliers**</u>

Angler's Den – Camarillo
Owner: Rick Graham – (805) 388-1566
Retail Tackle Shop

- November 2002 down 40% from last year.
- December 2002 down 25% from last year.

Going into savings to keep business afloat. Saltwater fishing business way off; freshwater helping to keep doors open. Sluggish economy not helping, but fishing restrictions most damaging.

Purfields Pro Tackle – Culver City
Owner: Dick Schaffer – (310) 397-6171
Retail Tackle Shop

Reports: As of October 15th, bottom fell out of business. November 2002 did 50% of November 2001. December was okay. Attributes to excellent fishing in Santa Monica Bay that month. Laid off an employee of 5 years in October (shop had 3 – now has 2). Spent less than 50% of what he spent last year at early season trade shows.

Comments: Bought store 6 years ago. Retired to this business and loves it. Now he wants to sell. He can't stand the political uncertainty of future. He feels victimized; has no voice. He feels nobody is really listening.

Tady Lure Corporation – Industry
Owner: Jim Shimizu – (626) 333-3358
Started: 1960 – 42 years
Manufactures saltwater metal lures used primarily in Southern California. Sells both dealer direct and to a lesser degree through distributors.

Reports: Sales for December 2002 not even 50% of December 2001. Worst December in 42 years of business. November 2002 and January 2003 reflect similar trends.

Comments: Dealers are scared and pulling in horns. They won't spend now. Historically, the industry depended on the quality of the bite, volume of fish that migrate into the region, water temperatures that controlled how eagerly resident fish bite. Now, the business is dependant on political issues.

Fishtrap Lures – San Diego
Owner: Barry Brightenberg – (858) 273-6970
Manufacturer of Plastic Baits

Reports: Business down 20% overall in 2002 as compared to 2001. Considered moving manufacturing out of state (perhaps to Mexico) to lower costs. Has cut back employees total hours; they are all part time now. These are all English as a second language employees who have been with him 4 to 8 years.

Comments: Historically, Fishtrap Lures has contributed and partaken in every underprivileged kids fishing trip out there. Is stopping all of this – he can no longer afford it.

B1

UNITED ANGLERS
of Southern California

5948 Warner Avenue
Huntington Beach, CA 92649
714 840-0227 TEL
714 840-3146 FAX

June 12, 2003

Dr. Don McIsaac, Executive Director
Pacific Fishery Management Council
7700 NE Ambassador Place
Portland, OR 97220

RE: **Recreational Fishing Business Disaster**

Dear Dr. McIsaac:

United Anglers of Southern California is the state's largest association of recreational anglers. We represent some 50,000 affiliated sportfishermen throughout California dedicated to ensuring quality fishing today and tomorrow.

Mr. Dan Fink, a United Anglers member and a long time businessman who is both a friend and business associate of many people who own businesses dependent upon recreational fishing is very concerned about the effects of rockfish regulations on recreational fishing businesses in Northern Los Angeles, Ventura, and Santa Barbara counties. Mr. Fink contacted our organization and volunteered his services to gather information related to the affects of rockfish regulations on businesses in these areas.

Attached is a summary of the results of his efforts. It is clear from this limited study that the rockfish regulations are having and unusual and previously unidentified impact on the recreational fishing communities in the subject area. Recreational fishing businesses, particularily landings and bait and tackle operations, do not benefit from the various programs designed to ease impacts of regulations on the commercial fishing community.

In light of improved data indicating better than previously estimated bocaccio populations, UASC respectfully requests that the council take emergency action to ease restrictions for the recreational sector for the remainder of 2003.

Sincerely,

Bob Osborn
Fishery Consultant for UASC

Exhibit B.1
Supplemental Attachment 1
June 2003

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic Atmospheric Administration
National Marine Fisheries Service
Sustainable Fisheries Division
7600 Sand Point Way N. E., Building. 1, Bin C15700
Seattle, WA 98115-0070

DATE: June 12, 2003

TO: DISTRIBUTION

FROM: F/NWR2 -Becky Renko Becky Renko

SUBJECT: PRELIMINARY Report #2 -- 2003 Pacific Whiting Fishery

This report consolidates preliminary state, federal, and tribal data for the 2003 Pacific whiting fishery off Washington, Oregon, and California. The catcher/processor and non-tribal mothership fishery started on May 15. The shore-based season in most of the Eureka area (between 42°- 40°30' N. lat.) began on April 1, the fishery south of 40° 30' N. lat. opened April 15 and the shore-based fishery north of 42° N. lat. begins on June 15.

	Allocation		Catch (mt)	Thru [date]	Status	Percent of allocation taken
	Percentages	Metric Tons				
California (south of 42 N lat.)	(5% shore alloc'n; included in WOC shore allocation)	2,545	1,502	6/5	CA season started April 1; 5% alloc'n	59.0%
Oregon	--	NA				
Washington	--	NA				
WOC shoreside	42% commercial OY	**50,904**	1,502			2.9%
Mothership (n. of 42 N. lat.)	24% commercial OY	**29,088**	26,021	6/7	started 0001 hrs 5/15/00	89.4%
Catcher/processor (n. of 42 N. lat.)	34% commercial OY	**41,208**	9,958	6/10	started 0001 hrs 5/15/00	24.1%
Total nontribal	the commercial OY is 82% of the total catch OY	121,200	37,481		--	30.9%
Tribal (Makah)	17% of the total catch OY	**25,000**	0			
Total directed fishing		146,200	37,481			25.6%
Other (research & incidental catch in non-groundfish fisheries)	1% of the total catch OY	**2,000**	unknown at this time			
Total	OY=optimum yield	148,200	37,481	--	--	25.2%

* Catch includes discards from at-sea processors; weigh-backs from shore-based catcher vessels; and small amounts landed under the trip limit between the seasons. The data for at-sea processing (catcher/processors and motherships) are preliminary and are based on reports from NMFS-certified observers. Data for shoreside processors also are preliminary and are provided by each State to NMFS for the purpose of monitoring the fishery. If you have questions on shoreside landings, please contact the appropriate state fishery management agency. Preliminary data for the Makah fishery will be from a NMFS-trained observer. All weights are round weight (the weight of the whole fish before processing) or round-weight equivalents. One metric ton is 2,204.6 pounds.

GROUNDFISH ADVISORY SUBPANEL STATEMENT ON OBSERVER DATA IMPLEMENTATION STATUS

The Groundfish Advisory Subpanel (GAP) was provided with an update on the observer model by Dr. Jim Hastie of the Northwest Fisheries Science Center. After discussing the latest data and its use, the GAP has the following comments.

First, the GAP is seriously concerned that no additional analysis has been done to update the data used to make significant inseason changes at the April meeting. As the majority of the GAP noted at the time, the data used in April is out of date and does not reflect current fisheries management measures, leading to false assumptions that have adversely affected sport and commercial fishermen, processors, and coastal communities.

Second, because real-time data is not used, we will continue to be in a situation where prior-year data gives false results and will continue to lead to a downward spiral in allowable catch. This situation will worsen as less harvest leads to less data.

Third, the GAP again expresses its frustration that - to date - only trawl data is being used in spite of the fact that the observer program covers all sectors of the commercial fishing fleet.

Fourth, as the data sets become smaller due to less fishing, more extrapolation will be used to cover the entire coast. Concentrated fishing effort in smaller and smaller areas will be more and more expanded, again leading to false conclusions. Stratification continues to be entirely too broad, taking into account no changes in seasonality or fish migration.

Finally, the majority of the GAP continues to oppose the inseason use of observer data unless that data is real-time.

PFMC
06/16/03

GROUNDFISH MANAGEMENT TEAM REPORT ON OBSERVER DATA IMPLEMENTATION STATUS

The Groundfish Management Team (GMT) received a report from Dr. Jim Hastie of the Northwest Fisheries Science Center (NWFSC) on the status of the data from the federal observer program and its incorporation into the bycatch model for overfished species. The replacement of 1999 logbook data with logbook data from 2000-2002, as well as the use of more recent catch data, to model vessel behavior will make the bycatch model more representative of the current fishery. The (GMT) is also pleased to note that NWFSC has been able to begin conducting analysis of discard rates for target species that are not included in the current bycatch projection model.

Processing and analyzing raw observer data into a form that is useful in a management context is a significant task. The GMT is sympathetic to the fact that other data processing and analytical priorities, such as stock assessments, compete for the resources that might otherwise be directed toward observer data. The GMT feels the observer program is an extremely important element in the informed management of West Coast groundfish and encourages identifying sufficient analytical resources to make the routine annual feed of observer information into the management process as timely as possible. The GMT also encourages the states to enter trawl logbook data and reconcile it with fishtickets as rapidly as possible to support the analysis of observer data.

PFMC
06/17/03

SCIENTIFIC AND STATISTICAL COMMITTEE REPORT ON OBSERVER DATA IMPLEMENTATION STATUS

The Scientific and Statistical Committee (SSC) received a presentation on this agenda item by Drs. Elizabeth Clarke and James Hastie. A number of changes have been made to the bycatch modeling effort since the April 2003 Council meeting:

- 2002 fishticket data have been added.
- 2000-2002 logbook data have replaced the 1999 data to estimate fishing depth.
- A new approach has been applied to model the effects of differential harvest limits on trawl vessels using small footropes.

There have been no changes in area stratification or bycatch rate values since the April meeting.

The SSC notes two issues that need to be resolved:

- As the SSC Groundfish and Economics Subcommittees reported (see Bycatch Model Review Workshop Report, April 2003), the three states use different procedures for adjusting hail weights from the trawl logbooks. These discrepancies should be evaluated for compatibility and potentially differential effects on bycatch estimation. Also, consider unifying the algorithm across states.
- The current draft of the bycatch model is the documentation supplied to the Bycatch Workshop. This document should be appended to the Bycatch Workshop Panel report and included in the Groundfish Stock Assessment and Fishery Evaluation (SAFE) document. As the bycatch model is updated, documentation should highlight and summarize the latest model and input data changes from the previous documentation. This information should be included in future SAFE documents.

PFMC
06/17/03

OBSERVER DATA ANALYSIS AND BYCATCH MODELING STATUS REPORT JUNE 2003, NWFSC

Observer Data Projects

The primary goal of the observer program is to estimate discard as accurately as possible. In order to develop information on total catch, the amount of retained catch must be known as well. Our plan is to use logbook and/or fishtickets for an estimate of retained catch. The observers do record a measure of retained catch. In most cases this reflects the boat's hail weight. These numbers must be reconciled with the fishticket information by much the same process as the states now use to adjust logbook data.

Status of matching observer data with fishtickets
Of the 619 observed groundfish trawl trips, fewer than 10 have not been matched to fishticket data. Landed catches from fishtickets are currently being used to adjust retained weights recorded by observers, for use in the calculating bycatch rates.

Status of matching observer data with logbooks
The process of matching observed tows to the appropriate logbook records will begin in June and is likely to require several weeks. In cases where it is not possible to match an observed tow to a logbook record, the current estimate of retained catch, based on the fishticket-adjusted weight recorded by the observer, will be used.

Analyses to look at how representative the observer data are
It is important to know if the observed trips represent accurately the catches and fishing patterns of the entire fleet. Based on matching of fishtickets and observer records, three comparisons of observed and unobserved trips have been developed and reported on previously. Additional analyses of the representativeness of fishing locations between the observed and unobserved fleets will be initiated when the matching of observer and logbook records has been completed.

Examination of stratification schemes for use of observer data in bycatch management model
Based on a preliminary matching of fishtickets and observer records, variances for bycatch ratios under some alternative post-stratifications of the data were calculated and summarized for discussion with the SSC at the March Council meeting. At the April meeting, the SSC suggested that additional decision criteria be evaluated for determining preferred levels of stratification. That evaluation has begun, but is incomplete at this time.

Bycatch Modeling Projects

Since the progress report presented at the April Council meeting, several changes have been made to the trawl bycatch/target projection model. These changes include the incorporation of newer logbook and fishticket data, as well as some structural changes in model operation.

Updating fishticket data used in the model
The previous version of the model used fishticket data from 1999-2001 for constructing baseline participation profiles for each trawl permit. The baseline profiles now reflect 1999-2002 fishticket data. Landings amounts for each target species or assemblage were combined across years using the weighting factors shown in Table 1. Different weighting factors were used for the landings in the first eight and last four months of the year, due to the closure of the DTS fishery in the latter part of 2001. Fleet projections for north and south of 40°10' N latitude were then constrained by the limits in place for the first 4 months of 2003 and all of 2002, estimated tonnages compared with actual landings, and scaling factors applied in order to better align estimated and actual landings during this period.

TABLE 1. Inter-annual weighting of fishticket landings in constructing baseline participation profiles.

	1999	2000	2001	2002
January-August	0.1	0.2	0.3	0.55
September-December	0.15	0.25	0.25	0.6

Updating logbook data used in the model

The previous model version used the 1999 logbook data for purposes of distributing target species catch among depth strata, and among target fisheries. The model now derives depth distributions for target species from the 2000 to 2002 (partial) logbook data. Weighting factors for combining data across years are shown in Table 2. The second half of the year was treated differently for Washington, because data for most of the last half of 2002 was unavailable when this revised approach was implemented. This approach will be standardized after complete data are available. At this time, species are not being distributed among target fisheries for purposes of bycatch accounting, due to the small number of observations in many cells when the current observer bycatch data are post-stratified by target fishery. As a result, the logbook data are only being used, currently, for distributing species tonnage among depth zones.

TABLE 2. Inter-annual weighting of logbook tonnage for constructing species depth distributions.

	2000	2001	2002
Oregon/California	0.15	0.3	0.55
Washington: Jan.-June	0.15	0.3	0.55
Washington: July-Dec.	0.35	0.65	0

Modeling effects of specifying differential limits when small footropes used during a period

During the end of 2002 and again starting in May of 2003, the trawl fishery north of 40°10' N latitude has been managed with differential vessel limits when small footropes are used any time during a cumulative period. In addition to lowering the target tonnage (and hence projected bycatch) of any vessels continuing to fish shoreward of the closed area, these differential limits are also intended to shift effort farther offshore. Alternatives for incorporating this depth shift are still being explored. However the default approach at this stage involves assessing the proportion of each DTS species attributed to depths beyond the closed area, using the weighted 2000-2002 logbook data noted above. If the sum of the highest bi-monthly proportions within a season (November-April or May-October) exceeds a specified threshold, then all groundfish fishing during that season is assumed to occur in depths greater than the closed area.

Accounting for the effects of higher trip limits during the projection period

In circumstances where modeled future trip limits exceed the amounts that were allowed in the same 2-month period during most or all of 1999-2002 (the period used to determine baseline participation), if baseline permit tonnage is not increased, the model is more likely to underestimate landings with the higher limits. In the past, these adjustments were handled on an ad-hoc basis while configuring new model runs. The model has now been changed so that such adjustments are computed automatically, based on the ratio between the modeled trip limits (as specified in a parameter input file) and a weighted average of trip limits during the 1999-2002 period.

Stratification of observer data

Alternative stratifications of observer data for constructing bycatch rates for use with the model are still undergoing evaluation. At this time the default approach continues to use a north-south, deep-shallow configuration. For any pair of depth boundary lines defining the closed area, the annual average bycatch rates for depths shallower or deeper than the closed area are applied during that period.

Preliminary modeling of management measures for 2004

An initial draft model run of management options for 2004 was provided to the GMT at their May meeting. This run was intended to reflect a possible realization from the range of GMT-proposed OYs for 2004, and was made using the revised model, including new observer-based bycatch rates, and the updated fishticket and logbook data. Trip limits (Table 3) and landings/bycatch results (Table 4) for that model are included here, for purposes of illustrating possible outcomes. Additional runs, which better reveal the range of impacts associated with the GMT's preliminary recommended OY ranges, will be completed prior to the Ad Hoc Allocation Committee meeting, June 10-11, 2003. Following that meeting additional model runs may be developed prior to Council and advisory body discussion at the June Council meeting. A full report of the initial as well as additional model runs will be presented at the June Council meeting

TABLE 3. Bi-monthly trip limits (pounds) for major target species, as part of a preliminary evaluation of 2004 management measures provided to the GMT on 5-8-03.

	North of 40°10'		38° - 40°10'		South of 38°	
Bi-monthly periods	1 & 6	2 - 5	1 & 6	2 - 5	1 & 6	2 - 5
Shallow line	75	75	100	100	100	100
Deep line	150	250	150	250	150	150
Sablefish	12,000	12,000	12,000	12,000	12,000	12,000
Longspine	13,000	13,000	13,000	13,000	13,000	13,000
Shortspine	2,400	2,400	2,400	2,400	2,400	2,400
Dover sole	29,000	29,000	29,000	29,000	29,000	29,000
Petrale sole	unlimited	10,000	unlimited	20,000	unlimited	20,000
Arrowtooth	unlimited	150,000	unlimited	10,000	unlimited	10,000
Other flatfish	50,000	50,000	100,000	100,000	100,000	100,000
Slope rockfish	1,800	1,800	1,800	1,800	30,000	30,000
If small footrope used during period						
Sablefish	5,000	5,000				
Longspine	5,000	5,000				
Shortspine	1,500	1,500				
Dover sole	10,000	10,000				
Petrale sole	10,000	10,000				
Arrowtooth	5,000	5,000				
Other flatfish	50,000	50,000				

TABLE 4. Projected landings of target species and total bycatch of rebuilding species, as part of a preliminary evaluation of 2004 management measures provided to the GMT on May 8, 2003.

	North of 40°10'	South of 40°10'	Total
Projected target species landings (mt)			
Total DTS	8,297	3,600	11,898
Sablefish	1,606	625	2,231
Longspine	1,379	622	2,001
Shortspine	500	241	741
Dover sole	4,813	2,112	6,925
Petrale sole	1,357	466	1,823
Arrowtooth	1,535	12	1,547
Other flatfish	1,571	900	2,471
Total flatfish	9,276	3,490	12,766
Yellowtail	154	0	154
Slope rockfish	133	118	252
Other rockfish	103	47	150
Projected bycatch of rebuilding species (mt)			
Lingcod	39.8	54.8	94.6
Canary	6.3	1.3	7.6
POP	42.5	0.2	42.8
Darkblotched	47.8	13.4	61.2
Widow	0.7	0.4	1.0
Bocaccio	0.0	45.2	45.2
Yelloweye	0.24	0.11	0.35
Cowcod	0.00	1.19	1.19

Inseason evaluation of bycatch in the 2003 trawl fishery

An updated evaluation of bycatch in the 2003 fishery will be presented to the Ad Hoc Allocation Committee at its June 10-11, 2003 meeting, and Council advisory bodies at the June Council meeting. This update will utilize the changes to the bycatch model described above and will reflect available landings data through the month of April.

GROUNDFISH ADVISORY SUBPANEL STATEMENT ON STOCK ASSESSMENTS AND REBUILDING ANALYSES FOR 2004 GROUNDFISH MANAGEMENT

The Groundfish Advisory Subpanel (GAP) attended the joint briefing on the 2003 stock assessments and then continued discussions on the technical issues surrounding the assessments and the rebuilding analyses.

Before commenting specifically on the assessments, the GAP has some general comments to make.

First, the GAP believes that assessments on transboundary species need to look at all data on the stocks throughout their range. Further, efforts should be made to develop more multi-national assessments and review panels for species such as bocaccio, Pacific ocean perch (POP), canary rockfish, sablefish, and lingcod. An assumption that species such as POP, which are nothing more than a fringe population in the Exclusive Economic Zone off the Pacific Coast, are truly affected only by this Council's management actions is absurd.

Second, data needs for assessments must be analyzed and a program formulated to fill in the holes. Nearly every stock assessment review (STAR) report notes significant data needs, yet no individual entity is charged with filling these holes. A clear plan must be developed which prioritizes the data needs, describes how to meet them, and assigns somebody to carry out the plan.

In this regard, particular attention must be given to developing and utilizing new survey methodology for species found mid-water and primarily in untrawlable locations. The data gaps evident in this year's widow rockfish assessment provide a clear example of the need for new methods; those gaps will only get worse as fishery-dependent data decreases due to harvest restrictions. The GAP notes that submersible surveys are being tried, but they encompass only a small portion of a species range and are expensive. Acoustic surveys, hook-and-line or pot surveys, or surveys using other technology must be put in place immediately.

In regard to the black rockfish assessment, the GAP noted the concerns expressed by the STAR Panel about the catch per unit of effort data obtained from the commercial passenger vessel fleet. Those familiar with the fishery pointed out that the issues of concern are easily explained by the known migration patterns of black rockfish and changes in gear and fishing techniques.

In regard to the widow rockfish assessment, the GAP is concerned there was no more hard data available than in previous assessments, yet the changes in current biomass are significant. The GAP also notes the absence of a potentially significant data set: the larval survey conducted by the Pacific Whiting Conservation Cooperative (PWCC). This survey takes place in an area that encompasses, but is more extensive than, the NMFS survey. Use of the PWCC data is recommended for all assessments in which the Santa Cruz larval survey data are used.

The limited range of the larval survey for bocaccio also raised concerns. Again, survey data should be used which better covers the range of the species, and the surveys must be appropriate for the species being surveyed.

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06/17/03

GROUNDFISH MANAGEMENT TEAM REPORT ON STOCK ASSESSMENTS AND REBUILDING ANALYSES FOR 2004 GROUNDFISH MANAGEMENT

Many of the management options the Groundfish Management Team (GMT) must consider for setting preliminary acceptable biological catches (ABCs) and optimum yields (OYs) are taken directly from rebuilding analyses of overfished species. Due to the complexity of those analyses, it is not unusual for several different rebuilding scenarios that have vastly different OYs to initially be brought to the GMT for consideration. Many of those scenarios will ultimately not be brought forward to the Council due to scientific considerations. The GMT could operate more efficiently if only those scenarios that have the most scientific merit are determined prior to the Council meeting, rather than waiting until the meeting where OYs are specified.

The GMT also reiterates that authors of assessments and rebuilding plans need to include all the quantities listed in the Terms of Reference. Authors will also need to include quantities not in the Terms of Reference, but are necessary for the management process. These include quantities such as ABCs, T_{MID} rebuilding calculations, and 5- to 10- year projections of baseline assessment models or rebuilding plan scenarios.

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06/17/03

SCIENTIFIC AND STATISTICAL COMMITTEE REPORT ON STOCK ASSESSMENTS AND REBUILDING ANALYSES FOR 2004 GROUNDFISH MANAGEMENT

The Scientific and Statistical Committee (SSC) led a joint meeting with the Groundfish Management Team (GMT) and the Groundfish Advisory Subanel (GAP) to facilitate a review of stock assessments, stock assessment review (STAR) reports, and rebuilding updates (where appropriate) for

Widow rockfish
Bocaccio
Pacific ocean perch (POP)
Black rockfish
Darkblotched rockfish
Yellowtail rockfish
Cowcod

The SSC considers these stock assessments to be the best available science and endorses their use by the Council. The updated rebuilding analyses for widow, POP, and darkblotched rockfish are based on assessments reviewed through the STAR process, and the SSC endorses their use by the Council.

The SSC has the following comments on each of the assessments and supporting materials:

Widow Rockfish (Exhibit B.3, Attachments 4, 5, and 6, June 2003)

The 2003 estimate of stock size is 24.6% of B_0, which is similar to the last assessment in 2000. However, stock productivity is estimated to be lower than it was in 2000, which translates into longer rebuilding times than suggested by previous analyses.

Three areas of uncertainty emerged as most important to the 2003 rebuilding analysis:

1. Whether recruits should be prespecified for 2003-2005 based on the NMFS Santa Cruz laboratory midwater trawl survey.

2. Whether projections should be based on sampling recruits per spawner or an estimated stock-recruitment relationship.

3. The use of a power coefficient to represent compensation (juvenile mortality) in translating the midwater trawl survey results into subsequent recruitment.

The SSC discussed, in detail, the procedure of prespecifying recruits versus other approaches. The procedure of prespecifying recruits uses results from the midwater trawl survey to project recruitment for 2003-2005 in the rebuilding program (recruitment after 2005 is based on sampling estimates of recruits in each year prior to 2001). The SSC prefers the approach of sampling recruits per spawner, which is the status quo from earlier analyses. The SSC concluded there is enough confidence in the midwater trawl survey to prespecify recruits, which narrowed discussion to models 7, 8, and 9 in Table 3 and Table 4 (page 5) of Attachment 5.

The SSC also discussed different values for the power coefficients. According to Table 18 (page 57) of the stock assessment document, different values of the power coefficients are equally likely, and there is no statistical basis for choosing among them. After further discussion, the SSC concluded there is a biological basis for determining a range of plausible values, which corresponds to the values used in models 7, 8, and 9. The SSC recommends these models be used as a central case (model 8), with high (model 9) and low (model 7) variants.

Since the nature of the relationship between larvae taken in the survey and subsequent recruitment to the fishery (3 years) is a major source of uncertainty in the widow assessment, the SSC recommends that this issue be thoroughly examined in the next assessment.

POP (Exhibit B.3, Attachments 1, 2 and 3, June 2003)

The 2003 estimate of stock size is 25.3% of B_0. The assessment for POP is complex, utilizing a Bayesian approach (also used in the 2000 POP assessment). While the SSC considers this type of analysis to be state-of-the-art, it raises a key issue about which estimates are best for use in rebuilding analyses. After a discussion about which summary statistics are most appropriate, and which to use as a default, the SSC reached consensus that results of the rebuilding analysis should follow the Bayesian approach as it captures more of the uncertainty.

Discussion by the SSC also considered alternative approaches for projecting future recruitment of POP. Figure 1 of Attachment 2 shows that time series from the 2000 assessment for the ratio of recruits per spawner has an upward trend. This approach was rejected in earlier rebuilding analyses in favor of using time series of recruits as a basis for the rebuilding projections. On the other hand, the 2003 assessment does not show a trend in either series. Since a major component of the POP stock exists in Canadian waters, the rationale for using recruits per spawner as a basis for rebuilding projections is questionable, because it implicitly assumes that future recruitment depends only on spawners in U.S. waters. Consequently, the use of recruits as a basis for rebuilding projections is reasonable.

Thus, the SSC recommends case C in Tables 1-3 (page 4, 6-7) in Attachment 2 be used by the Council.

Bocaccio (Exhibit B.3, Attachments 7, 8, and 9, June 2003)

The 2003 stock assessment for bocaccio is different than the assessment last year, which indicated the 1999 year class was weaker than previously believed. This result was driven by the 2001 Triennial Survey, which showed very low abundance of bocaccio and no sign of the 1999 year class (Figure 26, page 36 of Attachment 7). For the 2003 assessment, additional information in the form of larval abundance data from CalCOFI, and both length and catch per unit effort (CPUE) data from the recreational fisheries were used. The new data indicate a sharp increase in abundance and a much stronger 1999 year class. In fact, Figure 26 indicates that recent CPUE estimates for Northern California are record highs in a time series dating back to 1980. To bracket uncertainty from the apparently conflicting signals in the different data sources, the STAR Panel recommended two models, STAR B1 and STAR B2, which use the survey and recreational CPUE data, respectively. Each of these models de-emphasizes the other data source. The Stock Assessment Team (STAT) considered a third model that included both data sources to be important, but time to complete work on all three models was not possible at the STAR meeting. Subsequent work by the STAT Team produced an intermediate model, STAT C, which includes both survey and CPUE data.

After an in-depth discussion that considered trade offs among alternative approaches and other factors, the SSC concluded that an intermediate alternative is warranted and that model STAT C is a reasonable way to integrate the survey and CPUE data. The SSC recommends a decision table, with models STAR B1, STAR B2, and STAT C, similar to Table 3 (page 6) of Attachment 8, be used by the Council.

The SSC notes the assumed rate of natural mortality was changed from 0.2 in the 2002 assessment to a value of 0.15 in the 2003 assessment. This change is likely to have an influence on OY, but results using data from the 2003 assessment and the 2002 value for natural mortality were not available for review at this meeting.

The SSC also recommends that additional data, based on information in the California commercial passenger fishing vessel (CPFV) logbooks be evaluated for use in future bocaccio assessments.

Black rockfish (Exhibit B.3, Attachments 10 and 11, June 2003)

The SSC noted that without any clear trend in the four recreational CPUE statistics used by the model, the upturn in biomass and spawning output in the latter part of the 1990s is difficult to interpret. The reason for the increase is apparently due to the strong recruitment of age-two fish in 1996 and 1997, but those recruitments are unlikely to be well-estimated. In addition, the retrospective analysis (Figure 37) is poorly behaved, because the model seems to persistently overestimate biomass. Nonetheless, the SSC supports the conclusions of the STAR Panel that the assessment represents the best available science and is ready for use by the Council.

Cowcod (Exhibit B.3, Attachments 12 and 13, June 2003)

The update indicates that current management action has been effective in keeping cowcod removals within the established OY (Table 2). However, due to the effects of management on the CPFV recreational CPUE statistic (Figure A1), it will be difficult to monitor rebuilding in the future. As the STAR Panel report notes, *in situ* and ichthyoplankton surveys may provide useful fishery-independent information on the status of the stock.

Yellowtail rockfish (Exhibit B.3, Attachments 13 and 14, June 2003)

Results presented in Figure 11 of the assessment document may give the false sense that female spawner biomass is stable. However, due to the decline in recruitment that occurred in the mid-1990s and the relatively late maturity of this species, the model predicts a 25% decline in spawning biomass over the next 10 years, if the stock is harvested at the default harvest rate (Table 26). Even so, the yellowtail rockfish stock is unlikely to be fully harvested due to the constraints imposed by other overfished stocks (e.g., canary and widow rockfish).

Darkblotched rockfish (Exhibit B.3, Attachments 13, 15, and 16, June 2003)

Following the conclusion of the STAR review the assessment author successfully corrected the error in rebuilding projections for scenario (b), i.e., B_0 based on 1963-2000 recruitments and rebuilding recruitments re-sampled from 1983-2000. That scenario now produces results intermediate between scenario (a) and scenario (c), as expected (Table 16). However, results in the table are based on the probability of rebuilding by T_{MAX} = 0.7, although the interim rebuilding analysis adopted by the Council was for P = 0.8. A new table will be developed that will include 10-year projections at the higher probability level.

The STAR Panel recommended scenario (b) as the base case, bracketed by scenarios (a) and (c). The panel selected the intermediate result in an attempt to balance the conflicting effects of using the most recent information (i.e., the 2001 recruitment estimate) and the poor statistical precision associated with partial recruitment of the most recent year-classes.

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Status and Future Prospects for the Pacific Ocean Perch Resource in Waters off Washington and Oregon as Assessed in 2003

by

Owen S. Hamel[1]
Ian J. Stewart[1,2]
and
Andre E. Punt[2]

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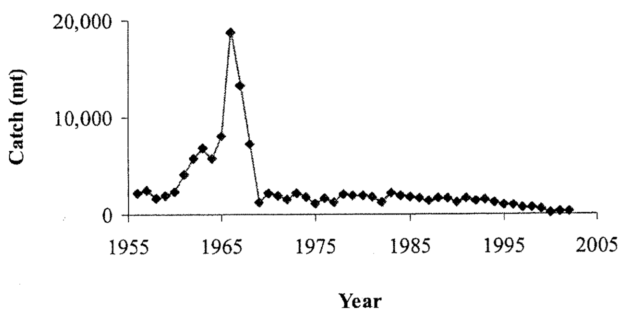
[1]Northwest Fisheries Science Center
U. S. Department of Commerce
National Oceanic and Atmospheric Administration
National Marine Fisheries Service
2725 Montlake Blvd East
Seattle, Washington 98112-2097

[2]School of Aquatic and Fishery Sciences
Box 355020
University of Washington
Seattle, Washington 98195-5020

Status and Future Prospects for the Pacific Ocean Perch Resource in Waters off Washington and Oregon as Assessed in 2003

This assessment applies to the Pacific ocean perch (*Sebastes alutus*) (POP) species of rockfish for the combined US Vancouver and Columbia INPFC areas. Catches are characterized by large removals of between 5,000 and 20,000 mt during the mid-1960's, primarily by foreign vessels. The fishery proceeded with more moderate removals of between 1,100 and 2,200 metric tons per year from 1969 through 1994, with the foreign fishery ending in 1977. Management measures further reduced landings to below 900 metric tons in 1995, with subsequent landings falling steadily until reaching between 100 and 300 metric tons per year from 2000 through 2002.

Catch history from 1956-2002



Catch estimates for past 10 years including discard

Year	Catch
1993	1500
1994	1176
1995	965
1996	938
1997	751
1998	739
1999	593
2000	171
2001	307
2002	239

The 2000 assessment used a forward projection age-structured model (Ianelli et al. 2000). The model used in the current assessment is based upon that model. However, there are a number of changes to the structure of the model. The multinomial likelihood assumed for the age- and size-composition data in the 2000 assessment was replaced by a robust normal likelihood. An ageing-error matrix was included to transform predicted age-compositions to age-compositions as they are observed by age-readers. The age 14 "plus" group for the "biased" fishery age-compositions (aged with the old surface ageing methods – 1966-80) was included in the likelihood function. The ability of the fishery selectivity curve to vary was limited by reducing the age at which selectivity is assumed to be flat to 14 (from 22), the maximum age for the "biased" age-composition data. The age at which survey selectivity is flat was increased from 10 to 12 to be more consistent with the way fishery selectivity is modeled. There were two survey selectivity functions in this assessment, one for the triennial shelf survey and another for the three slope (POP, AFSC and NWFSC) surveys. There are separate catchability coefficients for each survey.

A uniform prior was placed on the steepness of the stock-recruitment relationship and a uniform prior (in log space) was placed on the catchability coefficients for all four surveys. These priors reflect a lack of relevant auxiliary information. An informative prior, based on life history traits, was placed on natural mortality. The current model assumed no serial correlation in the recruitment anomalies unlike the 2000 assessment which estimated the extent of such serial correlation.

New data and changes to the data used in the previous assessment include updated (and reduced) estimates of historical foreign catch of Pacific Ocean perch; biomass indices and age- or size-composition data (for some years) from the Alaska Fisheries Science Center (1992, 1996, 1997, 1999-2001), and Northwest Fisheries Science Center (1999-2002) slope surveys, and the most recent year of data from the triennial shelf survey (2001). Four years (1999-2002) of "unbiased" (break-and-burn) fishery age data were now available and were included when fitting the model. The inclusion of non-independent fishery age- and size-composition data for 13 years (1968-80) was removed, by omitting the size-composition data from the model fit. Two additional years of fishery catch data (2001-2), along with updated PacFin catch records for the years 1981-2000, were available and were included in the assessment.

The reduction of the historical catch estimates had the greatest effect of the changes and additions to the data, resulting in lower estimates of both equilibrium unfished biomass and maximum sustainable yield.

A number of sources of uncertainty are explicitly included in this assessment. For example, allowance is made for uncertainty in natural mortality, the parameters of the stock-recruitment relationship, and the survey catchability coefficients. However, sensitivity analyses based on alternative model structures / data set choices suggested that the overall uncertainty may be greater than that predicted by a single model specification. There are also other sources of uncertainty that are not included in the current model. These include the degree of connection between the stocks of Pacific Ocean perch off British Columbia and those in PFMC waters; the effect of the PDO, ENSO and other climatic variables on recruitment, growth and survival of Pacific Ocean perch; and gender differences in growth and survival.

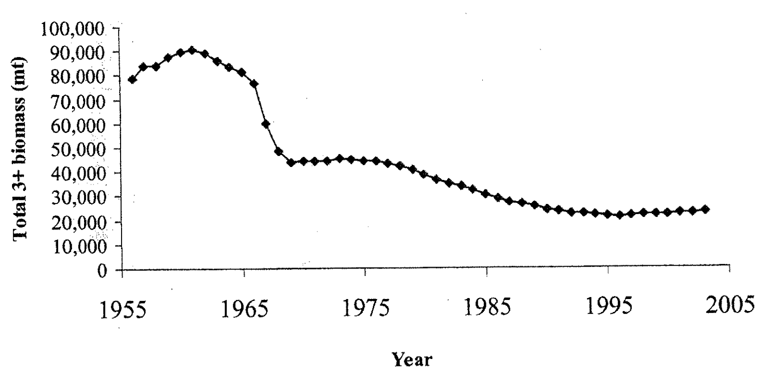
A reference case was selected which adequately captures the range for those sources of uncertainty considered in the model. Bayesian posterior distributions based on the reference case were estimated for key management and rebuilding variables. These distributions best reflect the uncertainty in this analysis, and are suitable for probabilistic decision making.

The point estimate (maximum of the posterior density function, MPD) for the depletion of the spawning biomass at the start of 2003 was 25.3%. The ABC for 2004 based on the MPD point estimates is 862 mt. The OY for 2004 from the rebuilding analysis based upon the MPD estimates and resampling from the historical recruitments between 1965 and 2001, and with a P_{max} of 0.7, is 375 mt.

The median value of the posterior distribution for the 2003 depletion was 28%. The median of the posterior distribution for ABC for 2004 is 931 mt. The OY for 2004 from the rebuilding analysis based upon the posterior distribution and resampling from the historical recruitments between 1965 and 2001, and with a P_{max} of 0.7, is 444 mt.

The point estimates of current biomass are relatively constant over the last several years, although there is some indication of an increasing trend in biomass in recent years.

3+ Biomass Levels from 1956 to 2003

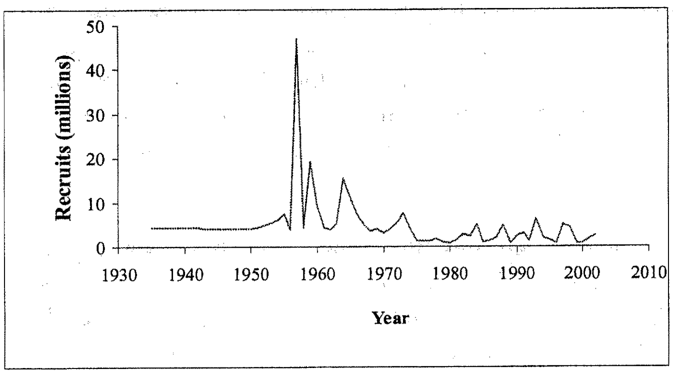


Biomass estimates for the past 10 years

Year	*Total 3+ biomass(mt)*
1994	*21,775*
1995	*21,359*
1996	*20,994*
1997	*21,193*
1998	*21,661*
1999	*21,631*
2000	*21,651*
2001	*22,171*
2002	*22,594*
2003	*23,073*

The first year for which there are age-composition data to support the estimate of recruitment is 1956, which also happens to be the first year for which catch data are available. The estimates of recruitment for the years prior to 1956 are close to the equilibrium estimate from the stock-recruitment relationship. The first few years with recruitment estimates that are informed by data are, however, still highly uncertain. The extremely large recruitment for 1957 may therefore partly reflect slightly higher average recruitment over the years 1935-56. Only by the early to mid-1960's are the estimates of recruitment reliable. Recent (1999-2000 in the table below) estimates of recruitment are highly variable by year, and lower on average than those for 1960-75, though similar to those for the 1980's. The estimates of recruitment for 2001 and 2002 are based on very limited information.

Recruitment estimates (1935-2002)

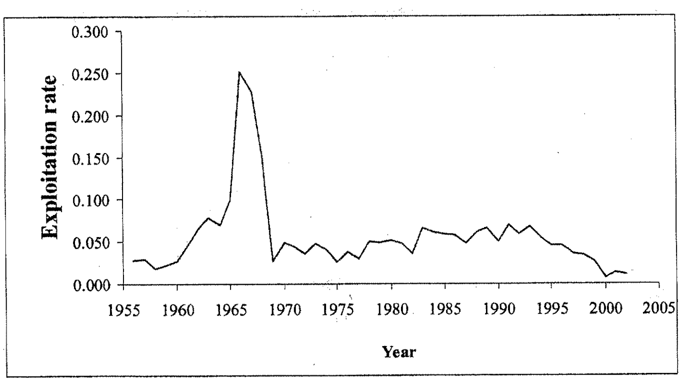


Recruitment estimates for the past 10 years (millions of recruits)

Year	*Recruitment*
1993	6.3035
1994	2.1485
1995	1.6477
1996	0.6562
1997	5.0646
1998	4.2753
1999	0.6699
2000	0.7996
2001	1.8888
2002	2.4637

The exploitation rate on fully-selected animals peaked near 25% in the mid-1960's when foreign fishing was intensive. The exploitation rate dropped by the late 1960's, but increased slowly and steadily from 1975 to the early 1990's, due to decreasing exploitable biomass. Over the past 10 years the exploitation rate has fallen from over 6% to near 1%.

Exploitation rate estimates (1956-2002)



Exploitation estimates for the past 10 years

Year	*Exploitation rate*
1993	0.0670
1994	0.0541
1995	0.0454
1996	0.0451
1997	0.0353
1998	0.0342
1999	0.0275
2000	0.0079
2001	0.0138
2002	0.0106

Near term projections show a slow increase in exploitable biomass. These were calculated by running the model forward in time, using the MPD recruitment resampling OY estimation with 70% chance of rebuilding by Tmax. Recruitment was assumed to be that from the spawner-recruit curve, but this assumption has very little influence on total biomass projections over the next three years.

Three year projection of catch and biomass based on MPD estimates

Year	*Catch*	*3+ Biomass*
2003	377 mt	23,073 mt
2004	376 mt	23,427 mt
2005	376 mt	23,819 mt

It is likely that the current management plan (i.e., bycatch only) is not conducive to accurate estimation of the removals from the fishery. This assessment relies heavily on the accuracy of these estimates.

The recruitment pattern for POP is similar to many rockfish species. Recent decades have provided rather poor year-classes compared to the 1950s and 1960s. The exploitation status of POP continues to be set to bycatch only. Since POP are at the southern limit of their geographical range, while the overall species condition has improved in other areas more central to their range (e.g., in the Canadian EEZ and in the Gulf of Alaska). Management actions of setting harvest guidelines to bycatch only (ABC=0) implemented over the past several years have not yet resulted in substantial stock increases based on available data.

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1.1 Introduction

In 1981 the Pacific Fishery Management Council (PFMC) adopted a 20-year plan to rebuild the depleted Pacific ocean perch (*Sebastes alutus*) resource in waters off the Washington and Oregon coast. This plan was based on the results of two studies. The first study employed a cohort analysis of 1966-76 catch and age-composition data as a basis for examining various schedules of rebuilding (Gunderson 1978). This report was later updated with four additional years of catch and age information (Gunderson 1981). The second study provided an evaluation of alternative trip limits as a management tool for the Pacific ocean perch fishery (Tagart et al. 1980). Controls on catch of Pacific ocean perch, and assessments of this species off Washington and Oregon have continued to the present day.

In this assessment, we have combined the data from the International North Pacific Fisheries Commission (INPFC) Columbia and US-Vancouver areas, and modeled the Pacific ocean perch stocks in these areas as a single stock. Examination of size-composition data for these areas indicates, however, that years of good recruitment coincide. Genetic studies of stock structure suggest mixing of the breeding animals between the two INPFC areas (Wishard et al. 1980, Seeb and Gunderson 1988). Examination of the along-shore catch-rate distribution of Pacific ocean perch during the surveys does not reveal substantial gaps which might indicate the need for separate management stocks. Common recruitment patterns, genetic similarities, and similar catch-rate distributions therefore suggest that the Pacific ocean perch along the west coast of the US are likely to be from a single stock. If separate stocks do exist, a biological basis for splitting them has not been established. Nevertheless, we recommend that management actions on a coast-wide stock should account for problems of effort concentration and distribute the catch relatively evenly because local "pockets" of relatively isolated Pacific ocean perch probably do exist (D. Gunderson, pers. comm.).

Prior to 1965, the Pacific ocean perch resource in the US Vancouver and Columbia areas of the INPFC were harvested almost entirely by Canadian and United States vessels. Most of the vessels were of multi-purpose design and used in other fisheries, such as salmon and herring, when not engaged in the groundfish fishery (Forrester et al. 1978). Generally under 200 gross tons and less than 33 meters (m) in length, these vessels had very little at-sea processing capabilities. These characteristics, for the most part, restricted the distance these vessels could fish from home ports, and limited the size of their landings. Landings from 1956-65 averaged slightly over 2,000 metric tons (mt) in each of the two INPFC areas included in this assessment, with an overall increasing trend of catch over this period.

Catches increased dramatically after 1965 with the introduction of large distant-water fishing fleets from the Soviet Union and Japan. Both nations employed large factory stern trawlers as their primary method for harvesting Pacific ocean perch. These vessels generally operated independently by processing and freezing their own catches. Support vessels, such as refrigerated transports, oil tankers, and supply ships permitted the large stern trawlers to operate at sea for extended periods of time. Peak removals by all nations combined are estimated at over 15,000 mt in 1966 and over 12,000 mt in 1967. These numbers are smaller than those used in the 2000 assessment because of a recent re-analysis of the foreign catch data (Rogers, 2003).

Catches declined rapidly following these peak years, and Pacific ocean perch stocks were considered to be severely depleted throughout the Oregon-Vancouver Island region by 1969 (Gunderson 1977, Gunderson et al. 1977). Landed catches over the period 1978-94 averaged 474 mt and 833 mt in the US-Vancouver and Columbia areas respectively. Landings for the combined region have continued to decline.

Pacific ocean perch stocks in the northeast Pacific were managed by the Canadian

Government in its waters, and by the individual states in waters off of the United States, prior to 1977. With implementation of the Magnuson Fishery Conservation and Management Act (MFCMA) in 1977, primary responsibility for management of the groundfish stocks off Washington, Oregon and California shifted from the states to the Pacific Fishery Management Council (PFMC). At that time, however, a Fishery Management Plan (FMP) for the west coast groundfish stocks had not yet been approved. In the interim, the state agencies worked with the PFMC to address conservation issues. In 1981, the PFMC adopted a management strategy to rebuild the depleted Pacific ocean perch stocks to levels that would produce Maximum Sustainable Yield (MSY) within 20 years. On the basis of cohort analysis (Gunderson 1978), the PFMC set Acceptable Biological Catch (ABC) levels to 600mt for the US portion of the INPFC Vancouver area and 950 mt for the Columbia area. To implement this strategy, the states of Oregon and Washington established landing limits for Pacific ocean perch caught in their waters. Trip limits have remained in effect to this day (Table 1). Recent catches have reflected bycatch only.

Research surveys have been used to provide fishery-independent information about the abundance, distribution, and biological characteristics of Pacific ocean perch. A coast–wide survey of the rockfish resource was conducted in 1977 (Gunderson and Sample 1980) with the objective of defining the distribution and measuring the abundance of the major species taken in bottom trawls. The 1977 coast wide shelf survey has since been repeated every three years, yielding fishery-independent indices of the resource size every three years from 1977-2001. The inter-annual variability of these nine survey indices is substantial and, given the large amount of sampling error each year, identifying trends from the indices alone is inappropriate unless a formal time-series approach is used (e.g., Pennington 1985).

The relative imprecision of the biomass index derived for Pacific ocean perch from the 1977 rockfish survey prompted requests from the fishing industry and resource managers for closer attention to the status of the resource. In response, the National Marine Fisheries Service (NMFS) coordinated a cooperative research survey of the Pacific ocean perch stocks off Washington and Oregon with the Washington Department of Fisheries (WDF) and the Oregon Department of Fish and Wildlife (ODFW) in March-May 1979. (Wilkins and Golden 1983). This survey provided a more precise biomass index, indicating stock sizes similar to those calculated from the 1977 triennial survey. Another Pacific ocean perch survey was conducted in 1985 to determine what impact six years of restrictive catch regulations had on the status of these stocks.

The values of the survey indices and the associated errors are modeled with several other data types as presented below. This improves the ability to assess population trends by taking into account the biology of the species and the fisheries involved in their harvest.

1.2. Data

1.2.1. Removals and regulations

Catch history

Landings data from the Pacific ocean perch fishery off the west coast of the continental United States are available from 1956 to the present (Figure 1; Table 2). This fishery took large catches during the mid-1960's. Canadian and United States vessels in the Vancouver and Columbia areas harvested this resource prior to 1965 when foreign vessels (mainly trawlers from the ex-Soviet Union and Japan) began intensive harvesting operations for Pacific ocean perch in the Vancouver area and, one year later, in the Columbia area. During the periods 1966-68 and 1972-74, the foreign fleets accounted for the bulk of the Pacific ocean perch removals. The foreign fishery for Pacific ocean perch ended in 1977 following the passage of the MSCFA. Foreign catch estimates for the years 1966-76 are taken from Rogers (2003). Figure 2 compares the catch series on which the analyses of this paper are based with that using during the 2000 assessment. Removals since

1979 have been restricted by the PFMC to promote the rebuilding of the resource. Estimated harvests by area show that a large proportion of the catches during the 1980s were from the Columbia area, but that catches are now split more evenly between the US-Vancouver and Columbia areas. Historical estimated total catches by domestic and foreign vessels are given in Table 2. These are adjusted for a 5% discard rate from 1956-80 (domestic catches), reflecting the relatively unregulated nature of the fishery over this time period, and a 16% discard rate thereafter, based on the work of Pikitch et al. (1988). A more recent report by Sampson (2002) reports a discard rate of about 10%, while the raw, unweighted, 2002 West coast fishery observer data gives a discard rate of 13%.

Fishery Size and age composition

Gunderson (1981) compiled fishery age-composition data for the Vancouver and Columbia INPFC areas. While the patterns of recruitment appear similar, the magnitudes of year-class strength varied between areas. The age-composition data for the two areas are combined (Table 3) to simplify the analysis, and because the fisheries operating in the two areas share many similarities.

The fishery age-composition data for 1966-80 were determined using the otolith surface ageing technique which involved counting the number of annual bands apparent on the surface of the otolith. This ageing technique is biased for Pacific ocean perch; the ages of animals older than 15 tend to be under-estimated. Therefore, when fitting the historic age-composition data, the information for animals aged 14 years and older are pooled into a "plus-group" at age 14 to reduce the impact of this bias. Fishery age-composition data based on the break-and-burn technique are available for 1999-2002 from the PACFIN database (Table 4). The break-and-burn technique is considered to provide unbiased estimates of age (Chilton and Beamish 1982). Therefore, for these more recent fishery age compositions data, ages 3-24 are fitted as individual age classes, with age 25 being the plus-group.

It is necessary to account for ageing error when fitting the model to the age-composition data. This involves converting from the model estimate of the age of a fish to its age given ageing error using an ageing-error matrix (which specifies the probability that a fish of given age will be aged to be any other age). The ageing-error matrix is based the assumption that ageing error is normally distributed with a mean of 0 (i.e. no bias) and a CV of 0.064. This CV is based on the results of a double-read analysis of 1,161 Pacific ocean perch otoliths at the Newport Laboratory of the Northwest Fisheries Science Center, NMFS (unpublished data). The distribution for the observed age of an animal in the plus-group is determined by first assuming that the age distribution of animals in the plus-group follows an exponential decline model with age (10% total annual mortality) and then applying the ageing-error matrix to this age distribution. Finally the observed age of an animal in the plus-group is calculated by summing this age distribution for each possible observed age and reforming the plus-group at age 25.

Fishery size-composition data were obtained from ODFW (1983-89, 1994-99) and from WDF (1968-88, 1994-99) The model is fitted to the size-composition data (17-40cm, where 40cm is a plus-group) from the commercial fishery for the years for which fishery size-composition data are available but fishery age-composition data are not (see Table 5). While the size-composition data from these years are not used when fitting the model, the fit to these data is nevertheless examined as part of the model diagnostics. An age to length conversion matrix is used to convert model-predicted age-compositions to model-predicted size-compositions when fitting to the size-composition data.

CPUE data

Catch-per-unit-of-effort (CPUE) data from the domestic fishery were combined for the INPFC Vancouver and Columbia areas (Figure 3; from Gunderson (1977)). Although these data reflect catch rates for the US fleet, the highest catch rates coincided with the beginning of removals by the foreign fleet. This suggests that, barring unaccounted changes in fishing efficiency during this period, the level of abundance was high at that time.

Recent logbook information is available for the several regions along the Pacific coast. A description of these data and a preliminary analysis of them was provided in Ianelli and Zimmerman (1998). However, it is unclear what, if any, relationship recent CPUE has with population abundance due to the largely bycatch nature of the present fisheries. For this reason the more recent CPUE data were not considered in the present assessment.

1.2.2. Surveys

NMFS Cruises

The results from four fishery-independent surveys are used in this assessment (Figure 4; Tables 6-9).

1. The triennial shelf survey that was conducted every third year from 1977-2001.
2. The POP surveys for 1979 and 1985.
3. The AFSC slope survey for "super-year" 1992 (including 1992-93 data), and for the years 1996, 1997 and 1999-2001.
4. The NWFSC slope survey for the years 1999-2002.

Size- rather than age-composition data are used when fitting the model for the years prior to 1989 (ages were determined using the biased surface ageing technique prior to 1989) and for those years for which there are no age-composition data. Survey age-composition data are not available for the 1995 triennial survey, the AFSC slope survey or the NWFSC slope survey, except for 2002.

The model-predicted age- and size-compositions are computed as described above for the commercial fishery. Size- and age-composition data from all the surveys are considered when evaluating the model fits.

A list of data used in this assessment is given in Table 10.

1.2.3. Biology and life history

Natural mortality, longevity, and age at recruitment

Assessments of Pacific ocean perch have changed substantially over the past two decades because of the impact of improved methods of age determination. Previously, Pacific ocean perch age determinations were done using scales and surface readings from otoliths. These gave estimates of natural mortality of about $0.15 yr^{-1}$ and longevity of about 30 years (Gunderson 1977). Based on the now-accepted break-and-burn method of age determination using otoliths, Chilton and Beamish (1982) determined the maximum age of *S. alutus* to be 90 years. Using similar information, Archibald et al. (1981) concluded that natural mortality for Pacific ocean perch should be on the order of $0.05 yr^{-1}$. Hoenig's (1983) relationship estimates that if Pacific ocean perch longevity is between 70 and 90 years (Beamish 1979, Chilton and Beamish 1982), M would be between 0.046 and $0.059 yr^{-1}$. In this assessment we follow the 2000 assessment by placing a fairly tight base-case prior distribution on natural mortality (lognormal with median $0.05 yr^{-1}$ and σ 0.1). Essentially, this acknowledges that there is some uncertainty regarding the value for M, while nevertheless constraining the estimate of M not to differ very substantially from past estimates. An alternative, more diffuse (median 0.055 and σ 0.25), prior is used in one of the tests of sensitivity (Figure 5). The age at recruitment is set at 3yr and ages 25 and older are grouped into a plus-group.

Sex ratio, maturation and fecundity

Survey data indicate that sex ratios are different among INPFC areas (e.g. Ito et al. 1987). The differences are, however, minor (within 5% of 1:1) so, for the purposes, of this assessment, a sex ratio of 1:1 is assumed. For the 1995 assessment, maturity-at-size was based on a total of 400 female Pacific ocean perch examined visually during the 1986-92 triennial surveys. However, the reliability of maturation studies using visual inspection has been questioned and histological examinations have found that visual examinations can be biased. We selected age 8 as an estimate of the age-at-50% female sexual maturity based upon the recommendation of the 2000 POP STAR panel. The maturity ogive is given in Figure 6. As part of the sensitivity analysis, a model run was conducted with a higher age-at-50%-maturity (10 years).

Length-weight relationship

The length-weight relationship for Pacific ocean perch was estimated using survey data collected from the west coast surveys (1977-89) Estimates from the 593 samples lead to the following relationship:

$$W(L) = 9.82 \cdot 10^{-3} L^{3.1265}$$

where L is length in cm and W is weight in grams. The mean weights-at-age were computed from the means lengths-at-age and this relationship (Figure 7).

Length at age

The length-age matrix used for this assessment is the same as that used for the 2000 assessment, which was based on 2,855 samples collected during the 1989-98 triennial surveys and aged using the break-and-burn method (Figure 8).

1.2.4 Changes in data from the 2000 assessment

The estimates of the historical foreign catch of Pacific ocean perch (1965-77) decreased from a total of 97,107 mt (used in the 2000 assessment) to 40,664 mt based upon the work of Rogers (2003) (Figure 2). The 2001 and 2002 catch data are included in this assessment, while the domestic catch data from 1981-2002 were updated to include not only the POP PACFIN catch category, as in previous assessments, but also the Nominal and Unspecified POP categories, which generally represented less than 10% (and often closer to 1%) of the total POP landings estimate. Finally, the present assessment assumed discard rates to be 5% before 1981 and 16% thereafter (Table 2). The 2000 assessment ignored discards.

In addition to making use of the biomass and age-composition data for the latest (2001) triennial survey, this assessment also includes data from surveys not considered in previous assessments: (1) the AFSC slope survey (survey biomass estimates for 'super year' 1992 and the years 1996, 1997, 1999, 2000, 2001, and size-composition data for 1996, 1997, 1999 and 2000) and (2) the NWFSC slope survey (survey biomass estimates for 1999-2002 and age-composition data for 2002).

Survey size-composition data were used only when survey age-composition data were not available during the 2000 assessment. However, the fishery age- and size-composition data (1968-80) were both included in the likelihood function in the 2000 assessment In this assessment, this use of both size- and age-composition data for any single year has been eliminated, and fishery size-composition data are ignored if the corresponding age-composition data are available. In addition, "unbiased" fishery age-composition data for 1999-2002 based on ageing 300-900 otoliths for each year using the break-and-burn method have been included in the likelihood function.

1.3. Assessment model

1.3.1. Past assessment methods

The condition of Pacific ocean perch stocks off British Columbia, Washington and Oregon have been assessed periodically since the intense pulse of exploitation in 1966-68. The mean exploitable biomass in the Vancouver area during 1966-68 was estimated at about 34,000 mt (Westrheim et al. 1972). Following the years of heavy fishing, catch-per-unit-of-effort (CPUE) for the Washington-based fleet in the Vancouver area dropped to 55% of the 1966-68 levels, indicating a decrease in biomass to 18,700 mt during 1969-71 (Technical Subcommittee 1972). Catch rates declined further during 1972-74 which indicated a further reduction in biomass by about 11% (Gunderson et al. 1977). The mean weighted CPUE rose slightly over the period 1975-77 (Fraidenburg et al. 1978a). However, this may have been completely or partially due to improvements in gear efficiency with the use of "high rise" trawl nets.

Columbia area biomass estimates since 1966 have been calculated by dividing landings by estimated exploitation rates. The mean biomass estimates declined from 23,000 mt during 1966-68 to 7,300 mt during 1969-72 and 4,300 mt during 1973-74 (Gunderson et al. 1977). An area-swept extrapolation from commercial CPUE data in the Columbia area resulted in a biomass estimate of 8,000 - 9,600 mt in 1977 (Fraidenburg et al. 1978b). Since the commercial fishery operates mainly in areas of high abundance, these estimates area likely to be positively biased.

A coast–wide survey of the rockfish resource was conducted in 1977 (Gunderson and Sample 1980) with the objective of defining the distribution and measuring the abundance of the major species taken in bottom trawls. The 1977 coast-wide shelf survey has since been repeated every three years, yielding fishery-independent indices of biomass every three years from 1977-2001. The relative imprecision of biomass indices derived for Pacific ocean perch from the 1977 rockfish survey prompted requests from the fishing industry and resource managers for closer attention to the status of the resource. In response, the National Marine Fisheries Service (NMFS) coordinated a cooperative research survey of the Pacific ocean perch stocks off Washington and Oregon with the Washington Department of Fisheries and the Oregon Department of Fish and Wildlife in March-May 1979. (Wilkins and Golden 1983). This survey provided more a precise biomass index, indicating stock sizes similar to those calculated from the 1977 triennial survey. Another Pacific ocean perch survey was conducted in 1985 to determine what impact six years of restrictive catch regulations had on the status of these stocks.

The survey design used for the 1985 POP survey was similar to that used in 1979 (Wilkins and Golden 1983), but was standardized to correct for inconsistencies that arose during the 1979 fieldwork. The two most serious inconsistencies involved the use of three different trawls by four different vessels and variable depth coverage (165 - 475 m off Washington and 165-420 m off Oregon). The 1985 survey was designed to correct these inconsistencies and to compensate for the differences between the two surveys. Sampling was done with the same style trawl net (Noreastern) in all areas. In the southern part of the Columbia area, which had been sampled exclusively with the Mystic trawl in 1979, half of the stations were sampled with the Noreastern and half with the Mystic. The relative fishing power of the two nets was used to adjust Noreastern trawl catch rates in that area to the fishing efficiency of the Mystic trawl. In this way the abundance in the southernmost subarea was calculated based on Mystic catch rates for comparison with 1979 results. No attempt was made to adjust fishing power in the Columbia Middle area although a modified 400 eastern trawl was used there in 1979. In calculating the 1985 Columbia South area abundance and size-composition data for comparison with the 1979 results, hauls deeper than 420 m in the Columbia Middle and South subareas were excluded from the data to conform with the 1979 depth coverage. Standardization of the survey design had no effect on the survey pattern in the Vancouver or the Columbia North areas.

Due to the directed effort of the 1979 and 1985 surveys to focus on Pacific ocean perch, these were at one time considered as estimates of absolute abundance whereas the triennial surveys have been always taken to be relative abundance indices.

In the 1992 and 1995 assessment documents, the population dynamics of Pacific ocean perch in the US-Vancouver and Columbia areas combined were examined using a statistical age-structured model (1990). The 2000 model was a forward projection age-structured model based upon the work of Fournier and Archibald (1982), Methot (2000) and Tagart et al. (1997).

1.3.2. Changes between the 2000 assessment model and the current model

A number of important changes have been made since the last assessment. Some of these are due to the inclusion of new data sources, while others have to do with other factors, including grouping data, modeling selectivities, the inclusion of ageing error, choice of prior distributions for the model parameters, and choice of the likelihood functions.

1. Fishery selectivity was estimated with separate parameters for ages 3-22 (subject to penalties) and allowed to change every 5th year in the 2000 assessment. The range of ages has been reduced to 3-14 to better reflect the number of age-classes for which historical (1966-80) fishery age-composition data are available, while the entire selectivity curve is allowed to change every 6th year to better accommodate the 47 years for which fishery catch data are available. The impacts of allowing the fishery selectivity to change every 5th year and time-invariant fishery selectivity are both examined in the tests of sensitivity.

2. The same time-invariant selectivity curve was assumed for the triennial and POP surveys during the 2000 assessment. Data from the AFSC and NWFSC slope surveys are included in the assessment for the first time in the present assessment. Two time-invariant selectivity curves are estimated: one for the triennial survey and another for the POP and the two slope surveys combined.

3. For the base-case analysis, and in common with the 2000 assessment, survey selectivity was estimated with separate parameters for each age. The maximum age for which a survey selectivity parameter is estimated has been increased from age 10 to age 12. The survey selectivity for age 10 is set to 1.0 rather than having survey selectivity average 1.0 over all ages to better allow selectivity to be compared among surveys and so that survey catchability is defined consistently across surveys. The sensitivity of the results to time-varying survey selectivity is considered in one of the sensitivity analyses.

4. The present assessment includes ageing error in contrast to the 2000 assessment. The age-reading error model is based on the results of a double-read analysis of 1,161 Pacific ocean perch otoliths conducted at the Newport field station of the NWFSC (Figure 9).

5. The likelihood function for the historical (1966-80) age-composition data now includes all of ages 3-14; the 2000 assessment ignored age 14.

6. The likelihood function for the age- and size-composition data has been taken to be the robust formulation of Fournier et al. (1998, 1990) as implemented in the Coleraine

package; the 2000 assessment assumed that the age- and size-composition data were multinomially distributed.

7. The base-case lognormal prior distribution for survey catchability (*q*) for the triennial survey in the 2000 assessment had a mean of 1.13 and a mode of 0.78 (i.e. a median of 1.0 and σ 0.5) while the less informative prior considered in the tests of sensitivity had a mean of 1.38 and a mode of 0.53 (i.e. a median of 1.0 and σ 0.8). This prior was expert opinion based on a meta-analysis of trawl survey catchability estimates for a variety of species (Harley et al. 2000). The catchability coefficient for the POP survey was assigned a non-informative prior (i.e. $U[-\infty,\infty]$ on log(q)). There are four surveys in the present assessment, and priors need to be assigned to the catchability coefficients for each. It was decided that there was not enough information to support an informative prior, and so uniform priors (i.e. $U[-\infty,\infty]$ on log(q)) were placed on the catchability coefficient for all four surveys for the base-case analysis. Sensitivity is explored to a more informative prior distribution (median 0.98, σ 0.45, mean 1.08, mode 0.8) which was stated in the 2000 assessment document as a more informative prior(Figure 10). Note that for this sensitivity analysis, we use the prior distribution reported in the 2000 assessment document which did not coincide with the prior distribution actually used in the analysis in 2000.

8. The survey biomass indices were assumed to be log-normally distributed in the current assessment; these indices were assumed to be normally distributed in the 2000 assessment.

9. The prior distribution placed on the steepness of the stock-recruitment relationship during the 2000 assessment was based upon Dorn's (2000) hierarchical meta-analysis of rockfish steepness. However, this prior distribution was a combination of the priors for the Beverton-Holt and Ricker stock-recruitment models, and was therefore inappropriate for either model. Furthermore, the Dorn's (2000) meta-analysis included results from the 1998 Pacific ocean perch assessment, the data for which is included in both the 2000 and 2003 assessments, resulting in the double use of data. Minte-Vera et al. (2003) present the correct prior distributions, i.e. excluding the data for West Coast Pacific ocean perch when conducting the meta-analysis. However, two of the most informative stocks in this corrected meta-analysis are Alaskan Pacific ocean perch stocks that have much higher steepness values than have been calculated for the West Coast Pacific ocean perch in previous assessments. It is not clear that the Alaskan stocks of Pacific ocean perch should have similar dynamics to the West Coast stock which suggests that even the revised prior of Minte-Vera et al. (2003) may be questionable for West Coast Pacific ocean perch. Therefore, the prior for steepness in the base-case analysis has been taken to be uniform over the interval [0.21-0.99]. Sensitivity is explored to the prior for Beverton-Holt steepness for Pacific ocean perch derived by Minte-Vera et al. (2003).

10. The extent of temporal autocorrelation in recruitment, ρ, was treated as an estimable parameter in the 2000 assessment. However, the point estimate of ρ fell into the extreme of the tail of its marginal posterior. Owing to this and to difficulties associated with estimating ρ, this parameter has been removed (set to 0.0) from the assessment model for the base-case analysis. The sensitivity of the results to fixing ρ to 0.5 is examined in one of the tests of sensitivity.

11. The standard deviation of the recruitment residuals σ_r is set at 1.0 in the base-case analysis. The value used in the 2000 assessment, 0.76, is used in one of the tests of sensitivity.

12. In the 2000 assessment, the recruitment likelihood function involved two parts, the first involving the deviations from the stock-recruitment relationship and the second the deviation from the mean recruitment. This second part has been removed from the model as it is inconsistent with the assumption of a stock-recruitment relationship.

13. The bias-correction for recruitment (needed due to the assumption that recruitment is log-normally-distributed about its expected value) has been removed from the recruitment likelihood prior to 1956 when running the model to obtain MPD estimates, as no data exists to support estimation of recruitments for these years. For the MCMC runs, where more realistic year-to-year variation in recruitment estimates exist even for years prior to 1956, the bias correction is included in the recruitment likelihood prior in all years.

1.3.3. Model features unchanged from the 2000 assessment model

The population dynamics model used in the present assessment is the same as that on which the 2000 assessment was based, i.e. a forward projection age-structured model similar to those developed by Methot (1990) and Tagart et al. (1997). As in past years, the concept of the estimation is to simulate the population dynamics using a process model, and to evaluate alternative simulated population trajectories in terms of how well they are able to mimic the available data. The observation model allows for both sampling error and ageing error. The model equations, the descriptions of the parameters of the model and the formulation of the likelihood function are given in Table 11.

Following the 2000 assessment, a prior probability distribution was placed on natural mortality instead of assuming a constant fixed value. The sensitivity of the results to a more diffuse prior for natural mortality is examined in one of the tests of sensitivity. Fishery selectivity is allowed to be a smooth function of age, and to vary over time. The prior distributions for natural mortality (Figure 5), R_0 and the recruitment residuals remain unchanged although the prior distribution for survey catchability has been modified (see Section 1.3.2, point 7).

The same parameterization of the Beverton-Holt stock-recruitment relationship was used in this assessment as was the case for the 2000 assessment:

$$\hat{R}_i = \frac{S_{i-3}e^{\xi_i}}{\alpha + \beta S_{i-3}}, \qquad \xi_i = \rho\xi_{i+1} + \sqrt{1-\rho^2}\,\omega_i \qquad \omega_i \sim N(0,\sigma_R^2)$$

where $\hat{R}_i$ is the expected recruitment at age 3 in year i,
S_i is the female spawning biomass in year i,
ξ_i is the correlated recruitment anomaly for year i, and
α, β are parameters of the stock-recruitment relationship.

The values for the stock-recruitment relationship parameters α and β are calculated from the values of R_0 (the number of 0-year-olds in the absence of exploitation and recruitment variability) and the "steepness" of the stock-recruit relationship (h). Steepness is the fraction of R_0 to be expected (in the absence of recruitment variability) when the mature biomass is reduced to 20% of its level (Francis 1992)[1], so that:

[1] For steepness = 0.2, recruitment is a linear function of spawning biomass (implying no surplus production if the Beverton-Holt stock-recruitment model is correct and there is no depensatory mortality) while for steepness = 1.0, recruitment is constant for all levels of spawning stock size.

$$\alpha = \tilde{B}_0 \frac{1-h}{4h}; \quad \beta = \frac{5h-1}{4hR_0}$$

where $\tilde{B}_0$ is the total egg production (or an appropriate proxy such as female spawning biomass) in the absence of exploitation (and recruitment variability), expressed as a fraction of R_0.

Estimation of the stock-recruitment relationship is integrated into the assessment. Therefore, assumptions about the priors for the parameters of this relationship (i.e. R_0 and h) are critical, particularly if the data are non-informative. F_{MSY} and related quantities such as *MSY* and B_{MSY} can be computed using the fitted stock-recruitment relationship as in Ianelli and Zimmerman (1998). The stock-recruitment relationship can also be seen as a surrogate for other factors affecting recruitment numbers, including climatic effects such as the Pacific Decadal Oscillation (PDO). In this assessment, a uniform prior distribution is assumed for steepness. An alternative prior, based on Dorn's meta analysis (Minte-Vera et al. 2003, and see Figure 11) is included as a test of sensitivity.

1.3.4. Likelihood contributions

The objective function minimized to obtain the point estimates of the model parameters includes contributions by the data (survey biomass estimates, CPUE data, fishery and survey age- and size- composition data; Table 10) and well as penalties (on the differences between estimates of recruitment and the values predicted from the deterministic component of the stock-recruitment relationship; on the differences between model-predicted and estimated total catches; on the variation in fishing mortality; on the extent of smoothness and dome-shapedness of fishery and survey selectivity; and on the extent to which fishery selectivity changes over time). The functional forms for each of these likelihood contributions are reported in Table 11.

The model was assumed to have converged when the largest gradient component of the objective function in the final phase was less than 10^{-7}. Issues of model convergence were assessed in several ways.

1. The Hessian matrix was inverted to ensure that it was positive definite; a non-positive definite Hessian matrix is an indication of a poorly converged or over-parameterized model.
2. The estimation was always initiated with starting values that were far from the final solution.
3. The estimation was conducted in several phases to avoid problems when highly non-linear models (such as that used here) enter biologically unreasonable regions (e.g., stock sizes smaller than the total catch or stock sizes several orders of magnitude too high).

1.3.5. Bayesian analysis

The joint posterior density function is proportional to the product of the likelihood function (see Table 11) and the prior probability distribution. A list of the estimable parameters and the priors assumed for them in the baseline analysis are given in Table 11. The Metropolis-Hastings variant of the Markov-Chain Monte Carlo (MCMC) algorithm (Hastings 1970; Gilks et al. 1996; Gelman et al. 1995) with a multivariate normal jump function was used to sample 3,000 equally likely parameter vectors from the joint posterior density function. This sample implicitly accounts for correlation among the model parameters and considers uncertainty in all parameter dimensions simultaneously. The samples on which inference is based were generated by running 12,000,000 cycles of the MCMC algorithm, discarding the first 3,000,000 as a burn-in period and selecting every 3,000th parameter vector thereafter. The initial parameter vector was taken to be the vector of maximum posterior density (MPD) estimates. A potential problem with the MCMC algorithm is how to determine whether convergence to the actual posterior distribution has occurred, and the selection of 12,000,000, 3,000,000 and 3,000 was based on generating a sample which showed no noteworthy signs of lack of convergence to the posterior distribution. We evaluated whether convergence had occurred in two ways.

1) Applying the MCMC algorithm from two alternative initial parameter vectors in addition to the application from the MPD estimates. The alternative initial parameter vectors were constructed by adding uniformly distributed noise to the MPD estimates, where the range of the normal distributions were ±2 standard deviations about the MPD estimates. The results of the three MCMC samples were compared using a variety of statistics including the statistic developed by Brooks and Gelman (1998).

2) Applying the diagnostic statistics developed by Geweke (1992), Heidelberger and Welch (1983), and Raftery and Lewis (1992) and by examining the extent of auto-correlation among the samples in the chain.

1.4. Results

1.4.1. Model selection and evaluation

The initial *a priori* model (Model 1) was based on the modifications to the 2000 assessment model (Ianelli et al. 2000) described above. These modifications include all of the following.

1. No serial correlation in the recruitment residuals (i.e. ρ=0).
2. The standard deviation of the fluctuations about the stock-recruitment relationship, σ_R, was set at 1.0.
3. A uniform prior was assumed for steepness.
4. Uniform priors (on a log-scale) were assumed for survey catchability.
5. The oldest age for which fishery selectivity was estimated was decreased from 22 to 14 years while the oldest age for which survey selectivity was estimated was increased from 10 to 12 years.
6. Fishery selectivity was allowed to change every 6^{th} rather than every 5^{th} year.
7. Survey selectivity for age 10 was set to 1.0 rather than imposing a constraint that average selectivity across ages equals 1.0.

1.4.2. Base-run results

Figure 12 shows the time-trajectories of the point estimates (i.e. those that correspond to the maximum of the objective function, which are also those corresponding to the maximum of posterior density function) for spawning biomass, fishery exploitation rate and recruitment. The fit to the stock-recruitment relationship (Figure 13) indicates a substantial amount of variability, especially during the early part of the time-series when several strong year-classes occurred. Recruitment was substantially larger than the predictions based on the stock-recruitment relationship for the majority of years from the mid-1950's through the early 1970's although recruitment also declined over this period. Fishing mortality peaked at around 28% in 1966-67 and has, until recently, stabilized between 3 and 7%. Over the past three years, fishing mortality has been approximately 0.7-1.3%.

The fits of the model 1 to the various indices are summarized in Figure 14 (survey biomass indices and fishery CPUE data), Figures 15 and 16 (fishery age-composition data), Figures 17 and 18 (survey age-composition data), Figure 19 (fishery size-composition data) and Figure 20 (survey size-composition). There is no evidence for model mis-specification in any of these fits.

The fishery selectivity pattern changes moderately over time (Figure 21). This may be partly due to the switch to fitting age- rather than size-composition data in 1980 and the differences in quality between or intrinsic information in these two sources of data. The selectivity patterns for both the triennial and slope surveys exhibit domes (Figure 22), although that for the triennial survey occurs at a lower age. As expected, selectivity for younger ages is notably lower for the slope surveys than for the triennial survey.

Table 12 lists the numbers-at-age matrix for Model 1 while Table 13 lists the point estimates of catch-at-age for this Model. Model 1 estimates that the spawning stock biomass was depleted to 25.3% of its unfished equilibrium level of 39,291 mt in 2003 (Table 14). In terms of exploitable (age 3+) biomass, the depletion is to 26.5% of unfished equilibrium level of 87,177 mt. The estimate of M is 0.053 yr^{-1} while steepness is estimated at 0.532. The estimate of *MSY* is 1,172 mt, which is smaller than all of the annual catches (including discard) from 1956-94; therefore overfishing ($F > F_{MSY}$) occurred throughout this period although the fishing mortality in 2002 was less than F_{MSY}.

The sensitivity analysis (Table 14) considered the following changes to the assumptions underlying Model 1:

1) Model 1b: replace the uninformative priors assumed for the catchability coefficients for all four surveys by (informative) prior distributions (mean = 1.08; mode = 0.8).
2) Model 1c: replace the uniform prior for steepness by the "correct" (i.e. Minte-Vera et al., submitted) prior from Dorn's meta-analysis.
3) Model 1d: increase the value of the parameter that determines the extent of serial correlation in the recruitment anomalies (ρ) from 0 to 0.5.
4) Model 1e: reduce the assumed standard deviation for the recruitment anomalies from 1.0 to 0.76 (the value used in the 2000 assessment).
5) Model 1f: increase the age at which fishery selectivity is assumed to be flat from 14 to 22 (the value used in the 2000 assessment).
6) Model 1g: Replace reference model prior for natural mortality with a more informative prior.
7) Model 1h: Do not allow the fishery selectivity to change over time.
8) Model 1i: Allow the survey selectivity to change every 5th year.
9) Model 1j: Increase the age at which the maturity curve has an inflection point (i.e. the age-at-50%-maturity) from age 8 to age 10.
10) Model 1k: Ignore the aging-error model and hence assume that there is no ageing error (an assumption on which the 2000 assessment was based).
11) Model 1l: Retrospective analysis – ignore the assessment data for 2002 (as if assessment were conducted in 2002)
12) Model 1m: Retrospective analysis – ignore the assessment data for 2001 and 2002 (as if assessment were conducted in 2001)
13) Model 1n: Omit the triennial survey indices from the likelihood function.
14) Model 1o: Omit the POP survey indices from the likelihood function.
15) Model 1p: Omit the AFSC slope survey indices from the likelihood function.
16) Model 1q: Omit the NWFSC slope survey indices from the likelihood function.
17) Model 1r: Omit the CPUE data from the likelihood function.

The results of the sensitivity analyses do not indicate great variation in results from the reference model (Model 1). Depletion levels for all but one of the sensitivity tests lie between 0.20 and 0.30. The exception is Model 1n, when the triennial survey indices are excluded from the assessment and depletion and *MSY* drop to 0.084 and 598t respectively. High sensitivity in this case is, however, perhaps not surprising because the triennial survey represents the longest time-series of biomass indices included in the assessment, and hence should be a key factor determining the final model outcomes.

Ignoring the data for 2001 and 2002 (Model 1m) has a much larger impact on current spawning biomass and hence depletion than omitting the data for 2002 only (Model 1l). This is because the 2001 triennial survey index is fairly low and influential. Note that the depletion level of 0.288 for Model 1m is for the year 2001 and should be compared to the estimated depletion level of 0.230 for 2001 in Model 1. Ignoring the 2001 data also leads to a markedly higher estimate of steepness and hence *MSY*.

Models 1b and 1c change the priors for survey catchability and steepness. Only the latter sensitivity test has a notable impact of the estimates of steepness (0.714 compared to 0.532 for Model 1) and depletion (0.272 compared to 0.253 for Model 1). The increased steepness (comparable with that when the data for 2001 and 2002 are ignored) imply a more optimistic picture of recovery and sustainable catch.

1.4.4. Markov-Chain Monte Carlo results

Evaluation of convergence
Figure 23 summarizes the convergence statistics for nine of the key model outputs (the ratio of the spawning biomass in 2003 to B_0, steepness, B_0, M, the spawning biomass in 2003, and the four survey catchability coefficients) based on the three MCMC chains. The panels for each chain show the trace, the posterior density function (estimated using a normal kernel density), the correlation at different lags, the 50-point moving average against cycle number (dotted line in the rightmost panels), and the running mean and running 95% probability intervals (solid lines in the rightmost panels). The results in Figure 23 and the values for the other diagnostic statistics do not indicate any serious convergence problems. One exception to this is that B_0 fails the Geweke test. However, this is a consequence of the fairly large number of samples from the posterior distribution; further thinning of the chain does not change the marginal posterior distributions notably but leads to B_0 passing the Geweke test.

It is not feasible to produce figures summarizing the convergence statistics for all of the very many parameters of the model. Figures 24a – e summarize the values of six statistics (the ratio of the batch standard deviation to the naive standard deviation, the extent of lag-1 auto-correlation, the value of the value of Raftery-Lewis statistic, the *p*-value computed from the Geweke statistic, whether the Heidelberger and Welch test is passed or not, and the value of the single-chain Gelman statistic) for a variety of model parameters and outputs. Ideally, the value of the first statistic should be close to 1, the value of the second statistic should be close to zero, the value of the third statistic should be less than 5, the value of the fourth statistic should be greater than 0.05, and the value of the last statistic should be less than 1.05. The results in Figure 24 suggest that the sample from the posterior is close to ideal. The *p*-value for the Geweke statistic is less than 0.05 reasonably often. However, this is not a major concern because this statistic can be triggered at random and the other statistics suggest that convergence has been achieved very successfully.

The posteriors
Figures 25-26 display posterior distributions for the time-trajectories of spawning biomass and recruitment. The median values of these time-trajectories are given in Table 15. The posterior distributions for nine key output quantities are displayed in Figure 27. These distributions summarize the uncertainty of the estimates of these quantities. The posterior medians for the nine output quantities are close to maximum posterior density estimates (see Table 14). Figure 28 shows the correlation among the nine key output quantities along with the ABC for 2004.

The posterior probability that the 2003 spawning biomass is less than $0.25B_0$ is 0.4 (i.e. there is a 40% probability that Pacific ocean perch is currently overfished). The posterior probability that the 2003 spawning biomass is less than half of B_{MSY} is ~0.1.

The posterior distribution for steepness is relatively wide (Figure 27). This confirms the expectation that the data are relatively uninformative about the shape of stock-recruitment relationship. A major cause of this uncertainty is due to the extremely high early recruitments (see Figures 12 and 13) which do not fall on the stock-recruitment relationship irrespective of the value for steepness. In reality, the stock-recruitment relationship may have changed since the 1940s and 1950s, possibly due to climate change.

1.4.5. Future research

There are a number of areas of future research, e.g.:

The inclusion of age 1 and 2 Pacific ocean perch catches and discards. This would involve a further examination of the size or age data for the discards, which are likely different from those for the retained catches.

The appropriate effective sample sizes for fishery and survey size- and age-compostion data.

The use of simulation models to evaluate how well it is possible to estimate recruitment using size-composition data or biased or unbiased age-composition data, or a mix of the three, as is the case in actuality for Pacific ocean perch. Such an analysis could inform whether recruitment from individual good recruitment years is spread out over several years when assessed using the model, and if smaller recruitments can lead to the same patterns if the recruitment anomalies are autocorrelated. The effects of assuming one pattern of recruitment, when another is accurate, on the estimates of the model parameters, especially those of the stock-recruitment relationship, could have a large impact on the assessment and the predictions of rebuilding OYs.

Climatic effects on recruitment, growth and survival. A first step might be to include PDO (Pacific decadal oscillation) or other climatic variables in the assessment as a predictor of recruitment success.

How to select an appropriate prior distribution for the survey catchability coefficients, or at least for the current NWFSC survey which will be continuing.

Inclusion of males and females separately in the model. While the sex-ratio is believed to be approximately 1:1, the growth rates and mean maximum sizes of males and females are slightly different, which may have some effect on selectivity and the estimates of total biomass.

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1.6. Tables

Table 1. Pacific Fishery Management Council groundfish management/regulatory actions regarding Pacific ocean perch (POP) since Fishery Management Plan implementation in 1982.

Date	Regulatory Action
November 10, 1983	Recommended closure of Columbia area to POP fishing until the end of the year as 950 t OY for this species has been reached; retain 5,000 pound trip limit or 10 percent of total trip weight on landings of POP in the Vancouver area.
January 1, 1984	Continuation of 5,000 pound trip limit or 10 percent of total trip weight on POP as specified in FMP. Fishery closes when area OY's are reached (see action effective November 10, 1983 above).
August 1, 1984	Recommended immediate reduction in trip limit for POP in the Vancouver and Columbia areas to 20 percent by weight of all fish on board, not to exceed 5,000 pounds per vessel per trip. When OY is reached in either area, landings of POP will be prohibited in that area (Oregon and Washington implemented POP recommendation in mid-July).
August 16, 1984 (Automatic closure)	Commercial fishing for POP in the Columbia area closed for remainder of the year. (See items regarding this species effective January 1 and August 1, 1984 above.)
January 10, 1985	Recommended Vancouver and Columbia areas POP trip limit of 20 percent by weight of all fish on board (no 5,000 pound limit as specified in last half of 1984).
April 28, 1985	Recommended the Vancouver and Columbia areas POP trip limit be reduced to 5,000 pounds or 20 percent by weight of all fish on board, whichever is less. Landings of POP less than 1,000 pounds will be unrestricted. The fishery for this species will close when the OY in each area is reached.
June 10, 1985	Recommended landings of POP up to 1,000 pounds per trip will be unrestricted regardless of the percentage of these fish on board.
January 1, 1986	Recommended the POP limit in the area north of Cape Blanco (42 degrees, 50 minutes N) should be 20 percent (by weight) of all fish on board or 10,000 pounds whichever is less; landings of POP should be unrestricted if less than 1,000 pounds regardless of percentage on board; Vancouver area OY = 600 t; Columbia area OY = 950 t.
December 1, 1986	OY quota for POP reached in the Vancouver area; fishery closed until January 1, 1987.
January 1, 1987	Recommended the coastwide POP limit should be 20 percent of all legal fish on board or 5,000 pounds whichever is less (in round weight); landings of POP unrestricted if less than 1,000 pounds regardless of percentage on board; Vancouver area OY = 500 t; Columbia area OY = 800 t.
January 1, 1988	Recommended the coastwide POP trip limit should be 20 percent (by weight) of all fish on board or 5,000 pounds, whichever is less; landings of POP be unrestricted if less than 1,000 pounds regardless of percentage on board; Vancouver area OY = 500 t; Columbia area OY = 800 t.
January 1, 1989	Established the coastwide POP trip limit at 20 percent (by weight) of all fish on board or 5,000 pounds whichever is less; landings of POP unrestricted if less than 1,000 pounds regardless of percentage on board (Vancouver area OY = 500 t; Columbia area OY = 800 t).
July 26, 1989	Reduced the coastwide trip limit for POP to 2,000 pounds or 20 percent of all fish on board, whichever is less, with no trip frequency restriction. Increased the Columbia area POP OY from 800 to 1,040 t.
December 13, 1989	Closed the POP fishery in the Columbia area because 1,040 t OY reached.
January 1, 1990	Established the coastwide POP trip limit at 20 percent (by weight) of all fish on board or 3,000 pounds whichever is less; landings of POP be unrestricted if less than 1,000 pounds regardless of percentage on board. (Vancouver area OY = 500 t; Columbia area OY = 1,040 t).
January 1, 1991	Established the coastwide POP trip limit at 20 percent (by weight) of all fish on board or 3,000 pounds whichever is less; landings of POP be unrestricted if less than 1,000 pounds regardless of percentage on board (harvest guideline for combined Vancouver and Columbia areas = 1,000 t).
January 1, 1992	Established the coastwide POP trip limit at 20 percent (by weight) of all groundfish on board or 3,000 pounds whichever is less; landings of POP be unrestricted if less than 1,000 pounds regardless of percentage on board (harvest guideline for combined Vancouver and Columbia areas = 1,550 mt).
January 1, 1993	Continued the coastwide POP trip limit at 20 percent (by weight) of all groundfish on board or 3,000 pounds whichever is less; landings of POP be unrestricted if less than 1,000 pounds regardless of percentage on board (harvest guideline for combined Vancouver and Columbia areas = 1,550 mt).
January 1, 1994	Adopted the following management measure for the limited entry fishery in 1994: POP: Trip limit of 3,000 pounds or 20 percent of all fish on board, whichever is less, in landings of POP above 1,000 pounds. Adopted the following management measure for open access gear except trawls in 1994: Rockfish: Limit of 10,000 pounds per vessel per trip, not to exceed 40,000 pounds cumulative per month, and the limits for any rockfish species or complex in the limited entry longline or pot fishery must not be exceeded.
May 1, 1994	Changed trip limit for rockfish taken with setnet gear off California. The 10,000 pound trip limit for rockfish caught with setnets, which applied to each trip, was removed. The 40,000 pound cumulative limit that applies per calendar month remains in effect.
January 1, 1995	Established cumulative trip limits of 6,000 pounds per month.
January 1, 1996	Established cumulative trip limits of 10,000 pounds every two months.
July 1, 1996	Reduced cumulative 2-month trip limit to 8,000 pounds.
January 1, 1997	Established cumulative trip limits of 10,000 pounds every two months.
January 1998	Harvest guidelines reduced from 750 mt to 650 mt with ABC=0. Limited entry fishery under 8,000 pounds per two-months until September with monthly limits of 4,000 pounds
January 1999	Monthly cumulative trip limit of 4,000 pounds for limited entry fishery. A 100 pound per month limit established for open access fishery.
January 2000	Monthly cumulative trip limit of 2,500 pounds (May-October) and 500 pounds (November-April) for limited entry fishery.
January 2001	Monthly cumulative trip limit of 2,500 pounds (May-October) and 1,500 pounds (November-April) for limited entry fishery
June 2001	Monthly cumulative trip limit increased to 3,500 pounds for limited entry fishery beginning July 1, 2001.
September 2001	POP limited entry and open access fisheries closed starting October 1, 2001 through the end of 2001.
January 2002	Monthly cumulative trip limit of 4,000 pounds (April-October) and 2,000 pounds (November-March) for limited entry fishery.
January 2003	Two-month cumulative trip limit of 3,000 pounds for limited entry trawl fishery and 1,800 pounds for limited entry fixed gear fishery throughout year.

Table 2. Pacific ocean perch landings and estimated total catch in metric tons (including estimated discards) from the US Vancouver and Columbia INPFC areas by foreign and domestic vessels.

Year	*Foreign catch*	*Domestic landings*	*Domestic catch including discard*	*Total*
1956		2.119	2.231	2.231
1957		2,320	2,442	2,442
1958		1,580	1,587	1,587
1959		1,860	1,958	1,958
1960		2,246	2,364	2,364
1961		3,924	4,149	4,149
1962		5,530	5,793	5,793
1963		6,449	6,788	6,788
1964		5,517	5,807	5,807
1965		7,660	8,063	8,063
1966	15,561	3,039	3,200	18,761
1967	12,357	885	932	13,289
1968	6,639	592	623	7,262
1969	469	692	728	1,197
1970	441	1,649	1,736	2,177
1971	902	997	1,049	1,951
1972	950	578	608	1,558
1973	1,773	353	372	2,145
1974	1,457	326	343	1,800
1975	496	623	656	1,152
1976	239	1,366	1,438	1,677
1977		1,180	1,242	1,242
1978		2,014	2,120	2,120
1979		1,854	1,952	1,952
1980		1,867	1,965	1,965
1981		1,445	1,720	1,720
1982		1,043	1,242	1,242
1983		1,860	2,215	2,215
1984		1,645	1,959	1,959
1985		1,506	1,792	1,792
1986		1,389	1,653	1,653
1987		1,096	1,305	1,305
1988		1,382	1,645	1,645
1989		1,433	1,706	1,706
1990		1,032	1,230	1,230
1991		1,433	1,659	1,659
1992		1,097	1,306	1,306
1993		1,260	1,500	1,500
1994		988	1,176	1,176
1995		810	965	965
1996		788	938[1]	938
1997		631	751	751
1998		621	739	739
1999		498	593	593
2000		144	171	171
2001		258	307	307
2002		201	239*	239*

1 Average of two previous years

Table 3. Table 3. Age-composition data for the domestic fishery catch in Vancouver and Columbia areas combined based on surface ageing (1966-80; from Gunderson, 1981). The data for ages 14 and older are grouped in a single "plus-group" when fitting the model to avoid potential problems with ageing bias.

Age	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980
3	0	0	0	0	6	0	0	2	0	0	0	0	0	0	0
4	0	0	19	0	0	0	4	9	0	0	0	4	2	0	0
5	12	44	29	18	22	0	31	29	6	87	200	7	23	8	4
6	24	61	559	7	233	12	65	44	14	88	1,353	91	48	17	23
7	82	543	1,206	64	319	117	142	70	15	105	425	529	95	34	53
8	294	872	1,648	109	711	291	277	110	28	67	289	144	333	87	159
9	353	1,580	1,191	97	1,459	956	540	311	94	101	201	118	183	257	345
10	801	2,780	1,667	230	1,081	1,640	990	709	241	218	316	98	195	191	351
11	1,401	4,989	2,484	578	907	1,083	1,511	1,170	402	321	420	155	208	166	214
12	2,731	8,115	4,142	1,267	904	798	620	1,326	505	373	403	157	279	195	189
13	1,648	6,322	3,845	1,369	937	686	402	564	370	390	297	141	264	178	197
14	1,201	5,496	3,130	1,103	807	652	420	279	142	351	248	122	296	170	200
15	1,425	4,523	2,703	1,060	818	667	426	242	106	97	133	83	215	164	176
16	1,342	3,595	2,051	586	700	572	402	218	79	77	62	71	170	146	166
17	812	2,501	1,317	215	390	538	377	233	66	86	61	42	106	124	146
18	589	1,326	938	184	269	252	271	187	65	70	60	37	68	99	107
19	259	992	651	71	148	220	137	146	41	54	45	36	33	73	60
20	118	379	520	7	74	149	90	105	37	32	49	27	30	44	69
21	35	115	248	0	27	75	58	72	34	23	15	12	17	32	39
22	12	141	146	4	0	21	31	25	25	12	25	2	11	21	23
23	12	44	34	0	0	0	6	10	14	8	15	5	3	18	16
24	0	27	0	0	0	0	0	0	5	3	16	1	0	2	20
25	0	0	0	0	0	0	0	0	0	0	0	0	0	4	12

Table 4. Age–compositions data for the domestic fishery catch in the US Vancouver and Columbia INFPC areas combined based on the break-and-burn method (1999-2002).

	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25+
1999	0	0	4	2	20	19	49	33	21	8	14	9	11	12	10	8	8	9	7	4	5	1	52
2000	0	0	18	1	7	30	47	65	59	37	47	39	44	22	27	7	11	8	8	11	6	1	101
2001	0	10	25	40	21	30	57	77	95	81	42	32	33	25	29	14	19	13	5	14	10	16	188
2002	0	2	8	69	65	35	45	85	78	85	59	31	32	13	19	23	12	10	7	12	11	17	104

Table 5. Size-composition data (categories in centimeters) for the domestic fishery catch in Vancouver and Columbia areas.

	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40+
1981	0	0	0	0	0	0	0	0	0	0	0	2	2	5	20	11	16	39	86	154	177	214	217	941
1982	0	0	0	0	0	0	0	0	1	0	2	0	3	1	3	5	22	39	72	115	160	202	223	951
1983	0	0	0	0	0	0	0	0	0	0	0	2	6	7	15	26	74	107	175	245	288	317	312	1156
1984	0	0	0	0	0	0	0	0	1	0	1	2	8	12	27	56	84	159	234	306	413	450	369	981
1985	0	1	0	0	0	0	0	0	1	0	3	9	4	25	35	52	127	207	344	389	413	464	492	1943
1986	0	0	0	0	0	0	0	0	0	1	3	1	7	7	22	40	55	161	248	357	369	430	463	1840
1987	0	0	0	0	0	0	0	0	0	0	1	1	2	13	21	48	82	141	223	303	372	400	302	1196
1988	0	0	0	0	0	0	0	0	0	0	1	1	1	4	7	9	6	11	20	44	61	59	51	241
1989	0	0	0	0	0	0	0	0	0	0	1	0	0	2	10	12	23	33	61	82	115	120	105	234
1994	0	0	0	0	0	0	0	0	0	0	0	1	4	13	25	47	45	68	72	95	100	115	75	238
1995	0	0	0	0	0	0	0	0	0	0	0	2	2	10	24	33	35	63	87	128	114	107	65	186
1996	0	0	0	0	0	0	0	1	1	2	7	11	14	42	58	55	94	121	146	143	150	142	121	455
1997	0	0	0	0	0	0	0	4	3	9	13	35	54	107	101	133	164	181	177	209	208	200	173	424
1998	0	0	0	0	1	2	0	1	4	4	14	20	23	27	60	98	123	151	147	135	139	119	101	307

Table 6. Survey age-composition data for the combined Vancouver and Columbia areas. Note that the data for ages 1 and 2 are not used when fitting the model, nor are the data from 1977-1980, the latter because of low sample size and the use of surface rather than break-and-burn ageing methods.

Age	1977	1979	1980	1985	1989	1992	1998	2001	2002
1	0	0	0	0	46,138			201,713	-
2	18,214	2,556	0	21,200	254,816	38,718		540,828	-
3	84,582	13,231	0	122,477	89,226	798,759	2,056,539	335,665	112,483
4	119,793	228,325	295,155	332,342	3,176,682	3,368,042	3,457,344	142,091	37,169
5	125,448	667,058	702,456	731,141	1,219,343	2,750,737	363,980	148,375	25,395
6	460,779	652,383	591,543	1,017,246	656,796	1,076,992	501,087	858,304	54,531
7	2,631,845	870,267	350,490	418,657	833,499	1,255,653	1,114,104	755,694	288,843
8	745,320	2,341,122	514,736	290,206	2,353,474	1,020,789	1,164,323	191,718	367,913
9	474,994	3,722,415	576,100	294,572	928,618	627,615	617,259	70,412	179,019
10	383,316	1,663,880	268,615	603,853	748,928	540,627	474,097	46,313	228,546
11	455,394	1,148,334	253,944	523,611	573,984	2,472,883	496,022	111,504	266,186
12	900,039	1,169,177	371,575	301,193	416,323	1,229,444	331,823	200,846	369,018
13	888,055	1,004,988	403,092	405,146	353,090	668,764	588,042	92,684	296,681
14	1,251,141	1,080,766	224,522	553,271	219,216	306,908	384,535	93,131	266,709
15	1,013,324	933,723	365,190	554,201	24,770	390,237	583,973	72,108	253,579
16	1,036,159	914,997	240,000	290,312	129,282	541,074	442,703	49,274	220,007
17	551,481	738,255	192,922	210,758	20,177	47,713	442,686	71,836	148,661
18	939,938	592,137	220,671	284,327	9,974	130,796	339,970	69,013	213,617
19	976,370	418,312	0	189,918	36,992	82,358	407,549	64,931	98,155
20	768,559	320,882	0	265,433	20,936	213,467	49,590	66,921	85,925
21	406,035	171,105	64,715	263,709	49,188	148,865	223,090	45,266	110,451
22	139,400	108,387	0	213,783	23,570	105,234	94,158	36,720	94,398
23	98,700	58,304	0	217,418	119,073	77,359	205,193	38,776	90,737
24	7,982	17,428	0	200,765	132,707	142,147	39,458	50,639	72,252
25	54,337	15,899	0	3,163,096	2,195,421	1,725,477	3,439,282	647,245	983,431

Table 7. POP, triennial and AFSC survey size compostion data (numbers (1977-1995) and proportions(1996-2000)).

	1977	1979	1980	1983	1986	1995	1996	1997	1999	2000
17	2,584	3,117	0	1,473	6,506	2,906	0.0005	0.0029	0	0.0022
18	6,140	7,630	3,679	23,991	53,295	11,052	0.0016	0	0	0.0012
19	43,904	0	2,620	81,723	41,690	15,612	0.0121	0.0071	0	0.0012
20	27,326	5,123	4,929	112,702	104,521	12,741	0.013	0.013	0.0027	0.0166
21	39,782	5,490	1,602	39,004	83,053	13,768	0.0092	0.0453	0	0.0104
22	60,688	14,459	19,007	48,154	33,164	15,787	0.0033	0.0471	0.0042	0
23	111,235	27,669	16,276	66,084	41,216	41,237	0.0009	0.1149	0.0027	0.0006
24	76,141	62,293	70,625	89,355	36,240	55,680	0.0006	0.1715	0.0116	0.0019
25	67,469	75,040	58,952	61,353	55,261	150,256	0.0011	0.226	0.0174	0.0006
26	71,551	113,413	75,296	92,155	101,218	295,345	0.0025	0.076	0.0137	0
27	123,024	164,058	112,373	59,602	289,455	282,386	0.0036	0.0236	0.0261	0
28	137,833	285,927	112,882	56,398	248,178	220,504	0.0081	0.0059	0.0228	0.0012
29	147,907	325,469	185,941	34,134	276,130	114,244	0.0506	0.0049	0.024	0.0019
30	188,555	251,458	317,137	57,269	341,303	193,641	0.0442	0.0157	0.0289	0.0019
31	434,441	443,636	291,127	55,976	272,989	142,663	0.0818	0.0203	0.0198	0.0278
32	787,543	725,956	423,489	44,155	184,777	149,017	0.0317	0.0384	0.0249	0.0382
33	1,065,585	1,366,737	217,998	84,491	229,861	111,459	0.0416	0.0202	0.0647	0.0902
34	924,884	2,156,232	237,176	91,813	170,925	169,644	0.0365	0.0128	0.1102	0.1714
35	641,234	2,242,299	293,713	179,254	264,174	205,715	0.0603	0.0365	0.1415	0.1304
36	649,319	2,073,524	267,499	264,220	96,217	369,945	0.0753	0.029	0.16	0.122
37	764,075	1,642,703	377,084	358,488	138,885	497,226	0.0958	0.0251	0.1045	0.1684
38	788,588	1,525,133	365,442	456,473	190,770	553,446	0.1081	0.0252	0.1018	0.0915
39	938,366	1,436,646	360,172	592,849	172,037	385,388	0.1128	0.0167	0.0524	0.0381
40+	7,431,350	3,916,376	2,902,115	4,300,601	860,253	1,828,881	0.2049	0.022	0.0628	0.0821

Table 8. Biomass indices (and associated coefficients of variance, expressed as percentages) from the triennial surveys by INPFC area (1977-2001).

Area/Year	Depth (m)	Biomass Estimates	Sampling CV
US Vancouver			
1977	91-366	7,589	64.8%
1980	55-366	3,128	53.7%
1983	55-366	3,786	37.6%
1986	55-366	1,214	38.3%
1989	55-366	7,719	55.3%
1992	55-366	5,358	65.4%
1995	55-500	3,555	63.0%
1998	55-500	4,495	45.0%
2001	55-500	1,110	49.0%
Columbia			
1977	91-366	6,656	22.5%
1980	55-366	3,340	81.4%
1983	55-366	2,947	43.4%
1986	55-366	1,583	69.8%
1989	55-366	1,536	53.9%
1992	55-366	2,243	45.7%
1995	55-500	761	28.0%
1998	55-500	3,084	43.0%
2001	55-500	1,710	56.2%

Table 9. Biomass indices (and associated coefficients of variance, expressed as percentages) from slope groundfish surveys for combined US Vancouver and Columbia INPFC areas (1979-2002).

Year/Survey	Depth (m)	Biomass Estimates	Sampling CV
1979 POP	165-475	16,044	29.6%
1985 POP	165-475	10,696	20.1%
"1992" AFSC	183-1280	6,971	37.7%
1996 AFSC	183-1280	4,730	30.5%
1997 AFSC	183-1280	2,146	38.5%
1999 AFSC	183-1280	8,857	50.9%
2000 AFSC	183-1280	2,465	51.9%
2001 AFSC	183-1280	9,675	78.0%
1999 NWFSC	183-1280	2,651	51.0%
2000 NWFSC	183-1280	2,556	56.7%
2001 NWFSC	183-1280	5,269	45.8%
2002 NWFSC	183-1280	3,770	55.4%

Table 10. List of the data sources and associated time periods used in present assessment.

Data Source	Years
Fishery Catch	1956-2002
Fishery age-composition data	1966-80 (biased); 1999-2002 (unbiased)
Fishery size-composition data	1981-99, 1994-98
Fishery CPUE	1956-73
Biomass estimates	
Triennial survey	1977,1980,1983,1986,1989,1992,1995,1998,2001
POP/Rockfish survey	1979,1985
AFSC slope survey	"1992", 1996, 1997, 1999-2001
NWFSC slope survey	1999-2002
Survey age-composition data	
Triennial survey	1989, 1992, 1998, 2001
POP / NWFSC slope surveys	1985, 2002
Survey size-composition data	
Triennial survey	1977, 1980, 1983, 1986, 1995
POP / NWFSC / AFSC slope surveys	1979, 1996, 1997, 1999, 2000

Table 11. Model parameters, equations, and likelihood components. The symbols i, j and k_i denote year (1956-2002), age (3-25) and the selectivity group (0-8) to which year i relates.

(a) The "free" parameters of the population dynamics model, the prior distributions assumed for them, and their ADMB phase. For parameters that are vectors, the length of the parameter vector is given. Priors indicated by asterisks are modified in the tests of sensitivity.

Parameter	Symbol	Length	Prior	Phase
Average recruitment	$\overline{R}$		Log-Uniform(-∞,∞)	1
Unfished equilibrium recruitment	R_0		Log-Uniform(-∞,∞)	1
CPUE catchability	q^f		Log-Uniform(-∞,∞)	1
Triennial survey catchability	q^T		Log-Uniform(-∞,∞)	6
POP survey catchability	q^P		Log-Uniform(-∞,∞)	6
AFSC survey catchability	q^A		Log-Uniform(-∞,∞)	6
NWFSC survey catchability	q^N		Log-Uniform(-∞,∞)	6
Natural mortality	M		Lognormal(.5,.1)	6
Stock-recruitment steepness	h		Uniform(.21,0.99)	7
Average fishing mortality	$\overline{F}$		Log-Uniform(-∞,∞)	1
Recruitment deviation	ε_i^R	68	Log-Uniform(-10,10)	3
Fishing mortality deviation	ε_i^F	47	Log-Uniform(-10,10)	2
Triennial survey selectivity-at-age	s_j^T	10	Log-Uniform(-∞,∞)	4
Slope survey selectivity-at-age	s_j^{Sl}	10	Log-Uniform(-∞,∞)	4
Fishery selectivity-at-age in first year of fishery	$s_{1956,j}^F$	12	Log-Uniform(-∞,∞)	2
Fishery selectivity deviations (every 6 years)	$\varsigma_{k_i,j}^F$	96 (12*8)	Log-Uniform(-5,5)	3

(Table 11 Continued).

(b) The pre-specified parameters of the model (baseline model). Values indicated by asterisks are modified in the tests of sensitivity.

Parameter	Symbol	Value
Plus-group age	$a_{\max}$	25
Age beyond which fishery selectivity is constant	a_S^F	14*
Age beyond which survey selectivity is constant	a_S^S	12
Probability an animal of age *j* is in length-class	$A_{j,l}$	Fig. 8
Probability an animal of age *j* is aged to be *j*'.	$B_{j,j'}$	Fig. 9*
Weight-at-age	W_j	Fig. 7
Age-at-50%-maturity	μ	8*
Extent of auto-correlation in recruitment	ρ	0*
Extent of variability in recruitment	σ_R	1.0*
Number of years in a grouping for time-varying fishery selectivity	g	6*
Weighting factors		
CPUE cv	τ	0.2
Catch biomass weight	λ_1	100
Age/size data weight	λ_3	1
Fishing mortality regularity weight	λ_5	0.1
Selectivity prior overall weight	λ_6	1
Fishery selectivity dome-shapedness penalty	λ_8	20
Fishery selectivity temporal penalty	λ_9	20
Selectivity curvature penalty	λ_{10}	20
Effective sample size		
Fishery age-composition	n_i^F	50
Fishery size-composition	m_i^F	50
Survey age-composition	n_i^S	50
Survey size-composition	m_i^S	25

(Table 11 Continued)

(c) The derived quantities

Quantity	Equation
Virgin Biomass	$B_0 = R_0(1, e^{-M}, e^{-2M}, \ldots, e^{-21M}, \frac{e^{-22M}}{1-e^{-M}}) \cdot \vec{W}$
Fishery selectivity-at-age	$s_{i,j}^F = s_{1956,j}^F \varsigma_{k_i,j}^F$
Fishing mortality rate	$F_{i,j} = \overline{F} \varepsilon_i^F s_{i,j}^F$
Total mortality rate	$Z_{i,j} = F_{i,j} + M$
Annual survival rate	$S_{i,j} = e^{-Z_{i,j}}$
Number at age	$N_{i,j} = \begin{cases} \overline{R}\varepsilon_i^R & j=3 \\ N_{i-1,j-1}S_{i-1,j-1} & 4 \le j \le 23 \\ N_{i-1,24}S_{i-1,24} + N_{i-1,25}S_{i-1,25} & j=25 \end{cases}$
Maturity-at-age	$\theta_j = 0.5[1+\exp(-2(j+2-\mu))]^{-1}$
Spawning biomass	$B_i = \sum_{j=3}^{x} N_{i,j}\, \theta_j\, W_j$
Predicted recruitment	$\hat{R}_i = \frac{B_{i-3}}{\alpha + \beta B_{i-3}}$; $\alpha = \frac{B_0}{R_0}\frac{1-h}{4h}$; $\beta = \frac{5h-1}{4hR_0}$
Recruitment anomaly	$\xi_i = \ln(\frac{N_{i,3} + 0.00000001^{*}}{\hat{R}_i + 0.00000001})$

* constants added to avoid ln(0) or dividing by 0.

(Table 11 Continued)

(d) Model predictions

Data Type	Symbol	Model prediction
Triennial survey abundance index i=1977,80,83,86,89,92,95,98,2001	Y_i^T	$\hat{Y}_i^T = q^T \sum_{j=3}^{x} s_{i,j}^T W_j N_{i,j}$
POP survey index i = 1979, 1985	Y_i^P	$\hat{Y}_i^P = q^P \sum_{j=3}^{x} s_{i,j}^{Sl} W_j N_{i,j}$
AFSC slope survey index i= 1992, 96, 97, 99, 2000, 2001	Y_i^A	$\hat{Y}_i^A = q^A \sum_{j=3}^{x} s_{i,j}^{Sl} W_j N_{i,j}$
NWFSC slope survey index i= 1999, 2000, 2001, 2002	Y_i^N	$\hat{Y}_i^N = q^N \sum_{j=3}^{x} s_{i,j}^N W_j N_{i,j}$
Historical CPUE index i = 1956, 1957, ... 1973	Y_i^f	$\hat{Y}_i^f = q^f \sum_{j=3}^{x} s_{i,j}^F W_j N_{i,j}$
Catch biomass i=1956, …, 2002	C_i	$\hat{C}_i = \sum_{j=3}^{x} W_j N_{i,j} \frac{F_{i,j}}{Z_{i,j}}(1-e^{-Z_{i,j}})$
Proportions at age (fishery or survey)	$P_{i,j}^{F/S}$	$\hat{P}_{i,j}^l = \frac{\sum_{j'=3}^{x} N_{i,j} s_{i,j'}^{F/S} B_{j,j'}}{\sum_{j''=3}^{x} N_{i,j''} s_{i,j''}^{F/S}}$
Proportions at length (fishery or survey)	$L_{i,j}^{F/S}$	$\hat{L}_{i,j}^l = \frac{\sum_{j'=3}^{x} N_{i,j} s_{i,j'}^{F/S} A_{j',l}}{\sum_{j''=3}^{x} N_{i,j''} s_{i,j''}^{F/S}}$

(Table 11 Continued)

(e) Components of the objective function (data-related); v denotes the number of years for which each data-type is available.

Component	Data type
$L_1 = \frac{v}{2}\ln(\pi/\lambda_1) + \lambda_1 \sum_i \ln((C_i + 0.01^*)/(\hat{C}_i + 0.01))^2$	Catch biomass
$L_2 = \frac{1}{2}(v\ln(2\pi\tau^2) + \sum_i \ln(Y_i^f/\hat{Y}_i^f)^2\tau^{-2})$	Cpue index
$L_3 = \frac{1}{2}\sum_{t=T,P,A,N}\sum_i \left(\ln(2\pi\ln(1+(\frac{\sigma_i^t}{Y_i^t})^2)^2) + \frac{\ln(Y_i^t/\hat{Y}_i^t)^2}{\ln(1+(\frac{\sigma_i^t}{Y_i^t})^2)^2}\right)$	Survey index (by survey type)
$L_5 = \frac{1}{2}\sum_{i,j} n_i^{F/S}\{\ln(\pi/\lambda_3) + \ln(\frac{0.1}{23} + \hat{P}_{i,j}^{F/S}(1-\hat{P}_{i,j}^{F/S}))\} + \lambda_3\sum_{i,j}\ln\left[\exp\left(\frac{n_i(P_{i,j}^{F/S} - \hat{P}_{i,j}^{F/S})^2}{2(\frac{0.1}{23} + \hat{P}_{i,j}^{F/S}(1-\hat{P}_{i,j}^{F/S}))}\right) + 0.01\right]^{**}$	Fishery and survey age data
$L_5 = \frac{1}{2}\sum_{i,j} m_i^{F/S}\{\ln(\pi/\lambda_3) + \ln(\frac{0.1}{24} + \hat{L}_{i,j}^{F/S}(1-\hat{L}_{i,j}^{F/S}))\} + \lambda_3\sum_{i,j}\ln\left[\exp\left(\frac{n_i(L_{i,j}^{F/S} - \hat{L}_{i,j}^{F/S})^2}{2(\frac{0.1}{24} + \hat{L}_{i,j}^{F/S}(1-\hat{L}_{i,j}^{F/S}))}\right) + 0.01\right]^{**}$	Fishery and survey size data

* constants added to avoid ln(0) or dividing by 0.

** This formulation is different than that of Fournier et al (1998), as we use the expected proportions instead of the observed proportions for calculating the variance. This reflects the unused robust likelihood code in the 2000 assessment model. Only a small difference exists between the results using this formulation and using that of Fournier et al. (1998). While the current formulation has been used in other stock assessments, we recommend changing the variance calculation to use the observed proportions in future West Coast Pacific ocean perch assessments.

(Table 11 Continued)

(f) Components of the objective function (priors)

Component	Parameter
$P_1 = \frac{n}{2}\ln(2\pi\sigma_R^2) + \sum_{i \ge 1935} \frac{(\xi_i - \rho\xi_{i-1})^2}{2(1-\rho^2)\sigma_R^2}$	Recruitment anomalies
$P_2 = 0.001\lambda_5 \sum_i \ln(\varepsilon_i^F)^2$	Fishing Mortality regularity
$P_{3a} = \lambda_6\lambda_{10} \sum_{w=T,SI} \sum_j \ln\left(\frac{s_j^w s_{j+2}^w}{(s_{j+1}^w)^2}\right)^2$	Selectivity curvature penalty for survey selectivities
$P_{3b} = \frac{\lambda_6\lambda_{10}}{9} \sum_k \sum_j \ln\left(\frac{s_{k,j}^F s_{k,j+2}^F}{(s_{k,j+1}^F)^2}\right)^2$	Selectivity curvature penalty for fishery selectivities
$P_{3c} = \lambda_6\lambda_8 \sum_k \sum_{j=3}^{a_m^s - 1} \min(0, \ln(s_{k,j}^F / s_{k,j+1}^F)^2$	Penalty for fishery selectivity dome-shapedness
$P_{3c} = \frac{\lambda_6\lambda_9}{g} \sum_{k=1}^{8} \sum_j \ln(s_{k-1,j}^F / s_{k,j}^F)^2$	Penalty for changes between groups of (m) years for fishery selectivity
$P_4 = \frac{\ln(2\pi)}{2} + \ln(0.1) + \frac{(\ln(M/0.05))^2}{0.02}$	Natural mortality

Table 12. Point estimates of the numbers at age (millions of fish) for the US west coast population of Pacific ocean perch (1956-2003) based on Model 1.

	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	
56	3.90	6.94	5.58	4.56	3.84	3.35	3.02	2.80	2.65	2.54	2.43	2.32	2.21	2.11	2.01	1.91	1.82	1.74	1.65	1.58	1.51	1.44	
57	46.84	3.70	6.58	5.29	4.32	3.63	3.16	2.83	2.60	2.44	2.33	2.23	2.13	2.03	1.93	1.84	1.75	1.67	1.59	1.52	1.45	1.38	30.96
58	4.41	44.43	3.51	6.24	5.01	4.08	3.42	2.95	2.62	2.38	2.23	2.12	2.03	1.94	1.85	1.76	1.68	1.60	1.52	1.45	1.38	1.32	29.50
59	19.18	4.18	42.15	3.33	5.92	4.74	3.85	3.21	2.75	2.43	2.20	2.05	1.96	1.88	1.79	1.71	1.63	1.55	1.48	1.41	1.34	1.28	28.49
60	9.26	18.20	3.97	39.97	3.15	5.60	4.47	3.61	2.99	2.54	2.22	2.02	1.89	1.80	1.73	1.65	1.57	1.50	1.42	1.36	1.29	1.23	27.32
61	4.42	8.78	17.26	3.76	37.86	2.98	5.27	4.18	3.34	2.73	2.31	2.02	1.84	1.72	1.64	1.57	1.50	1.43	1.36	1.30	1.24	1.18	26.00
62	3.82	4.19	8.33	16.36	3.56	35.69	2.79	4.86	3.79	2.97	2.40	2.03	1.78	1.62	1.51	1.45	1.39	1.32	1.26	1.20	1.14	1.09	23.95
63	5.20	3.62	3.97	7.89	15.46	3.35	33.17	2.54	4.33	3.27	2.53	2.04	1.73	1.52	1.38	1.29	1.23	1.18	1.13	1.08	1.03	0.98	21.38
64	15.43	4.93	3.44	3.76	7.45	14.50	3.09	30.05	2.24	3.66	2.70	2.09	1.71	1.45	1.27	1.16	1.08	1.03	0.99	0.94	0.90	0.86	18.72
65	11.16	14.63	4.67	3.25	3.55	7.00	13.46	2.82	26.77	1.93	3.08	2.28	1.79	1.46	1.24	1.09	0.99	0.92	0.88	0.84	0.81	0.77	16.69
66	7.29	10.59	13.87	4.43	3.07	3.33	6.45	12.11	2.46	22.23	1.56	2.50	1.88	1.47	1.20	1.02	0.89	0.81	0.76	0.72	0.69	0.66	14.35
67	4.95	6.92	10.03	13.09	4.14	2.81	2.91	5.29	9.10	1.62	13.57	0.96	1.60	1.20	0.94	0.77	0.65	0.57	0.52	0.48	0.46	0.44	9.60
68	3.64	4.70	6.55	9.46	12.24	3.79	2.47	2.41	4.02	6.09	1.01	8.56	0.63	1.04	0.78	0.61	0.50	0.42	0.37	0.34	0.32	0.30	6.54
69	4.14	3.45	4.45	6.19	8.89	11.33	3.41	2.13	1.96	3.01	4.34	0.72	6.28	0.46	0.76	0.57	0.45	0.37	0.31	0.27	0.25	0.23	5.02
70	2.98	3.93	3.28	4.22	5.86	8.39	10.63	3.16	1.94	1.75	2.69	3.91	0.66	5.74	0.42	0.70	0.52	0.41	0.33	0.28	0.25	0.23	4.80
71	4.07	2.83	3.72	3.10	3.99	5.50	7.80	9.69	2.79	1.66	1.50	2.33	3.48	0.59	5.10	0.37	0.62	0.47	0.36	0.30	0.25	0.22	4.46
72	5.33	3.86	2.68	3.53	2.93	3.75	5.14	7.16	8.66	2.43	1.44	1.32	2.10	3.12	0.53	4.58	0.34	0.56	0.42	0.33	0.27	0.23	4.21
73	7.58	5.06	3.66	2.54	3.34	2.77	3.52	4.76	6.51	7.73	2.17	1.30	1.20	1.91	2.85	0.48	4.18	0.31	0.51	0.38	0.30	0.24	4.05
74	4.10	7.19	4.79	3.47	2.40	3.15	2.59	3.24	4.27	5.70	6.76	1.92	1.17	1.09	1.73	2.57	0.43	3.77	0.28	0.46	0.34	0.27	3.87
75	1.33	3.88	6.82	4.54	3.28	2.27	2.94	2.39	2.93	3.78	5.04	6.06	1.75	1.06	0.99	1.57	2.34	0.40	3.43	0.25	0.42	0.31	3.76
76	1.15	1.26	3.68	6.47	4.30	3.09	2.11	2.70	2.17	2.64	3.43	4.61	5.60	1.61	0.98	0.91	1.45	2.16	0.37	3.17	0.23	0.39	3.77
77	1.38	1.09	1.20	3.49	6.10	4.02	2.84	1.90	2.40	1.91	2.33	3.07	4.21	5.11	1.47	0.90	0.83	1.32	1.97	0.33	2.89	0.21	3.79
78	1.81	1.31	1.03	1.13	3.30	5.73	3.73	2.60	1.71	2.15	1.71	2.12	2.83	3.87	4.70	1.36	0.83	0.77	1.22	1.81	0.31	2.66	3.68
79	1.12	1.71	1.24	0.98	1.07	3.07	5.23	3.31	2.26	1.48	1.86	1.51	1.92	2.55	3.49	4.24	1.22	0.75	0.69	1.10	1.64	0.28	5.72
80	0.88	1.06	1.62	1.17	0.92	1.00	2.81	4.67	2.90	1.96	1.29	1.65	1.37	1.73	2.31	3.16	3.84	1.11	0.67	0.63	0.99	1.48	5.43
81	1.45	0.83	1.01	1.54	1.11	0.86	0.91	2.51	4.08	2.51	1.70	1.14	1.49	1.24	1.57	2.09	2.86	3.47	1.00	0.61	0.57	0.90	6.25
82	2.76	1.38	0.79	0.96	1.45	1.04	0.80	0.83	2.28	3.70	2.28	1.54	1.02	1.34	1.11	1.41	1.87	2.57	3.12	0.90	0.55	0.51	6.41
83	2.18	2.62	1.31	0.75	0.91	1.37	0.97	0.74	0.77	2.09	3.40	2.09	1.40	0.93	1.22	1.01	1.28	1.70	2.33	2.83	0.82	0.50	6.30
84	5.18	2.07	2.48	1.24	0.70	0.85	1.26	0.88	0.66	0.68	1.86	3.02	1.83	1.23	0.81	1.07	0.89	1.12	1.49	2.05	2.48	0.72	5.96
85	1.02	4.91	1.97	2.35	1.17	0.66	0.78	1.15	0.79	0.59	0.61	1.66	2.66	1.61	1.08	0.72	0.94	0.78	0.99	1.32	1.80	2.19	5.88
86	1.19	0.96	4.66	1.86	2.22	1.10	0.61	0.71	1.03	0.70	0.53	0.55	1.47	2.35	1.42	0.95	0.63	0.83	0.69	0.87	1.16	1.59	7.11
87	2.13	1.13	0.91	4.41	1.76	2.09	1.02	0.55	0.64	0.92	0.63	0.47	0.48	1.29	2.07	1.25	0.84	0.56	0.73	0.61	0.77	1.02	7.68
88	4.80	2.02	1.07	0.87	4.17	1.65	1.93	0.92	0.50	0.57	0.83	0.57	0.42	0.43	1.16	1.85	1.12	0.75	0.50	0.65	0.54	0.69	7.79
89	0.74	4.55	1.92	1.01	0.82	3.89	1.51	1.73	0.82	0.44	0.50	0.73	0.50	0.37	0.38	1.02	1.62	0.98	0.66	0.44	0.57	0.48	7.43
90	2.65	0.71	4.31	1.82	0.96	0.76	3.56	1.35	1.52	0.71	0.38	0.44	0.63	0.43	0.32	0.33	0.88	1.41	0.86	0.58	0.38	0.50	6.89
91	3.13	2.51	0.67	4.09	1.71	0.90	0.70	3.23	1.21	1.36	0.64	0.34	0.39	0.56	0.38	0.29	0.29	0.79	1.26	0.76	0.51	0.34	6.57
92	1.38	2.97	2.38	0.63	3.85	1.60	0.82	0.63	2.82	1.05	1.18	0.56	0.30	0.34	0.49	0.33	0.25	0.25	0.68	1.09	0.66	0.44	[illegible]
93	6.30	1.31	2.82	2.25	0.60	3.60	1.47	0.74	0.55	2.49	0.93	1.04	0.49	0.26	0.30	0.43	0.29	0.22	0.22	0.60	0.96	0.58	
94	2.15	5.98	1.24	2.67	2.11	0.55	3.19	1.27	0.63	0.47	2.14	0.81	0.91	0.43	0.23	0.26	0.38	0.26	0.19	0.20	0.52	0.84	[illegible]
95	1.65	2.04	5.67	1.17	2.51	1.95	0.49	2.80	1.10	0.55	0.42	1.89	0.72	0.81	0.38	0.20	0.23	0.33	0.23	0.17	0.17	0.47	5.59
96	0.66	1.56	1.93	5.37	1.10	2.33	1.77	0.44	2.47	0.97	0.48	0.37	1.70	0.64	0.73	0.34	0.18	0.21	0.30	0.20	0.15	0.16	5.44
97	5.06	0.62	1.48	1.83	5.05	1.02	2.11	1.58	0.39	2.19	0.87	0.43	0.33	1.53	0.58	0.66	0.31	0.16	0.19	0.27	0.18	0.14	5.03
98	4.28	4.80	0.59	1.40	1.73	4.71	0.94	1.91	1.41	0.35	1.97	0.78	0.39	0.30	1.39	0.53	0.60	0.28	0.15	0.17	0.25	0.17	4.70
99	0.67	4.06	4.56	0.56	1.32	1.61	4.33	0.85	1.71	1.27	0.31	1.79	0.71	0.36	0.28	1.27	0.48	0.54	0.25	0.14	0.16	0.22	4.44
00	0.80	0.64	3.85	4.32	0.53	1.24	1.49	3.95	0.77	1.56	1.16	0.29	1.65	0.66	0.33	0.25	1.16	0.44	0.50	0.23	0.13	0.14	4.29
01	1.89	0.76	0.60	3.65	4.09	0.50	1.17	1.40	3.70	0.72	1.46	1.09	0.27	1.55	0.62	0.31	0.24	1.10	0.42	0.47	0.22	0.12	4.17
02	2.46	1.79	0.72	0.57	3.45	3.85	0.47	1.09	1.30	3.44	0.67	1.36	1.02	0.25	1.45	0.58	0.29	0.22	1.02	0.39	0.44	0.21	4.01
03	2.46	2.34	1.70	0.68	0.54	3.26	3.62	0.44	1.02	1.21	3.21	0.63	1.28	0.96	0.24	1.36	0.54	0.27	0.21	0.96	0.36	0.41	3.95

Table 13. Point estimates of the catch-at-age (millions of fish) for the US west coast population of Pacific ocean perch (1956-2002) based on Model 1.

	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25+
1956	0.000	0.001	0.002	0.005	0.011	0.021	0.035	0.053	0.070	0.080	0.080	0.077	0.073	0.070	0.067	0.063	0.060	0.058	0.055	0.052	0.050	0.048	1.073
1957	0.003	0.001	0.003	0.007	0.015	0.027	0.044	0.065	0.086	0.095	0.090	0.083	0.079	0.076	0.072	0.069	0.065	0.062	0.059	0.057	0.054	0.052	1.157
1958	0.000	0.006	0.001	0.006	0.011	0.020	0.032	0.046	0.058	0.062	0.058	0.054	0.051	0.049	0.047	0.045	0.042	0.040	0.038	0.037	0.035	0.033	0.745
1959	0.001	0.001	0.019	0.004	0.017	0.030	0.046	0.063	0.077	0.080	0.072	0.065	0.062	0.060	0.057	0.054	0.052	0.049	0.047	0.045	0.043	0.041	0.905
1960	0.001	0.004	0.002	0.059	0.011	0.043	0.065	0.087	0.103	0.103	0.090	0.079	0.074	0.070	0.067	0.064	0.061	0.058	0.056	0.053	0.050	0.048	1.066
1961	0.001	0.003	0.017	0.010	0.243	0.041	0.137	0.179	0.204	0.196	0.165	0.140	0.127	0.119	0.113	0.109	0.103	0.099	0.094	0.090	0.085	0.081	1.795
1962	0.001	0.002	0.012	0.062	0.033	0.706	0.104	0.297	0.327	0.301	0.242	0.198	0.174	0.158	0.148	0.141	0.135	0.129	0.123	0.117	0.112	0.106	2.339
1963	0.001	0.002	0.007	0.037	0.177	0.082	1.457	0.177	0.461	0.417	0.312	0.234	0.199	0.175	0.158	0.148	0.142	0.136	0.129	0.123	0.118	0.112	2.451
1964	0.003	0.003	0.005	0.015	0.073	0.303	0.116	1.788	0.205	0.401	0.287	0.206	0.168	0.143	0.126	0.114	0.107	0.102	0.098	0.093	0.089	0.085	1.843
1965	0.003	0.010	0.009	0.017	0.047	0.196	0.677	0.224	3.253	0.279	0.433	0.298	0.233	0.191	0.162	0.142	0.129	0.120	0.115	0.110	0.105	0.100	2.180
1966	0.005	0.020	0.075	0.064	0.109	0.249	0.850	2.455	0.733	7.740	0.527	0.794	0.596	0.466	0.381	0.323	0.284	0.258	0.241	0.230	0.220	0.210	4.559
1967	0.003	0.013	0.052	0.181	0.141	0.201	0.368	1.030	2.612	0.544	4.435	0.295	0.489	0.367	0.287	0.235	0.199	0.175	0.159	0.148	0.142	0.136	2.939
1968	0.002	0.006	0.023	0.089	0.285	0.187	0.217	0.330	0.828	1.483	0.239	1.888	0.138	0.230	0.172	0.135	0.110	0.093	0.082	0.074	0.070	0.067	1.443
1969	0.000	0.001	0.004	0.014	0.048	0.127	0.076	0.083	0.112	0.171	0.207	0.026	0.227	0.017	0.028	0.021	0.016	0.013	0.011	0.010	0.009	0.008	0.181
1970	0.000	0.002	0.005	0.017	0.056	0.164	0.411	0.214	0.190	0.171	0.221	0.245	0.041	0.359	0.026	0.044	0.033	0.026	0.021	0.018	0.016	0.014	0.300
1971	0.001	0.001	0.004	0.010	0.031	0.088	0.247	0.541	0.226	0.134	0.101	0.120	0.179	0.030	0.262	0.019	0.032	0.024	0.019	0.015	0.013	0.011	0.230
1972	0.000	0.001	0.002	0.008	0.016	0.043	0.117	0.287	0.504	0.141	0.070	0.049	0.077	0.115	0.019	0.169	0.012	0.021	0.015	0.012	0.010	0.008	0.155
1973	0.001	0.002	0.004	0.008	0.024	0.041	0.104	0.248	0.491	0.582	0.137	0.062	0.058	0.092	0.137	0.023	0.200	0.015	0.024	0.018	0.014	0.012	0.194
1974	0.000	0.002	0.005	0.009	0.015	0.040	0.066	0.145	0.279	0.371	0.370	0.080	0.048	0.045	0.071	0.106	0.018	0.156	0.011	0.019	0.014	0.011	0.160
1975	0.000	0.001	0.007	0.015	0.029	0.044	0.094	0.102	0.139	0.169	0.180	0.151	0.044	0.027	0.025	0.039	0.058	0.010	0.085	0.006	0.010	0.008	0.094
1976	0.000	0.001	0.006	0.032	0.058	0.090	0.101	0.173	0.154	0.177	0.183	0.173	0.210	0.061	0.037	0.034	0.054	0.081	0.014	0.119	0.009	0.014	0.141
1977	0.000	0.000	0.001	0.013	0.062	0.088	0.103	0.092	0.129	0.097	0.095	0.087	0.119	0.145	0.042	0.025	0.024	0.038	0.056	0.009	0.082	0.006	0.108
1978	0.000	0.001	0.002	0.007	0.057	0.213	0.228	0.211	0.155	0.183	0.117	0.102	0.136	0.186	0.226	0.065	0.040	0.037	0.058	0.087	0.015	0.128	0.177
1979	0.000	0.001	0.002	0.006	0.017	0.106	0.297	0.251	0.190	0.117	0.118	0.067	0.085	0.114	0.156	0.189	0.055	0.033	0.031	0.049	0.073	0.012	0.255
1980	0.000	0.001	0.003	0.007	0.015	0.035	0.164	0.363	0.250	0.159	0.084	0.076	0.063	0.079	0.106	0.145	0.176	0.051	0.031	0.029	0.046	0.068	0.249
1981	0.000	0.000	0.001	0.005	0.009	0.017	0.030	0.105	0.172	0.105	0.075	0.060	0.079	0.066	0.083	0.111	0.152	0.184	0.053	0.032	0.030	0.048	0.331
1982	0.000	0.000	0.001	0.002	0.009	0.015	0.020	0.026	0.073	0.117	0.076	0.062	0.041	0.054	0.045	0.057	0.075	0.103	0.126	0.036	0.022	0.020	0.258
1983	0.000	0.001	0.002	0.003	0.011	0.037	0.045	0.043	0.045	0.122	0.210	0.155	0.104	0.069	0.090	0.075	0.095	0.126	0.173	0.210	0.061	0.037	0.466
1984	0.001	0.001	0.003	0.005	0.008	0.022	0.056	0.048	0.037	0.038	0.109	0.211	0.128	0.086	0.057	0.075	0.062	0.078	0.105	0.143	0.174	0.050	0.417
1985	0.000	0.002	0.003	0.010	0.013	0.017	0.034	0.062	0.043	0.032	0.035	0.114	0.182	0.110	0.074	0.049	0.064	0.053	0.068	0.090	0.123	0.150	0.402
1986	0.000	0.000	0.006	0.008	0.024	0.027	0.026	0.038	0.055	0.038	0.030	0.037	0.099	0.159	0.096	0.065	0.043	0.056	0.047	0.059	0.078	0.107	0.481
1987	0.000	0.000	0.001	0.018	0.020	0.050	0.040	0.028	0.034	0.049	0.033	0.027	0.027	0.073	0.116	0.070	0.047	0.031	0.041	0.034	0.043	0.057	0.431
1988	0.001	0.001	0.002	0.005	0.061	0.052	0.101	0.062	0.035	0.040	0.057	0.042	0.031	0.032	0.085	0.136	0.082	0.055	0.037	0.048	0.040	0.050	0.571
1989	0.000	0.003	0.004	0.006	0.013	0.133	0.086	0.126	0.062	0.033	0.038	0.058	0.040	0.030	0.030	0.081	0.130	0.078	0.053	0.035	0.046	0.038	0.593
1990	0.000	0.000	0.006	0.008	0.012	0.020	0.154	0.075	0.088	0.041	0.022	0.027	0.038	0.026	0.020	0.020	0.054	0.086	0.052	0.035	0.023	0.030	0.418
1991	0.001	0.002	0.001	0.026	0.029	0.032	0.042	0.250	0.098	0.108	0.051	0.029	0.033	0.048	0.033	0.024	0.025	0.067	0.106	0.064	0.043	0.029	0.556
1992	0.000	0.002	0.004	0.003	0.055	0.049	0.042	0.041	0.194	0.071	0.080	0.040	0.021	0.024	0.035	0.024	0.018	0.018	0.049	0.078	0.047	0.032	0.430
1993	0.001	0.001	0.008	0.024	0.019	0.227	0.131	0.073	0.053	0.226	0.078	0.079	0.037	0.020	0.023	0.032	0.022	0.017	0.017	0.045	0.073	0.044	0.428
1994	0.000	0.004	0.003	0.023	0.054	0.028	0.233	0.103	0.049	0.035	0.146	0.050	0.056	0.026	0.014	0.016	0.023	0.016	0.012	0.012	0.032	0.052	0.337
1995	0.000	0.001	0.012	0.008	0.054	0.085	0.030	0.193	0.073	0.034	0.024	0.098	0.037	0.042	0.020	0.011	0.012	0.017	0.012	0.009	0.009	0.024	0.291
1996	0.000	0.001	0.004	0.038	0.023	0.099	0.107	0.030	0.161	0.060	0.027	0.019	0.086	0.033	0.037	0.017	0.009	0.011	0.015	0.010	0.008	0.008	0.277
1997	0.001	0.000	0.002	0.010	0.083	0.034	0.100	0.083	0.020	0.105	0.038	0.017	0.013	0.061	0.023	0.026	0.012	0.007	0.007	0.011	0.007	0.005	0.201
1998	0.000	0.002	0.001	0.007	0.027	0.150	0.043	0.097	0.070	0.016	0.084	0.030	0.015	0.012	0.053	0.020	0.023	0.011	0.006	0.007	0.009	0.006	0.181
1999	0.000	0.001	0.006	0.003	0.017	0.040	0.159	0.036	0.071	0.050	0.011	0.052	0.021	0.010	0.008	0.037	0.014	0.016	0.007	0.004	0.005	0.007	0.129
2000	0.000	0.000	0.001	0.006	0.002	0.009	0.015	0.047	0.009	0.017	0.011	0.002	0.014	0.005	0.003	0.002	0.010	0.004	0.004	0.002	0.001	0.001	0.035
2001	0.000	0.000	0.000	0.008	0.026	0.006	0.021	0.029	0.076	0.014	0.025	0.016	0.004	0.022	0.009	0.004	0.003	0.016	0.006	0.007	0.003	0.002	0.060
2002	0.000	0.000	0.000	0.001	0.016	0.035	0.006	0.017	0.020	0.050	0.009	0.015	0.011	0.003	0.016	0.006	0.003	0.002	0.011	0.004	0.005	0.002	0.044

Table 14: Estimates of model parameters, output statistics and fit diagnostics for Model 1 and for the 17 tests of sensitivity.

Derived Quantities of Interest	Model 1	Model 1b	Model 1c	Model 1d	Model 1e	Model 1f	Model 1g	Model 1h	Model 1i	Model 1j	Model 1k
Depletion	0.253	0.249	0.272	0.298	0.253	0.214	0.255	0.237	0.279	0.233	0.242
2003 spawning biomass	9,946	9,754	10,262	9,467	10,114	10,152	10,516	10,054	11,097	8,573	10,249
Unfished spawning biomass	39,291	39,133	37,670	31,767	39,906	47,388	41,172	42,464	39,835	36,789	42,305
B_{MSY}	13,516	13,476	10,511	8,638	15,841	17,750	15,327	14,936	12,831	11,775	13,878
MSY	1,172	1,159	1,507	1,267	822	1,115	1,129	1,238	1,355	1,238	1,406
MSYL	0.344	0.344	0.279	0.272	0.397	0.375	0.372	0.352	0.322	0.320	0.328
F_{MSY}	0.035	0.034	0.056	0.057	0.021	0.026	0.029	0.033	0.042	0.037	0.040
F_{2002}/F_{MSY}	0.284	0.291	0.170	0.180	0.458	0.377	0.315	0.289	0.212	0.264	0.238
Likelihoods											
Objective function	279.19	280.50	282.06	273.99	269.08	273.29	279.66	308.77	270.04	279.49	281.98
Triennial survey biomass likelihood	36.15	36.21	36.21	36.04	36.41	36.42	36.00	36.38	36.68	36.15	36.64
POP survey biomass likelihood	0.16	0.14	0.21	0.15	0.21	0.06	0.15	0.14	0.22	0.17	0.21
AFSC survey biomass likelihood	26.65	26.58	26.90	26.58	26.64	26.58	26.60	26.47	26.87	26.72	26.85
NWFSC survey biomass likelihood	3.26	3.26	3.21	3.24	3.28	3.24	3.31	3.10	3.10	3.25	3.25
CPUE likelihood	12.13	12.08	11.98	11.05	12.57	8.34	12.57	8.18	12.02	12.11	12.09
Triennial survey age likelihood	-33.09	-33.10	-32.82	-31.56	-32.10	-34.31	-32.93	-31.87	-37.29	-33.01	-30.73
POP/slope survey age likelihood	9.61	9.63	9.86	10.28	9.45	7.34	9.83	10.91	6.96	9.63	10.10
Fishery biased age likelihood	53.24	53.24	53.00	51.89	53.80	53.32	53.04	74.71	54.38	53.29	49.89
Fishery unbiased age likelihood	19.55	19.56	19.48	19.49	19.52	18.50	19.64	20.90	19.74	19.53	20.74
Triennial survey size likelihood	39.92	39.97	39.69	40.25	40.53	36.53	40.23	40.06	31.27	39.84	40.70
POP/slope survey size likelihood	39.57	39.44	39.64	39.62	40.01	39.80	39.50	38.81	37.73	39.60	41.11
Fishery size likelihood	31.43	31.43	31.52	32.44	31.12	31.62	31.63	47.09	29.95	31.41	32.38
Priors											
Catch fit prior	0.23	0.23	0.21	0.25	0.20	0.15	0.24	0.13	0.23	0.22	0.20
Fdevs prior	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Fishery selectivity dome prior	6.69	6.70	6.48	5.45	7.07	10.76	6.41	0.00	9.17	6.72	7.88
Fishery selectivity time change prior	8.77	8.76	8.77	8.88	9.02	12.58	8.76	0.00	14.33	8.75	8.89
Fishery selectivity curvature prior	6.65	6.64	6.60	6.29	6.72	6.39	6.65	15.62	9.16	6.65	6.60
Survey selectivity curvature prior	2.14	2.23	2.14	2.21	2.17	2.23	2.08	1.96	0.06	2.13	2.44
Rho/SigmaR sp-rec prior	17.40	17.46	17.79	12.82	3.54	15.08	16.38	17.33	16.72	17.61	13.88
Natural mortality prior	-1.25	-1.28	-1.34	-1.38	-1.09	-1.36	-0.43	-1.15	-1.25	-1.27	-1.14
Steepness prior	0.00	0.00	2.53	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Catchability prior	0.00	1.29	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Parameters											
Natural mortality	0.053	0.052	0.052	0.050	0.054	0.051	0.059	0.054	0.053	0.052	0.054
Steepness	0.532	0.531	0.714	0.734	0.396	0.449	0.457	0.508	0.593	0.586	0.577
Rho	0.000	0.000	0.000	0.500	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Sigma R	1.000	1.000	1.000	1.000	0.760	1.000	1.000	1.000	1.000	1.000	1.000
Triennial survey catchability	0.253	0.258	0.250	0.267	0.246	0.245	0.233	0.251	0.233	0.252	0.239
POP survey catchability	0.454	0.466	0.456	0.476	0.447	0.456	0.416	0.439	0.337	0.454	0.442
NWFSC survey catchability	0.211	0.219	0.206	0.224	0.207	0.212	0.196	0.207	0.142	0.210	0.204
AFSC survey catchability	0.271	0.280	0.267	0.287	0.264	0.273	0.250	0.272	0.192	0.270	0.261

Table 14 (continued): Estimates of model parameters, output statistics and fit diagnostics for Model 1 and for the 17 tests of sensitivity.

Derived Quantities of Interest	Model 1	Model 1l	Model 1m	Model 1n	Model 1o	Model 1p	Model 1q	Model 1r	Model 1 posterior median
Depletion	0.253	0.238	0.288	0.084	0.258	0.288	0.252	0.243	0.274
2003 spawning biomass	9,946	9,298	11,159	3,073	10,150	11,445	9,910	10,332	10,231
Unfished spawning biomass	39,291	39,131	38,806	36,381	39,304	39,732	39,402	42,473	37,269
B_{MSY}	13,516	13,323	10,774	15,200	13,390	12,794	13,705	15,040	
MSY	1,172	1,208	1,647	598	1,194	1,334	1,150	1,199	
MSYL	0.344	0.340	0.278	0.418	0.341	0.322	0.348	0.354	
F_{MSY}	0.035	0.036	0.061	0.016	0.036	0.041	0.034	0.032	
F_{2002}/F_{MSY}	0.284	0.368	0.101	1.983	0.271	0.207	0.294	0.296	
Likelihoods									
Objective function	279.19	268.84	262.74	236.04	279.00	251.92	275.91	264.60	
Triennial survey biomass likelihood	36.15	36.75	25.62	0.00	36.12	35.63	36.04	35.93	
POP survey biomass likelihood	0.16	0.05	0.10	0.09	0.00	0.22	0.15	0.20	
AFSC survey biomass likelihood	26.65	26.94	28.85	21.77	26.72	0.00	26.65	26.76	
NWFSC survey biomass likelihood	3.26	3.23	0.02	3.69	3.24	3.25	0.00	3.28	
CPUE likelihood	12.13	12.01	11.73	11.06	12.16	12.32	12.17	0.00	
Triennial survey age likelihood	-33.09	-33.86	-19.20	-31.68	-33.03	-32.55	-33.12	-33.10	
POP/slope survey age likelihood	9.61	6.80	6.42	10.17	9.58	9.50	9.50	10.22	
Fishery biased age likelihood	53.24	53.45	54.00	53.73	53.12	53.35	53.23	50.82	
Fishery unbiased age likelihood	19.55	12.92	8.90	19.44	19.53	19.61	19.56	19.44	
Triennial survey size likelihood	39.92	38.36	36.51	36.82	40.01	39.39	40.02	40.05	
POP/slope survey size likelihood	39.57	39.37	37.96	39.99	39.80	39.27	39.46	39.63	
Fishery size likelihood	31.43	31.49	31.47	30.36	31.40	31.42	31.50	31.73	
Priors									
Catch fit prior	0.23	0.22	0.21	0.15	0.21	0.20	0.23	0.09	
Fdevs prior	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
Fishery selectivity dome prior	6.69	6.67	6.63	7.21	6.61	6.67	6.69	5.61	
Fishery selectivity time change prior	8.77	8.84	8.89	8.62	8.78	8.71	8.80	10.07	
Fishery selectivity curvature prior	6.65	6.81	7.03	6.34	6.64	6.65	6.66	6.28	
Survey selectivity curvature prior	2.14	2.62	2.05	2.04	2.00	2.20	2.24	2.20	
Rho/SigmaR sp-rec prior	17.40	17.39	16.78	17.46	17.36	17.37	17.39	16.57	
Natural mortality prior	-1.25	-1.23	-1.22	-1.21	-1.26	-1.28	-1.23	-1.19	
Steepness prior	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
Catchability prior	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
Parameters									
Natural mortality	0.053	0.053	0.053	0.053	0.053	0.052	0.053	0.053	.054
Steepness	0.532	0.543	0.723	0.348	0.541	0.593	0.521	0.504	0.532
Rho	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	
Sigma R	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	
Triennial survey catchability	0.253	0.254	0.247	0.366	0.249	0.232	0.253	0.246	0.247
POP survey catchability	0.454	0.502	0.495	0.580	0.465	0.448	0.459	0.444	0.438
NWFSC survey catchability	0.211	0.224	0.129	0.621	0.204	0.188	0.160	0.204	0.203
AFSC survey catchability	0.271	0.290	0.242	0.612	0.262	0.380	0.273	0.262	0.265

Table 15. MPD and Posterior median estimates for spawning biomass and recruitment.

	MPD estimates		Posterior Medians	
Year	SpBiomass	Recruits	SpBiomass	Recruits
1956	35,119	3.90	32,727	6.90
1957	33,896	46.84	31,637	39.17
1958	32,733	4.41	30,548	7.49
1959	32,215	19.18	30,259	16.28
1960	31,789	9.26	30,160	9.69
1961	31,817	4.42	30,852	4.10
1962	33,501	3.82	32,637	3.70
1963	35,107	5.20	34,128	4.92
1964	34,744	15.43	33,978	16.32
1965	34,427	11.16	33,607	11.15
1966	31,909	7.29	31,138	7.43
1967	23,135	4.95	22,360	4.94
1968	17,328	3.64	16,636	3.75
1969	15,549	4.14	14,933	4.04
1970	17,377	2.98	16,853	2.94
1971	18,321	4.07	17,862	4.29
1972	18,779	5.33	18,389	5.00
1973	18,995	7.58	18,670	8.32
1974	18,695	4.10	18,420	3.87
1975	18,446	1.33	18,232	1.32
1976	18,501	1.15	18,313	1.12
1977	18,459	1.38	18,315	1.31
1978	18,847	1.81	18,772	1.72
1979	18,680	1.12	18,648	1.09
1980	18,097	0.88	18,099	0.87
1981	17,154	1.45	17,201	1.64
1982	16,238	2.76	16,305	1.88
1983	15,567	2.18	15,646	2.15
1984	14,384	5.18	14,471	5.38
1985	13,285	1.02	13,380	0.92
1986	12,317	1.19	12,435	1.14
1987	11,581	2.13	11,671	2.13
1988	11,166	4.80	11,196	4.70
1989	10,762	0.74	10,794	0.71
1990	10,283	2.65	10,331	2.66
1991	9,813	3.13	9,859	3.12
1992	9,190	1.38	9,239	1.42
1993	8,965	6.30	8,995	6.60
1994	8,629	2.15	8,664	2.21
1995	8,342	1.65	8,362	1.64
1996	8,259	0.66	8,272	0.65
1997	8,218	5.06	8,234	5.39
1998	8,468	4.28	8,517	4.51
1999	8,776	0.67	8,890	0.68
2000	8,872	0.80	9,022	0.78
2001	9,052	1.89	9,210	1.90
2002	9,372	2.46	9,592	2.16
2003	9,946	2.46	10,241	2.16

1.7. Figures

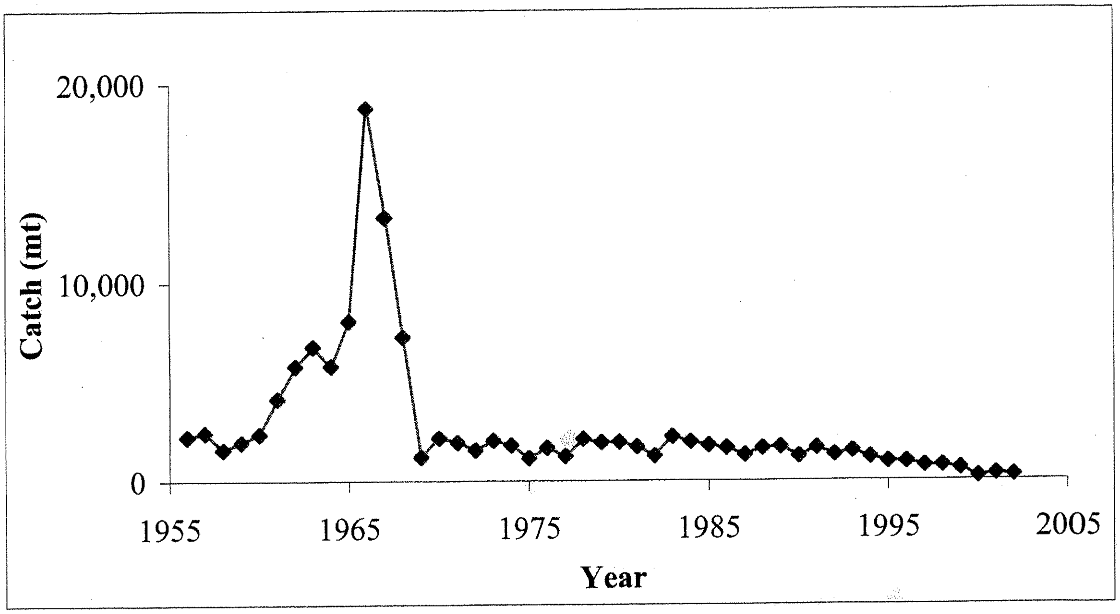


Figure 1. Catch history of Pacific ocean perch (domestic and foreign fleets combined).

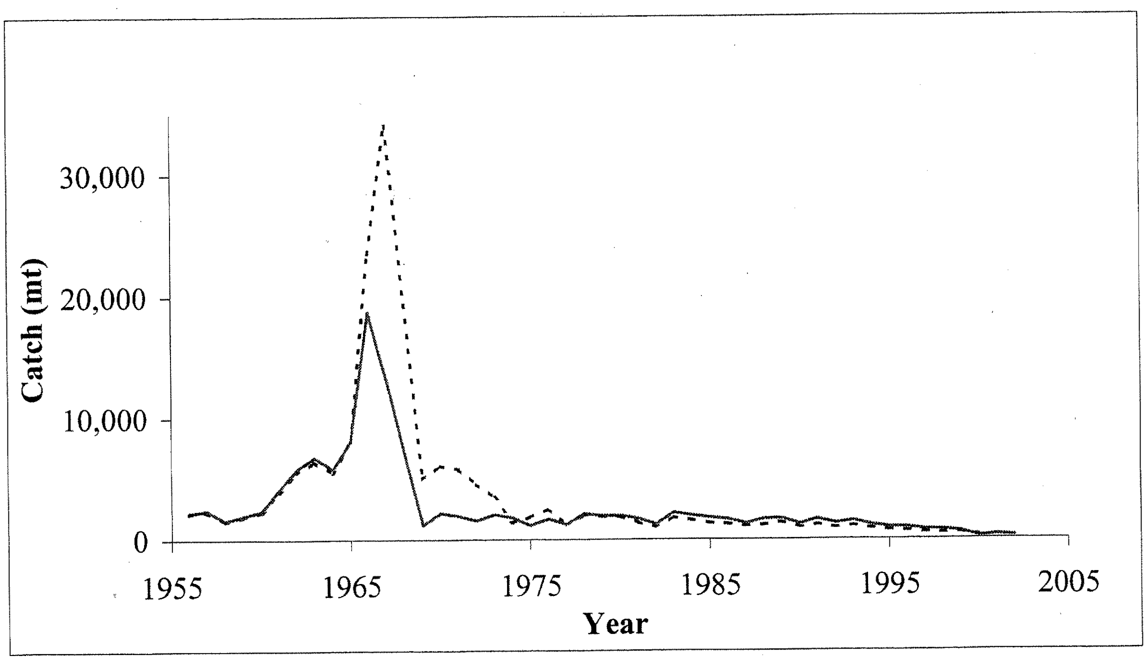


Figure 2. Pacific ocean perch catch data used in the 2000 (dotted line) and the 2003 (solid line) assessments.

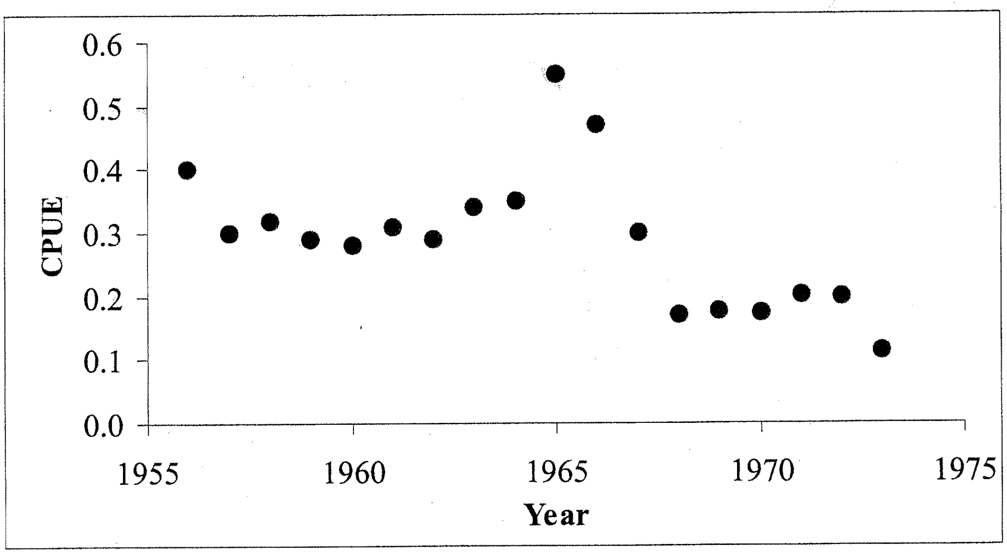
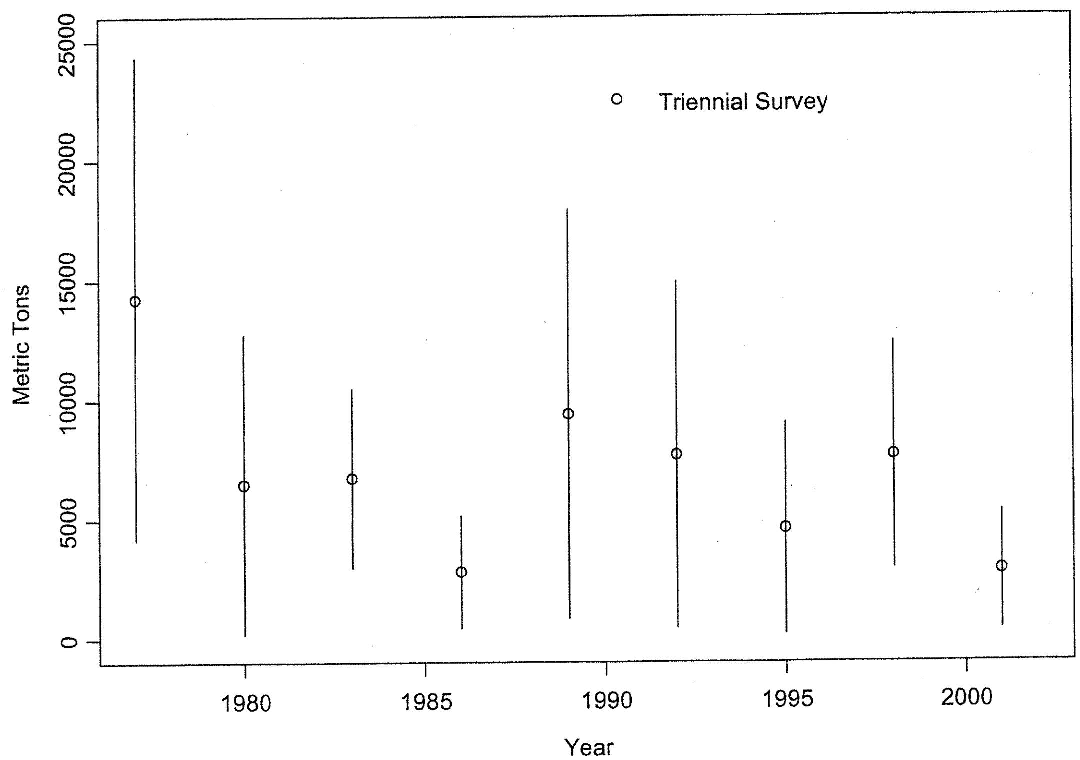


Figure 3. Pacific ocean perch catch-per-unit-of-effort data for the domestic fishery in the US-Vancouver and Columbia INPFC areas combined



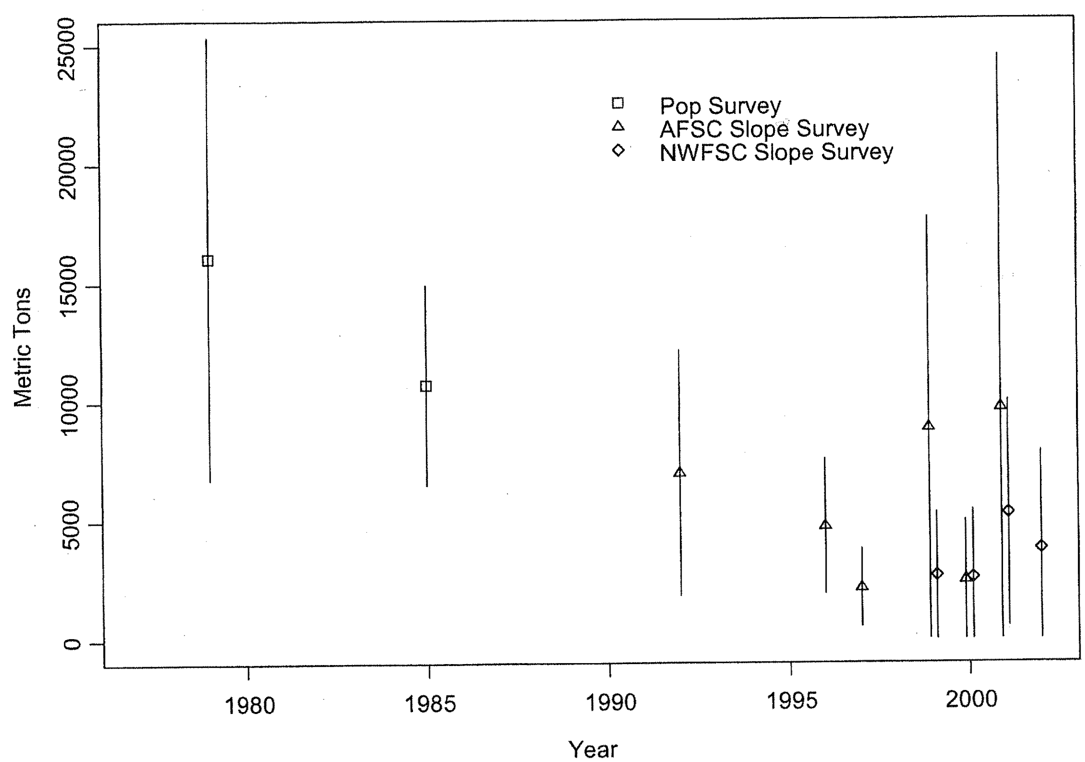


Figure 4. Survey biomass indices with their associated 95% confidence intervals for Pacific ocean perch (1977-2002)

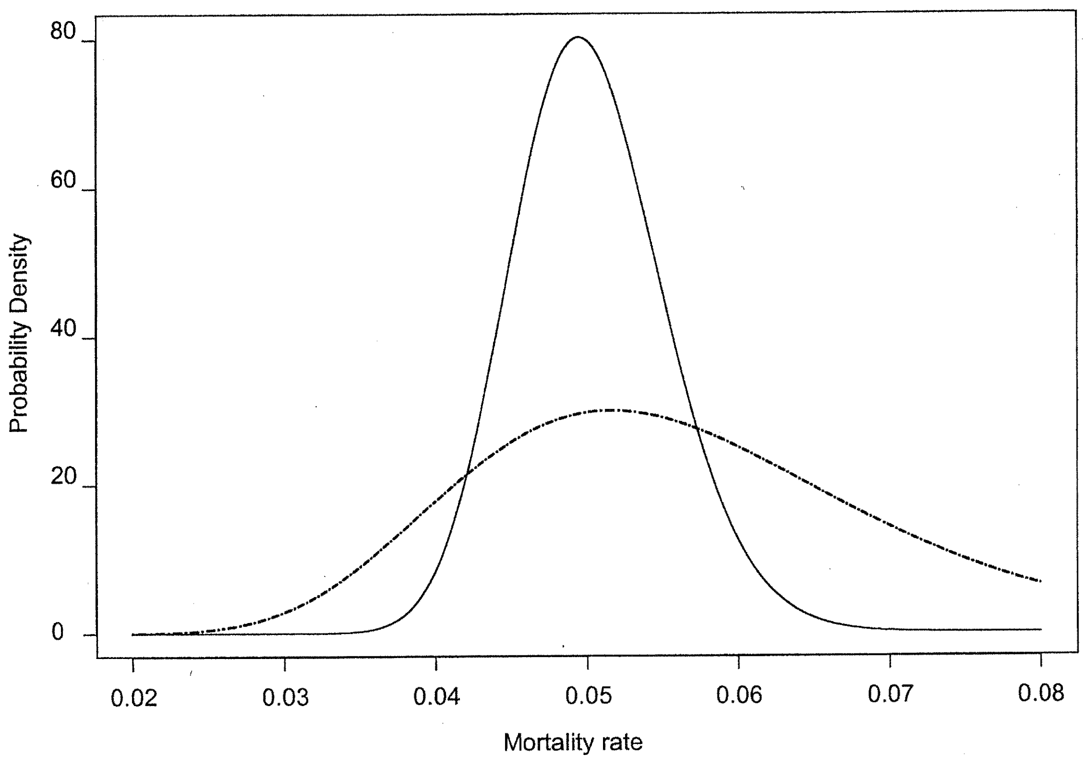


Figure 5. Base-case prior distribution assumed for natural mortality (solid line) and the alternative (diffuse) prior (dashed line).

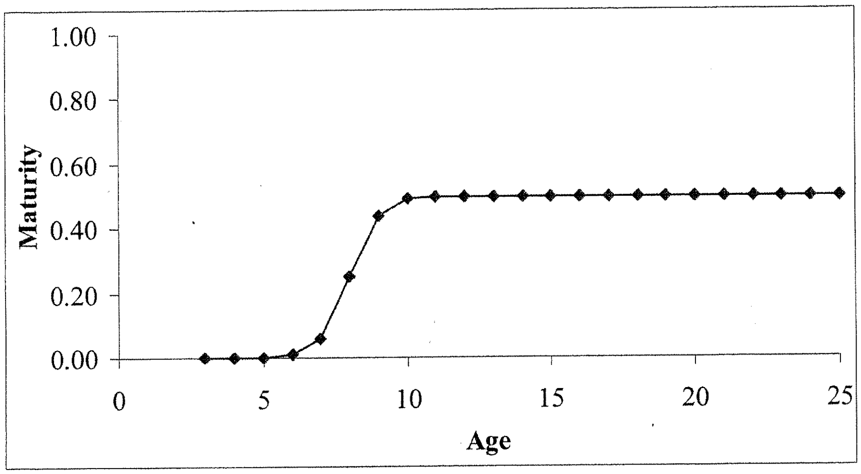


Figure 6. Modeled proportion of Pacific ocean perch that are mature females by age.

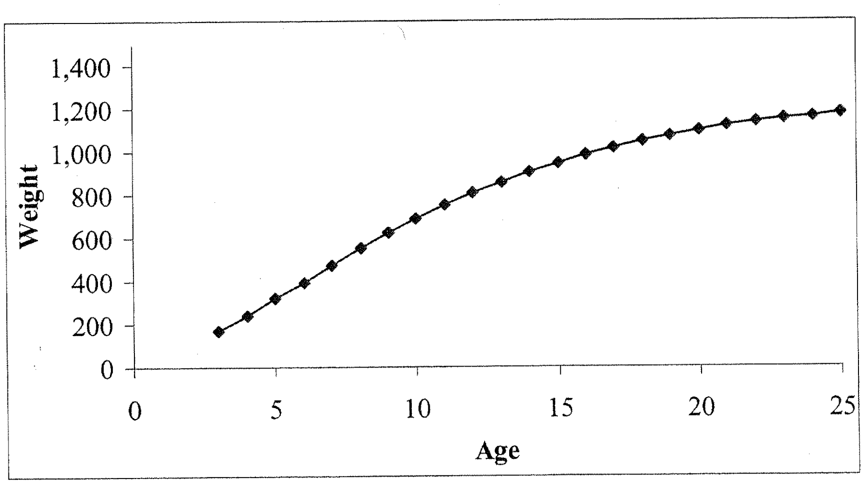


Figure 7. Weight at age (grams) for Pacific ocean perch used in the assessment model.

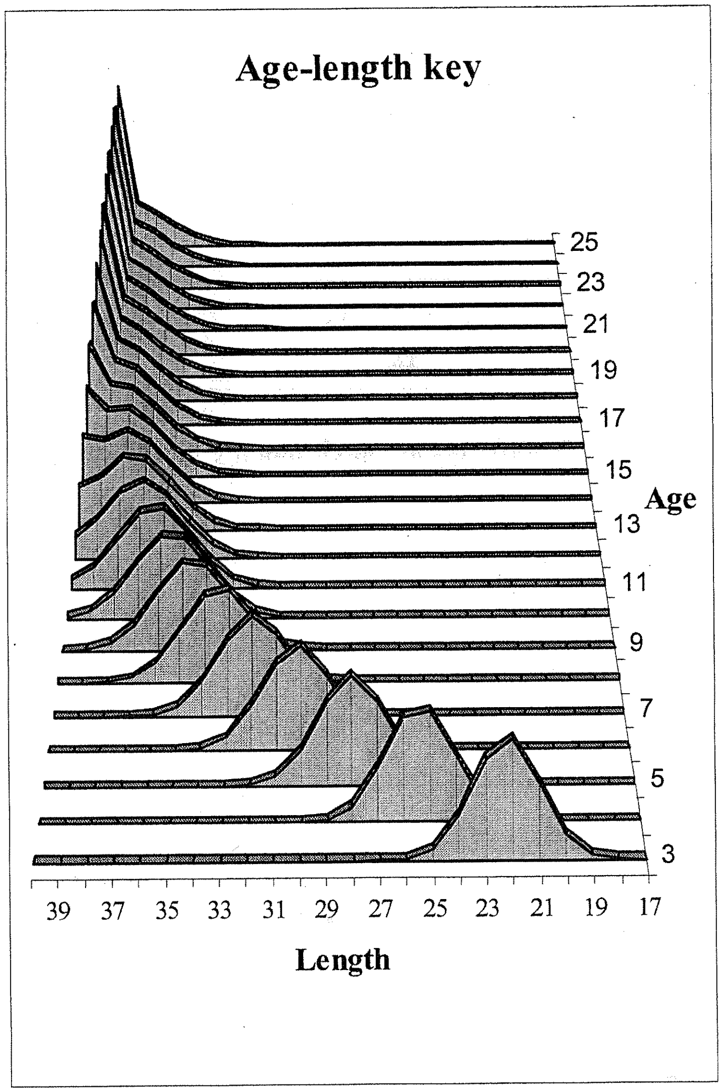


Figure 8. Length distributions by age used in the age-length transition matrix.

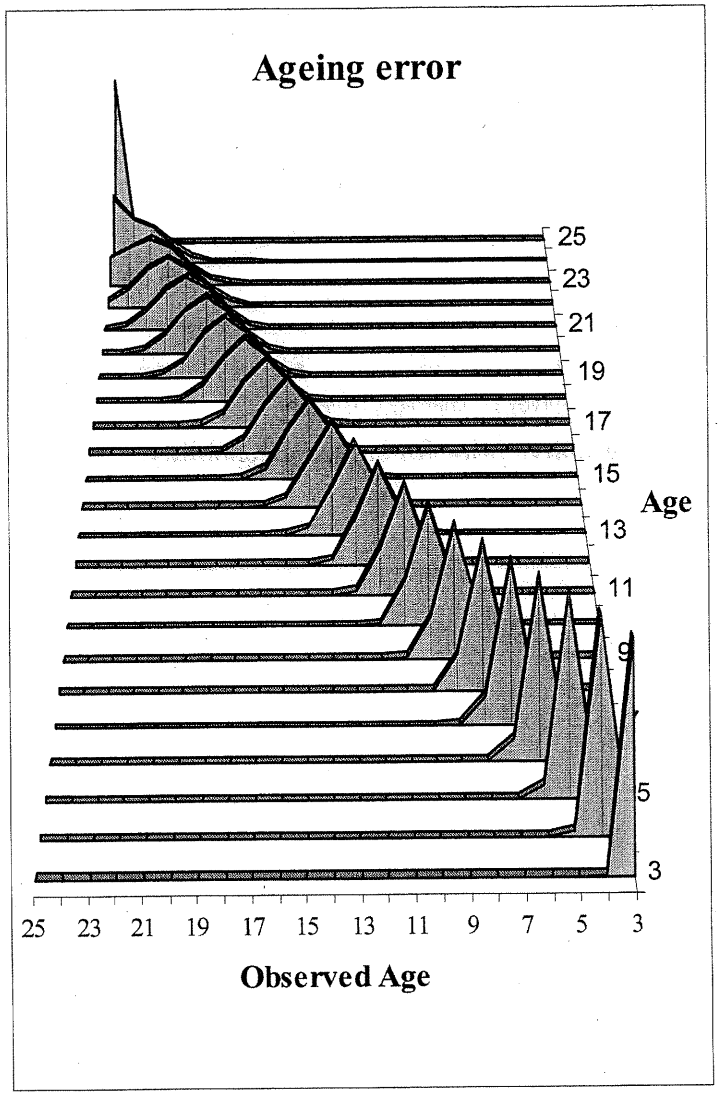


Figure 9. Assumed relationship between observed age and true age used as an ageing error matrix.

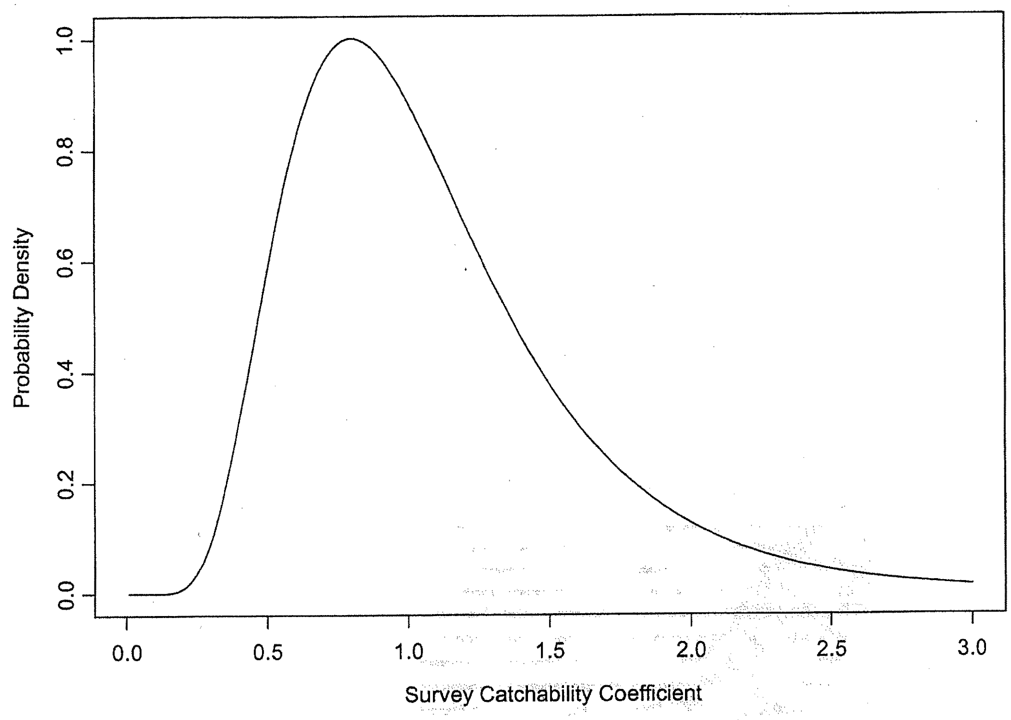


Figure 10. Alternative informative prior for survey catchability.

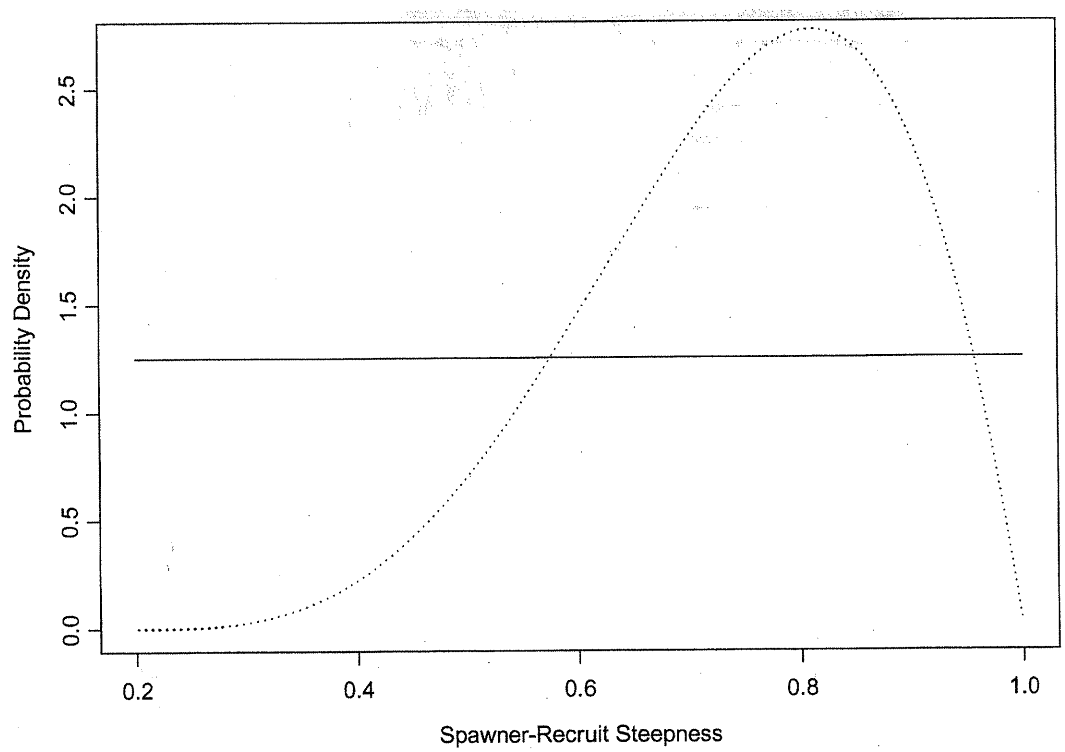


Figure 11. Uniform prior distribution assumed for steepness (solid line) and the more informative prior for steepness based on Dorn's (2000, and Minte-Vera et al. 2003) meta-analysis (dotted line).

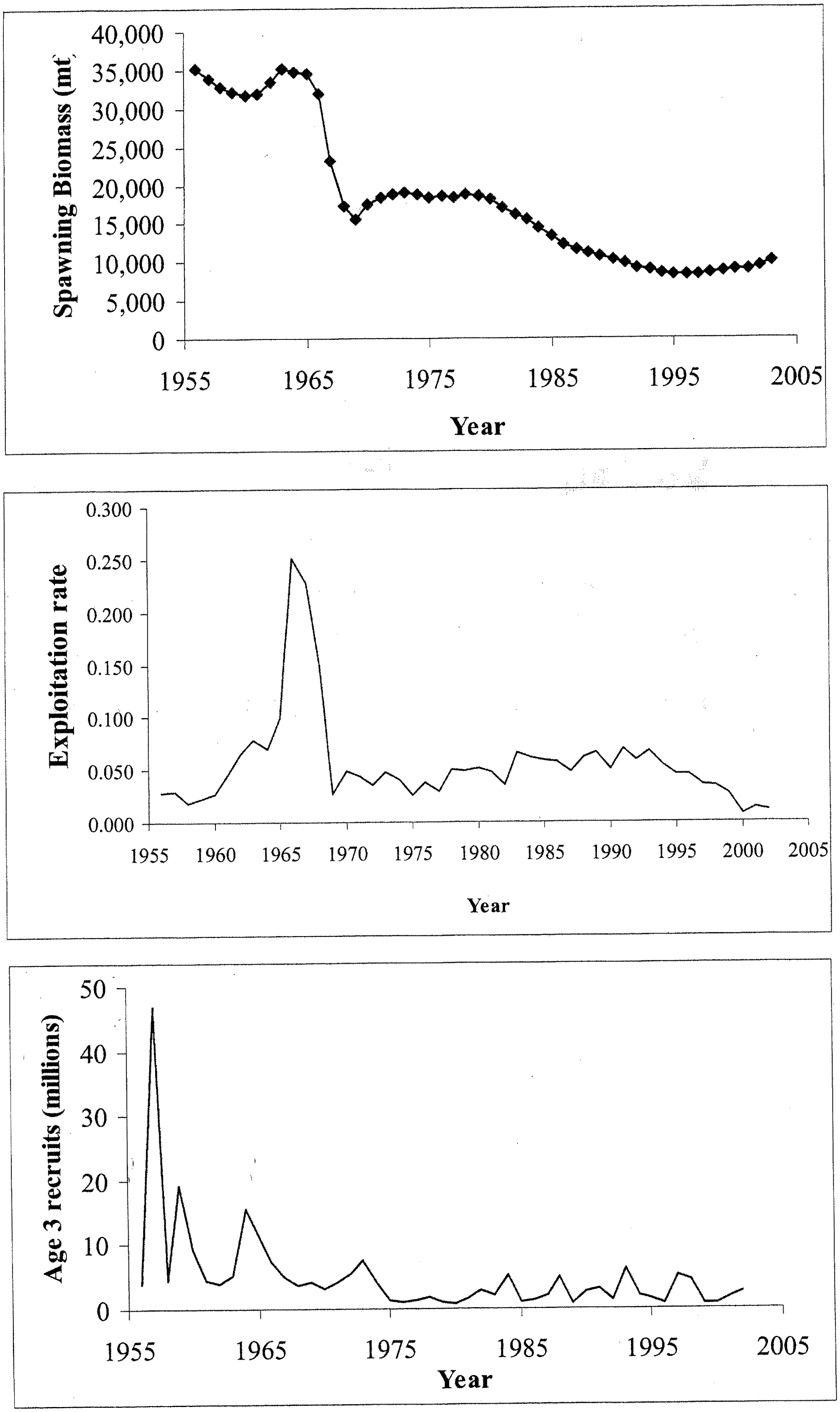


Figure 12. Time series of spawning biomass, exploitation rate and recruitment.

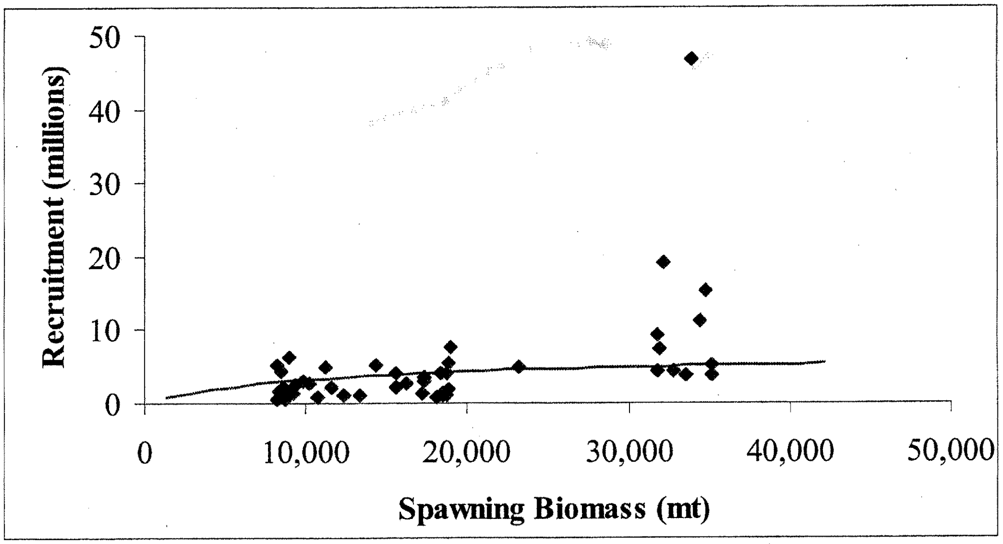


Figure 13: Fit of the deterministic stock-recruitment relationship to the spawning stock biomass and recruitment data.

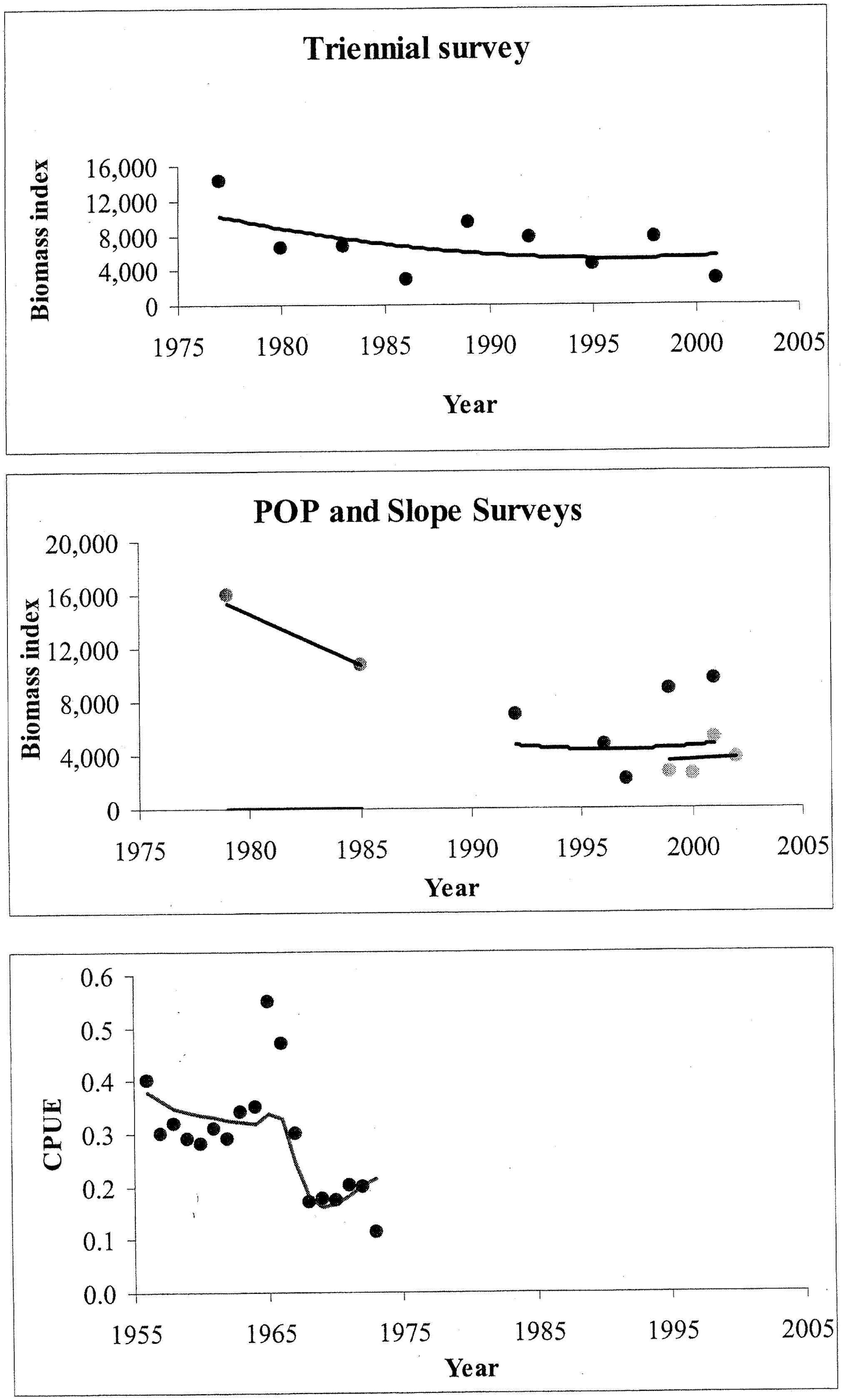


Figure 14. Fit of Model 1 to the survey biomass indices and to the fishery CPUE data. Note that each survey has a unique catchability coefficient so that there is a separate trajectory of survey-selected biomass for each survey; the curves shown are only through expected biomass indices for the years of data.

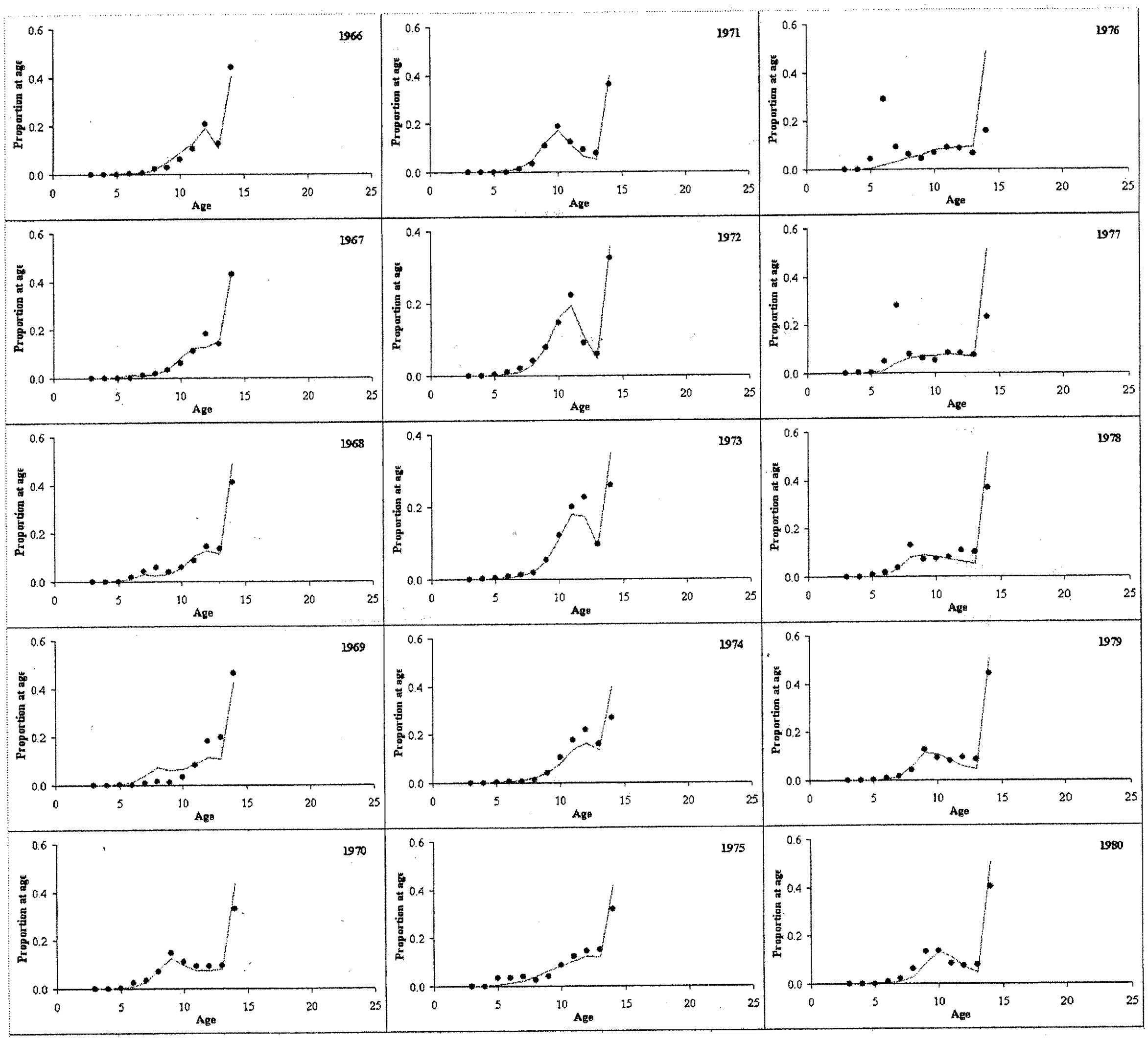


Figure 15. Fit of model 1 to the "biased" (1966-80) fishery age-composition data.

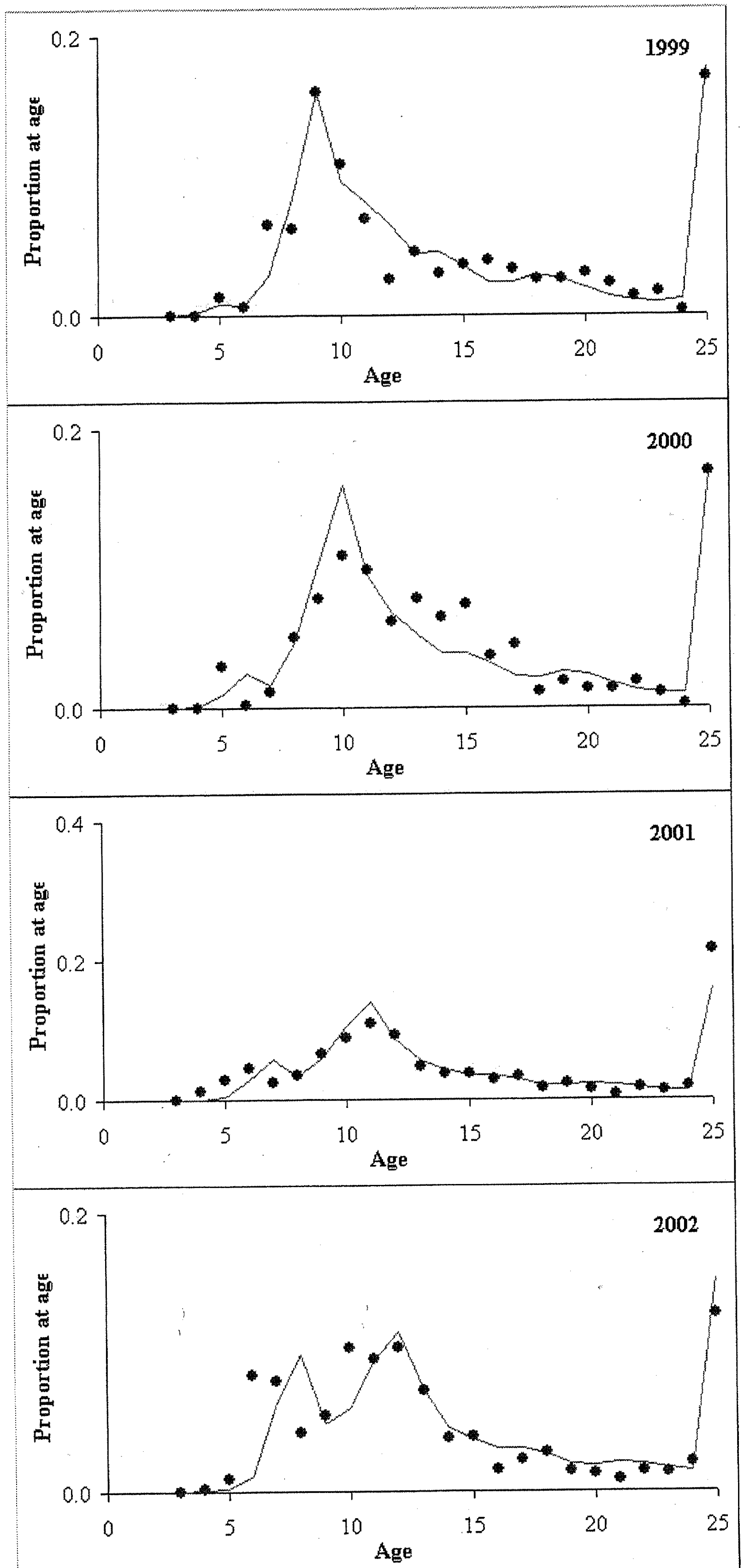


Figure 16. Fit of Model 1 to the "unbiased" (1999-2002) fishery age-composition data.

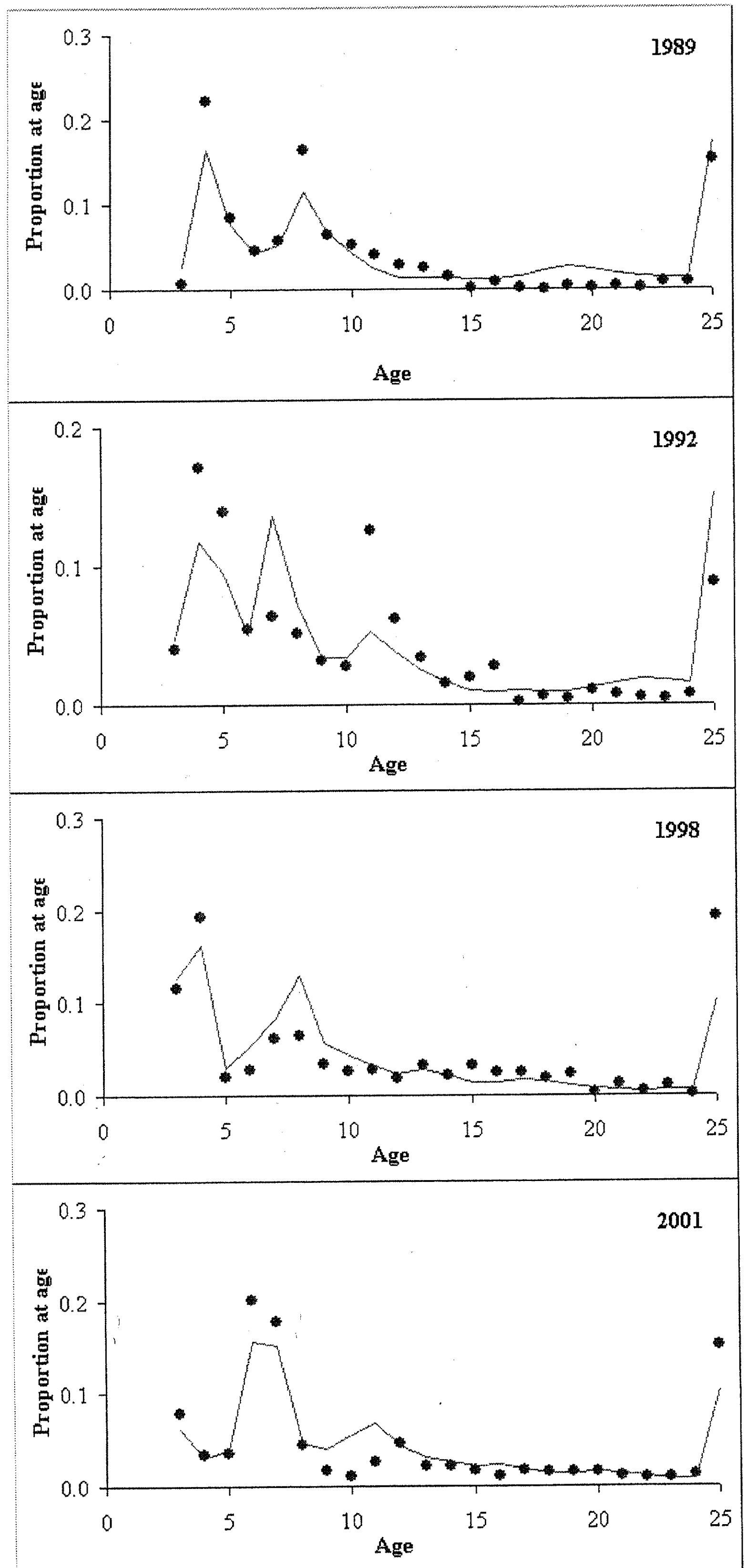


Figure 17. Fit of model 1 to triennial survey age-composition data.

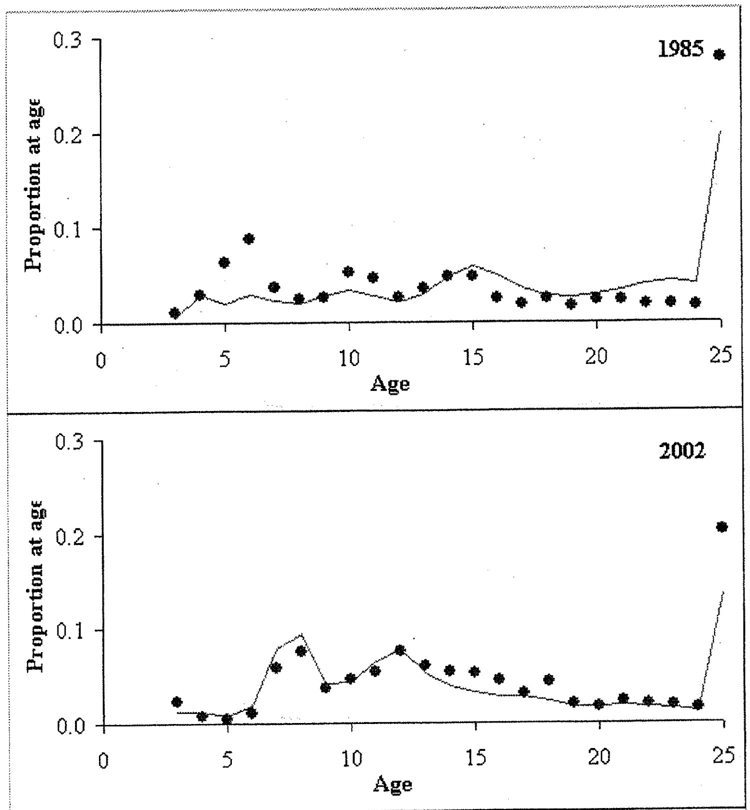


Figure 18. Fit of Model 1 to POP and slope survey age-composition data.

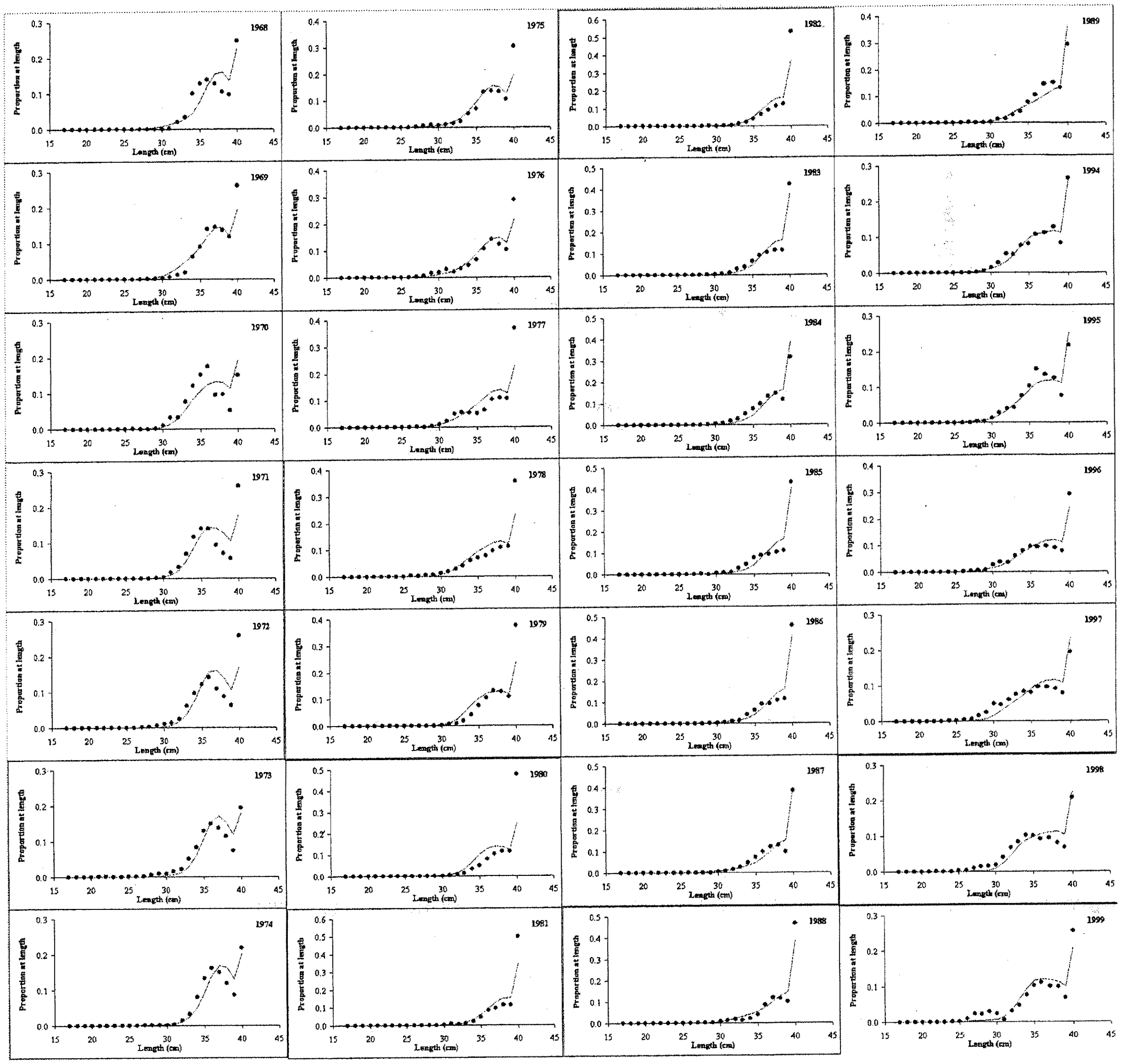


Figure 19. Fit of Model 1 to fishery size-composition data (1968-1989,1994-1999). Note that the data for 1968-1980 and for 1999 are not used when fitting the model.

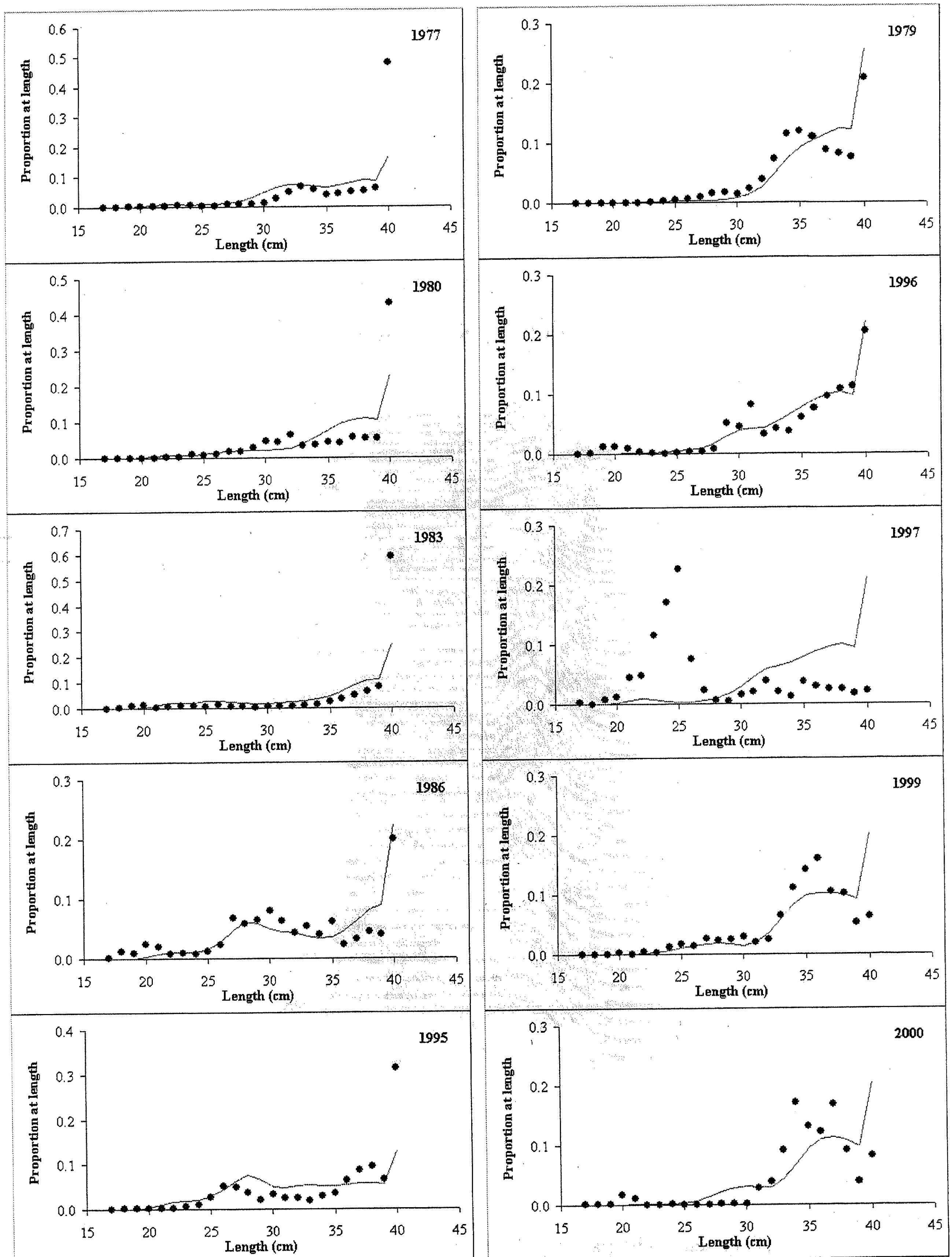


Figure 20. Fit of Model 1 to triennial and slope survey size-composition data.

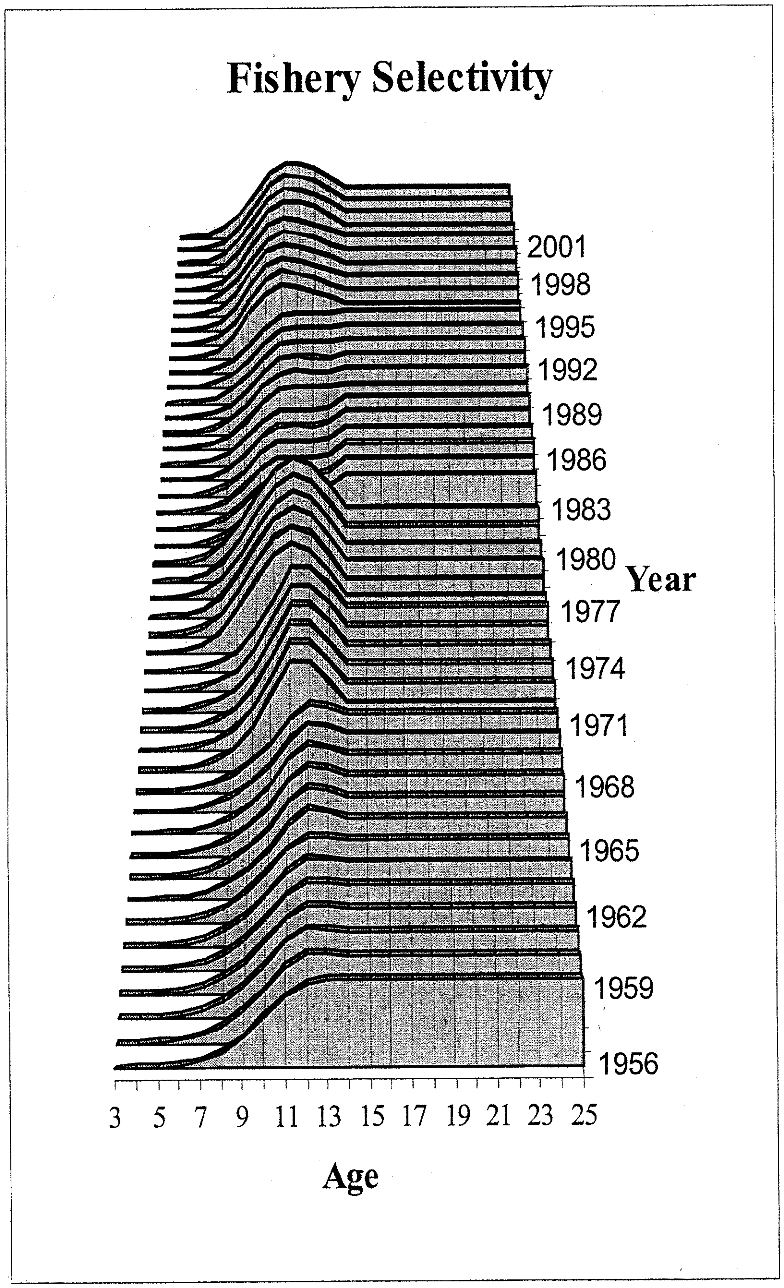


Figure 21. Fishery selectivity patterns (1956-2002).

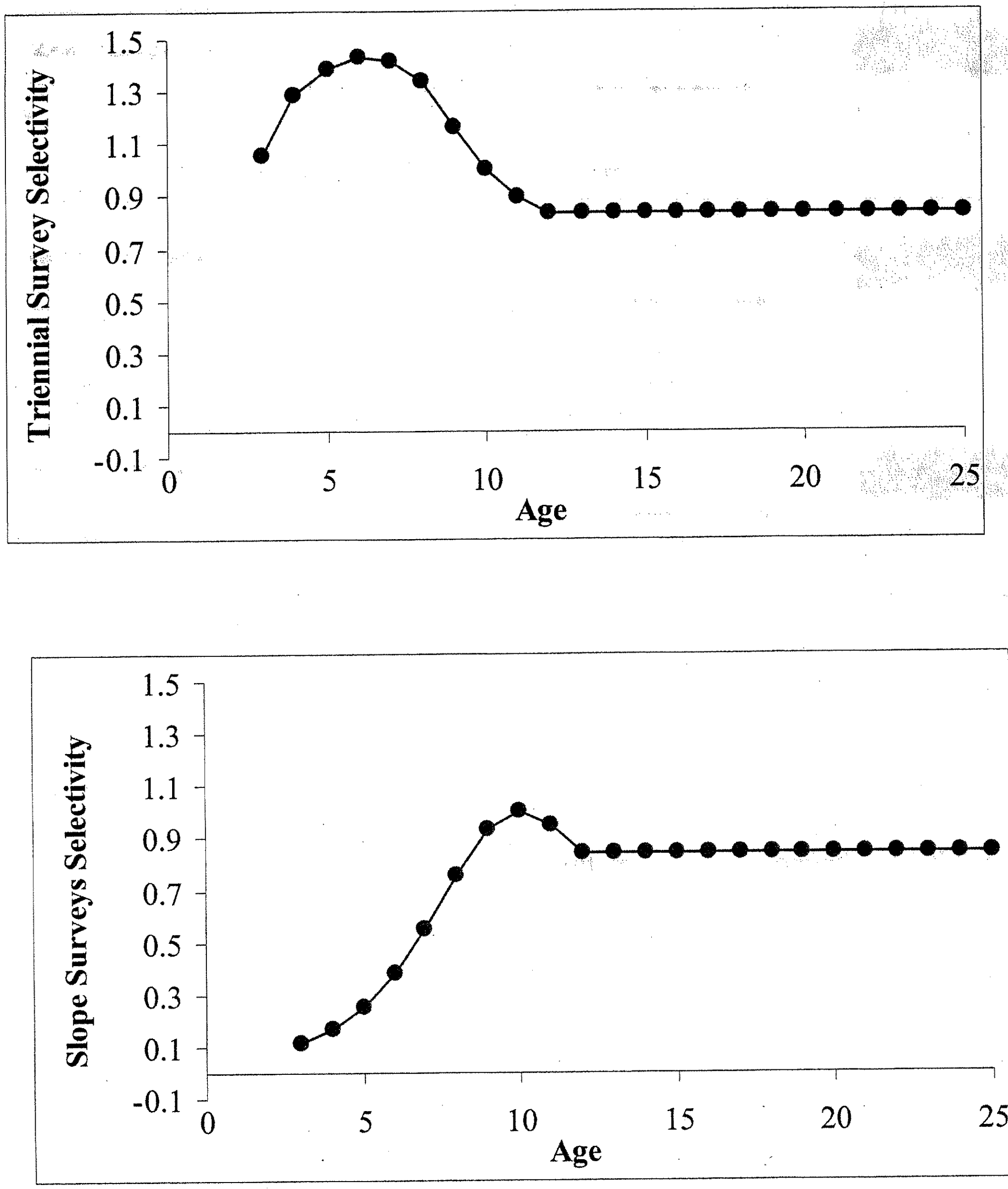


Figure 22. Selectivity patterns for the triennial and slope surveys.

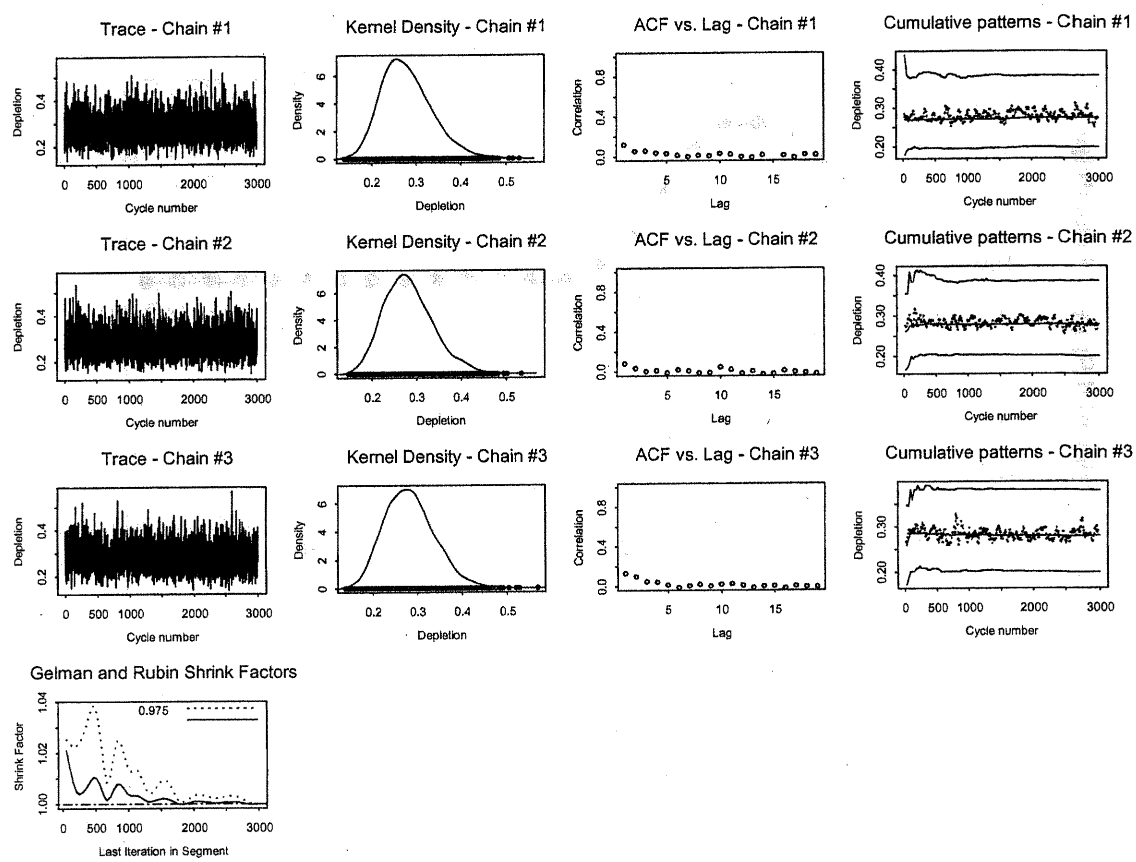


Figure 23a. MCMC diagnostics for depletion.

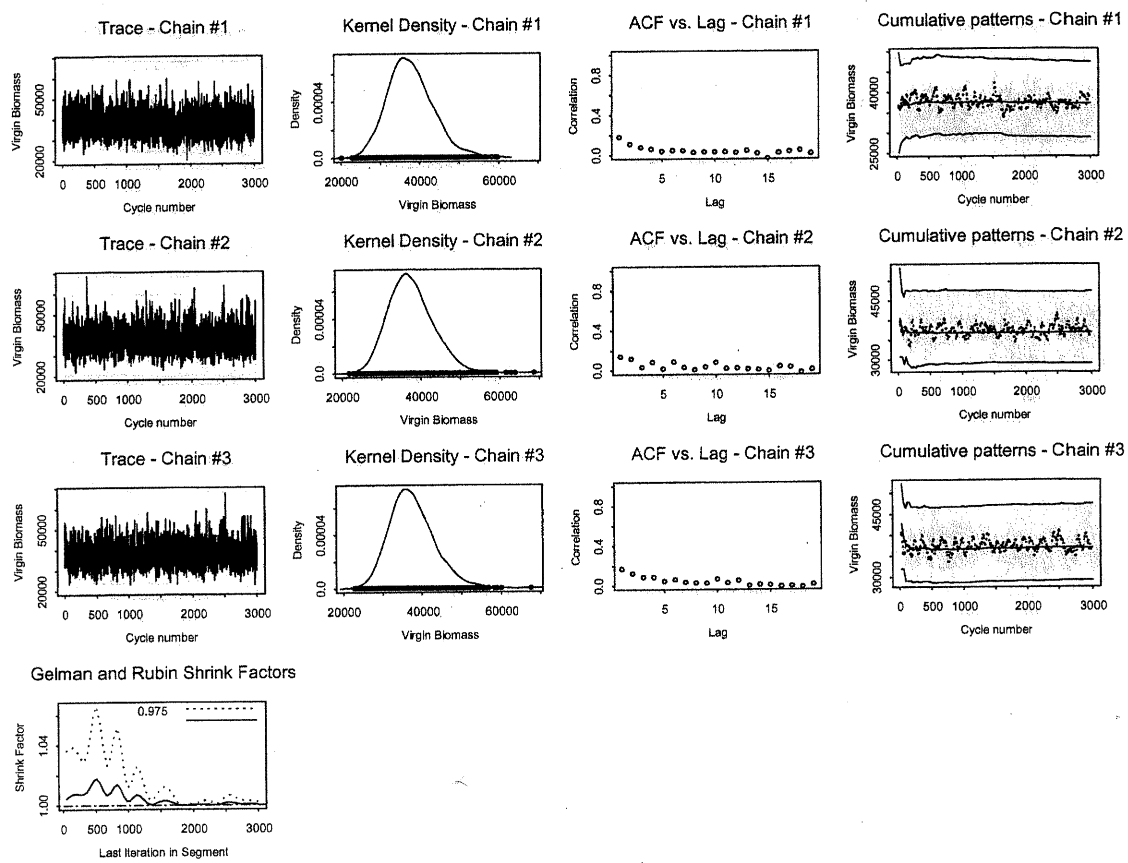


Figure 23b. MCMC diagnostics for virgin biomass.

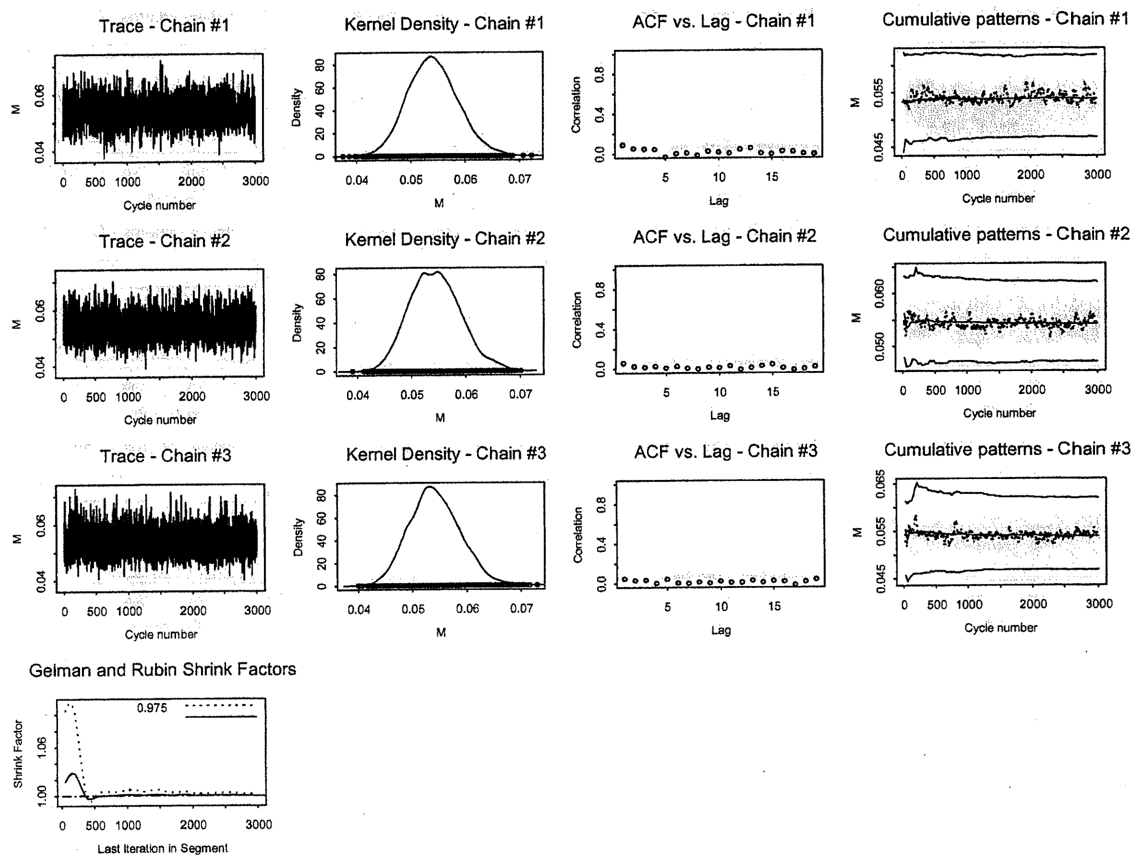


Figure 23c. MCMC diagnostics for natural mortality.

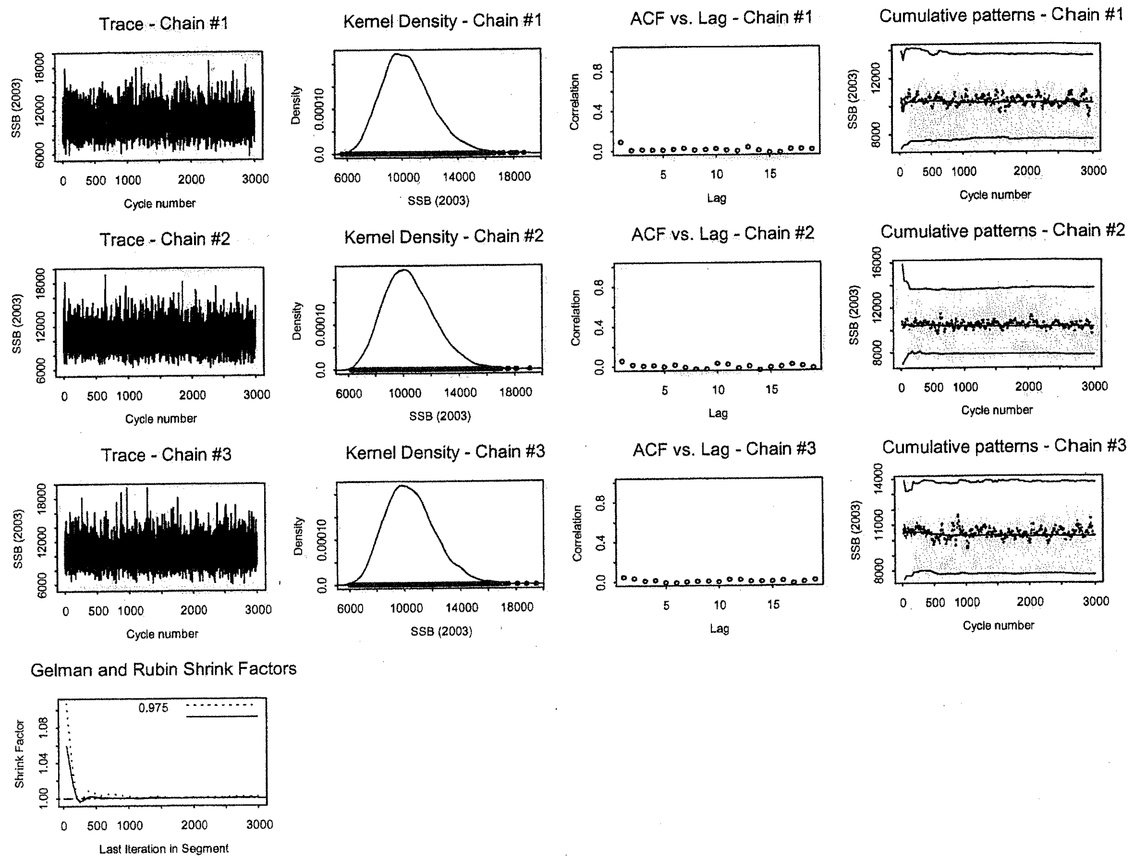


Figure 23d. MCMC diagnostics for current spawning biomass.

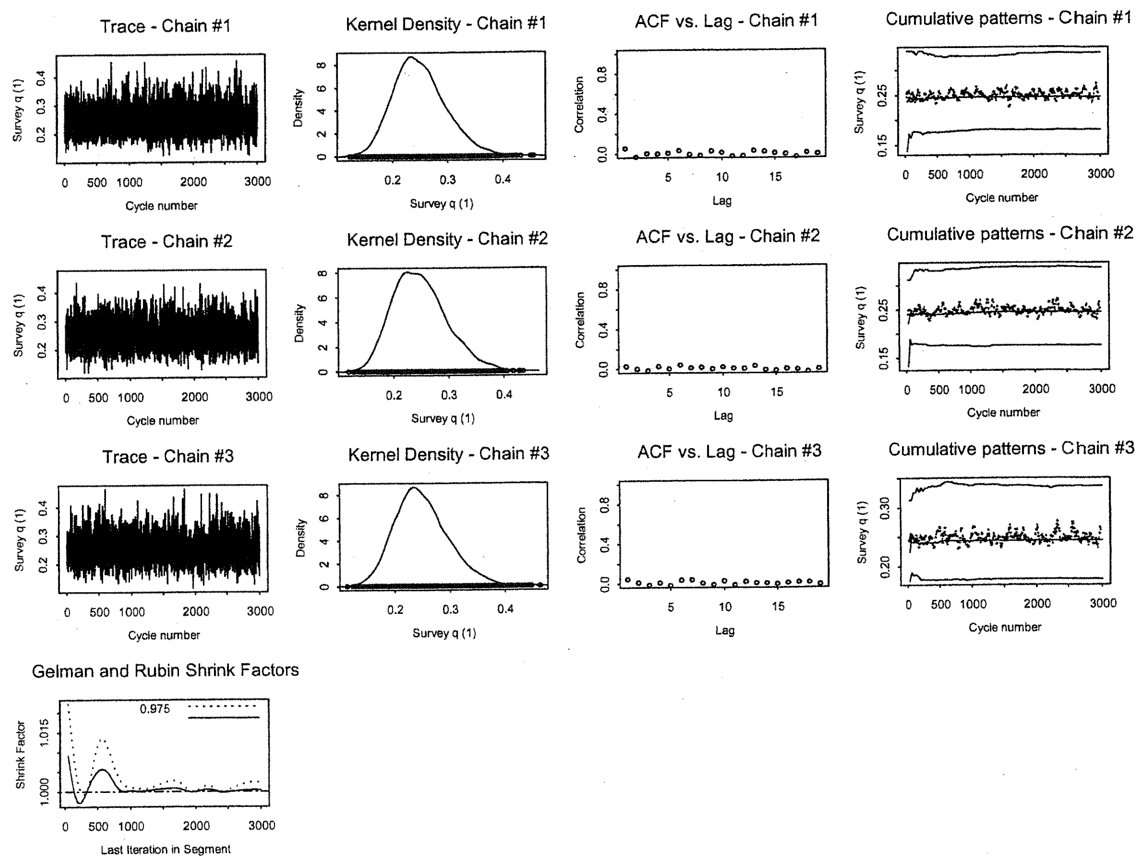


Figure 23e. MCMC diagnostics for triennial survey catchability.

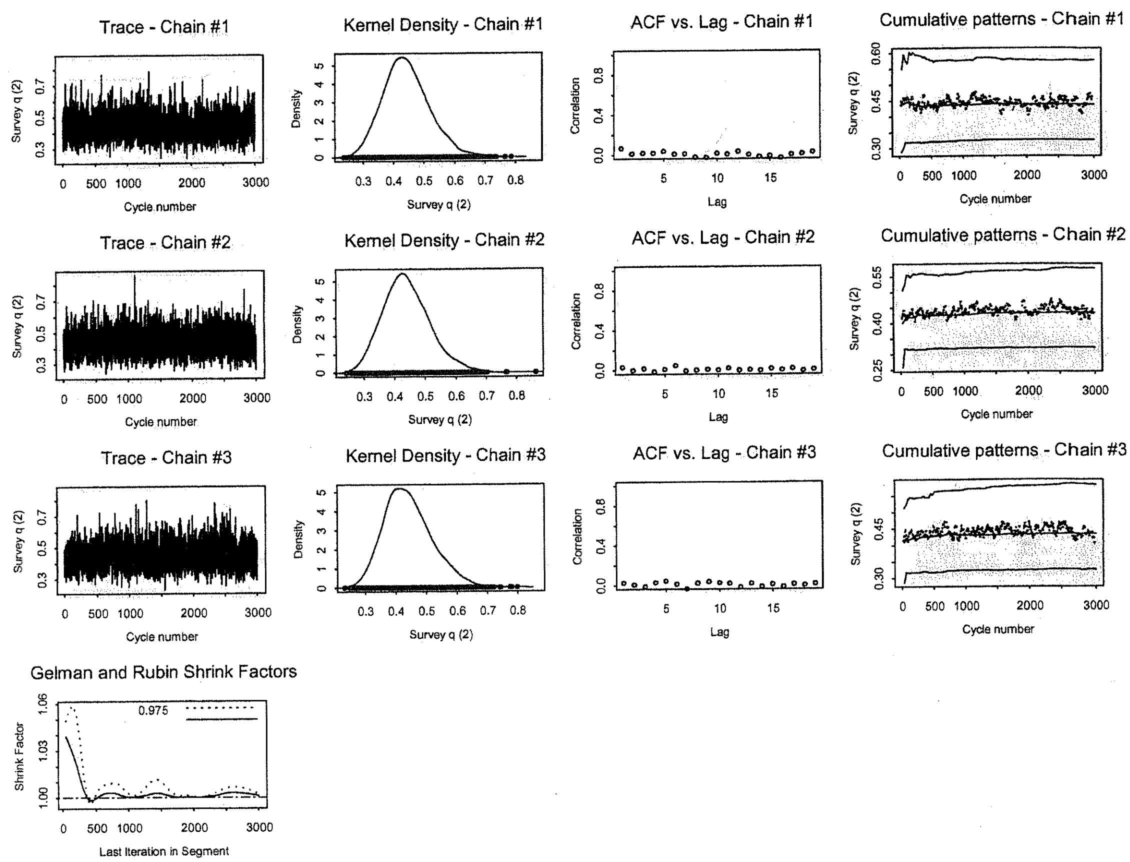


Figure 23f. MCMC diagnostics for POP survey catchability.

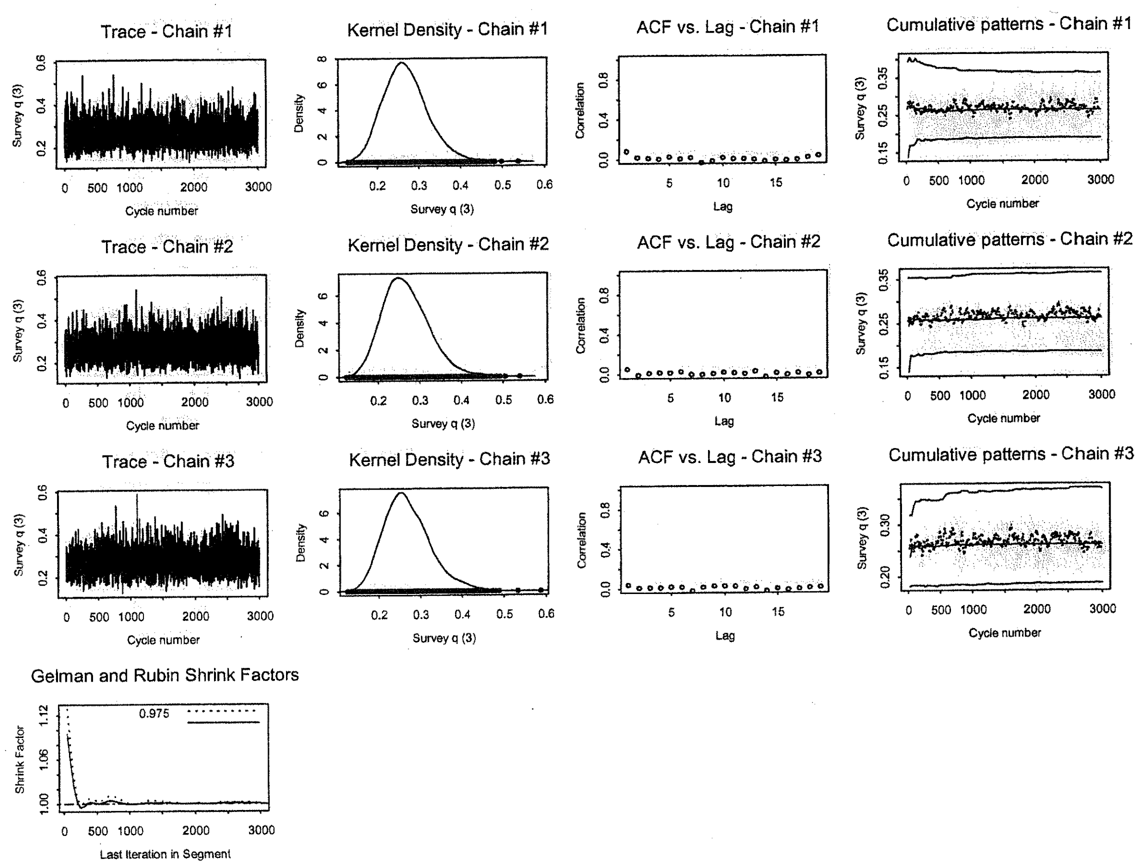


Figure 23g. MCMC diagnostics for AFSC slope survey catchability.

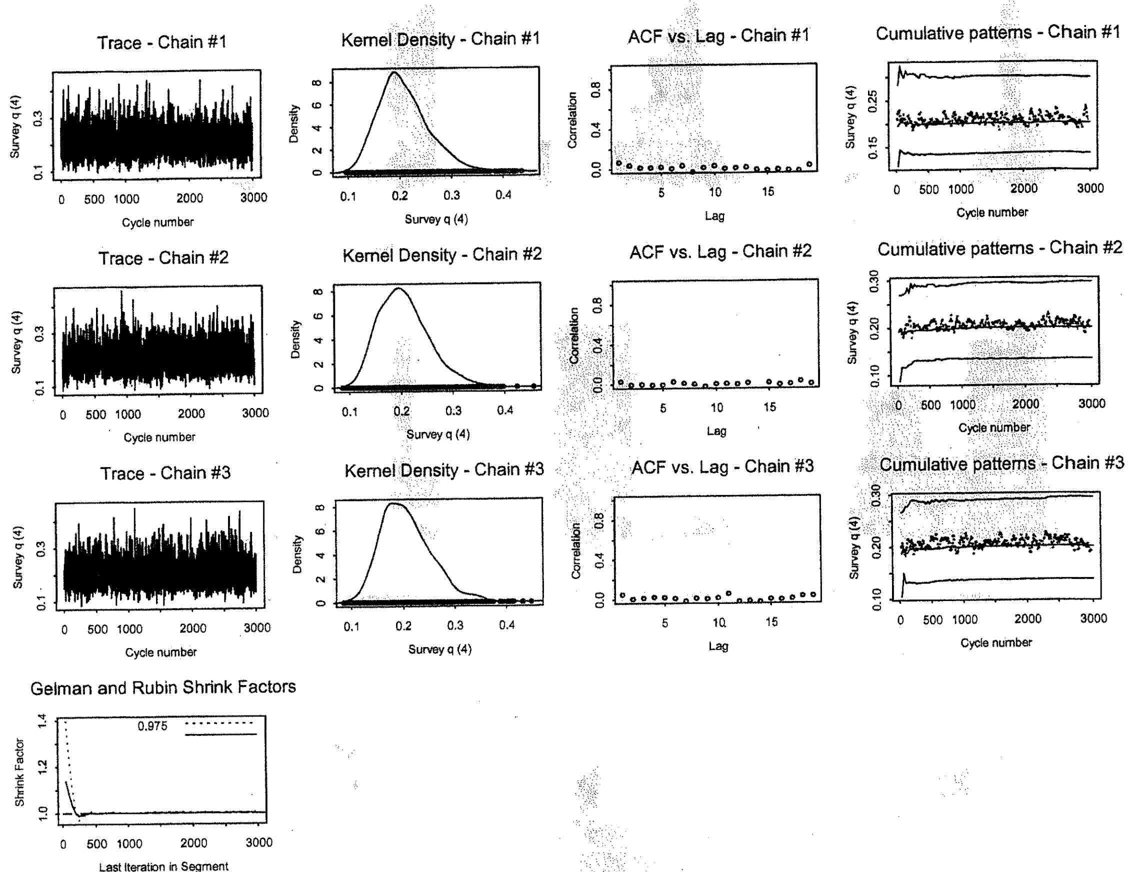


Figure 23h. MCMC diagnostics for NWFSC slope survey catchability.

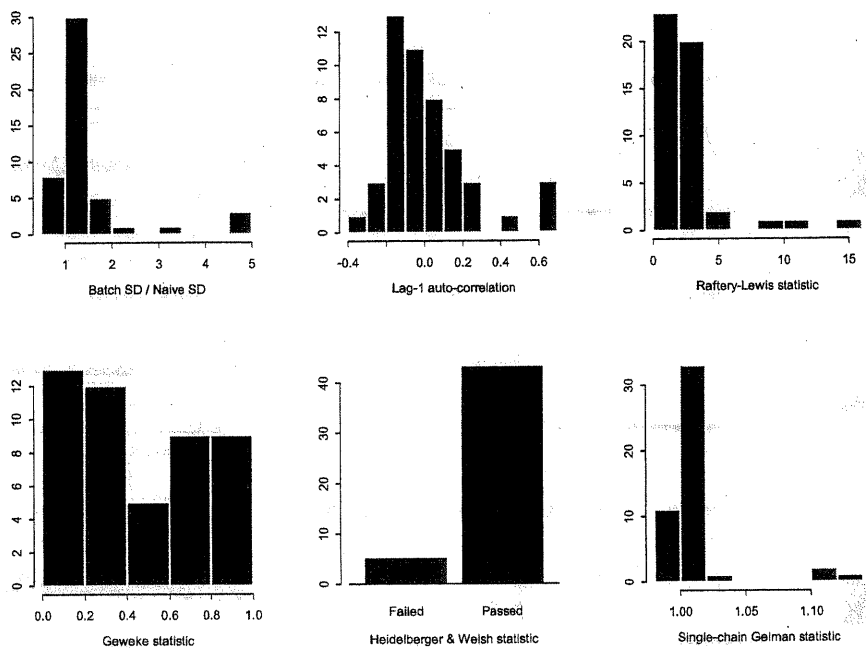


Figure 24a. Summary of six diagnostic statistics for the 48 annual recruitments.

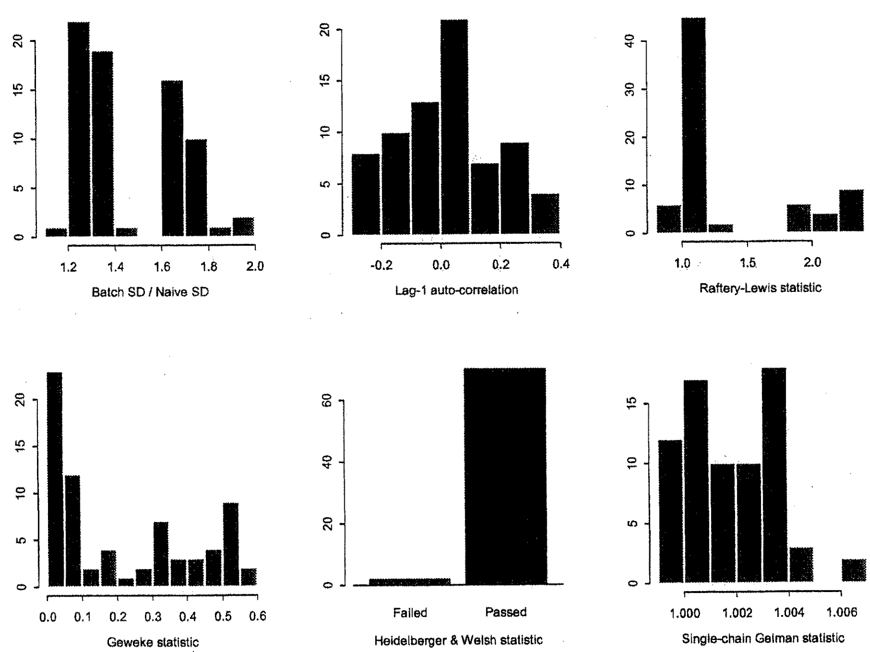


Figure 24b. Summary of six diagnostic statistics for the 72 annual estimates of spawning biomass.

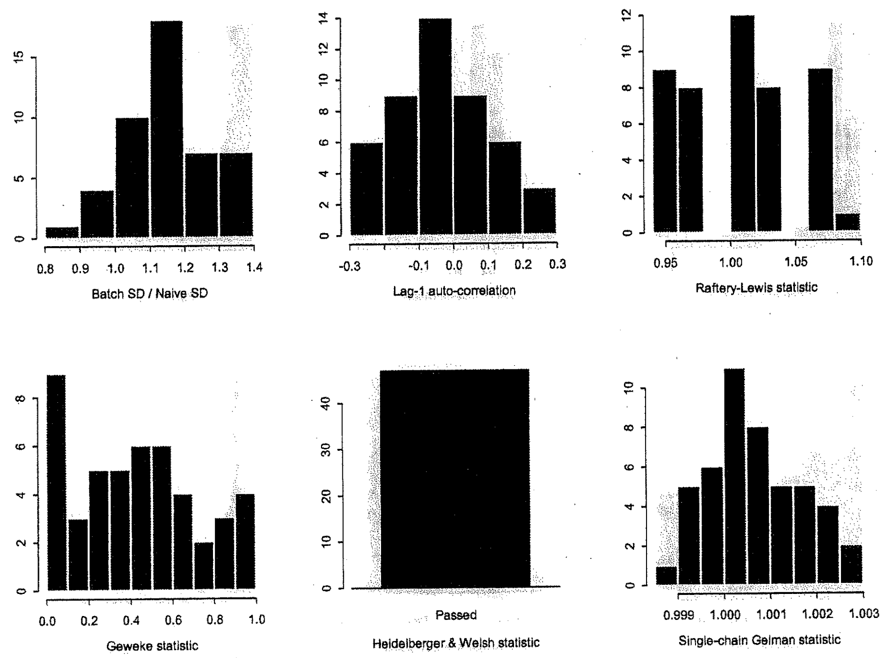


Figure 24c. Summary of six diagnostic statistics for the 47 fully-selected fishing mortalities.

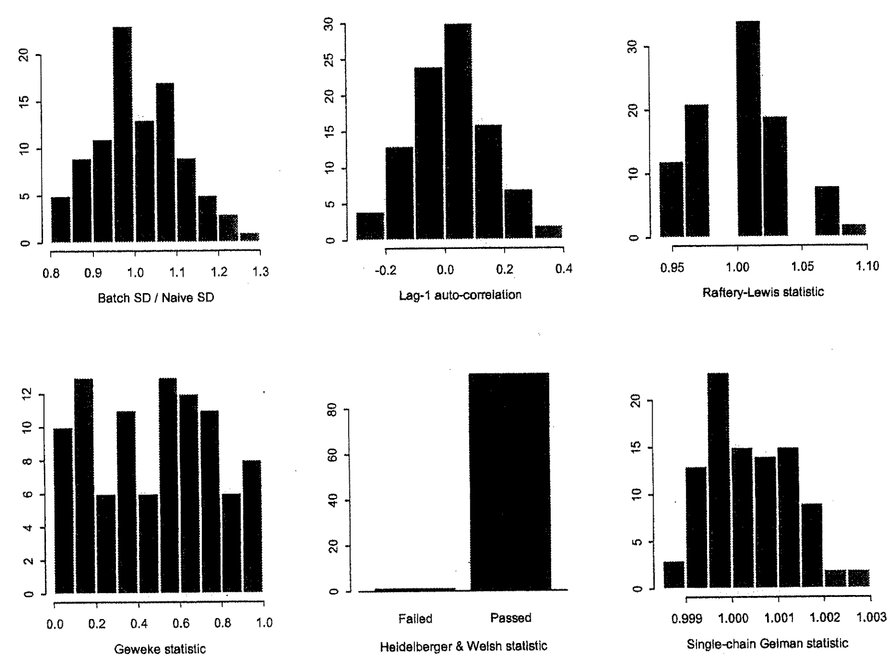


Figure 24d. Summary of six diagnostic statistics for the 96 selectivity deviations.

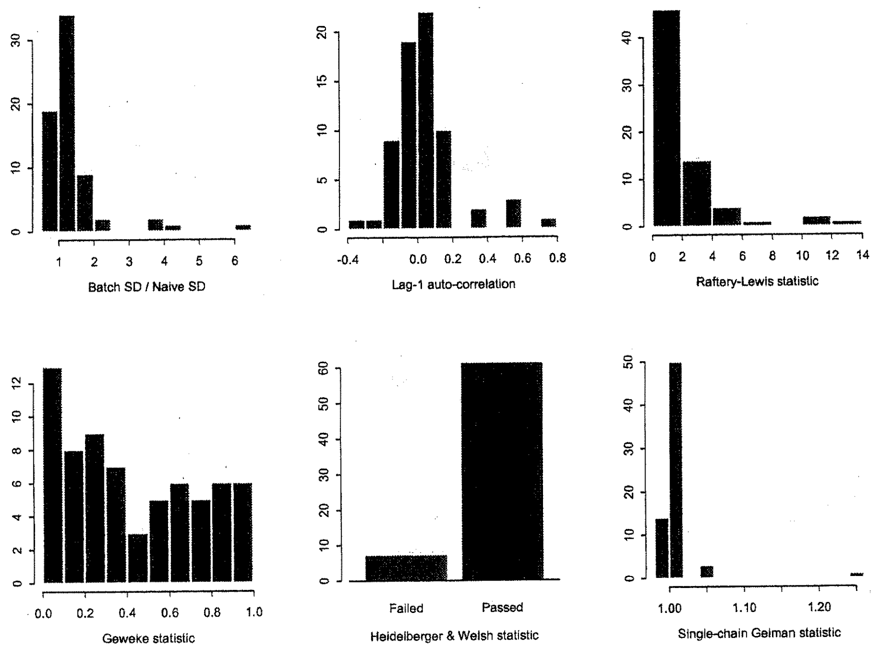


Figure 24e. Summary of six diagnostic statistics for the 68 recruitment residuals.

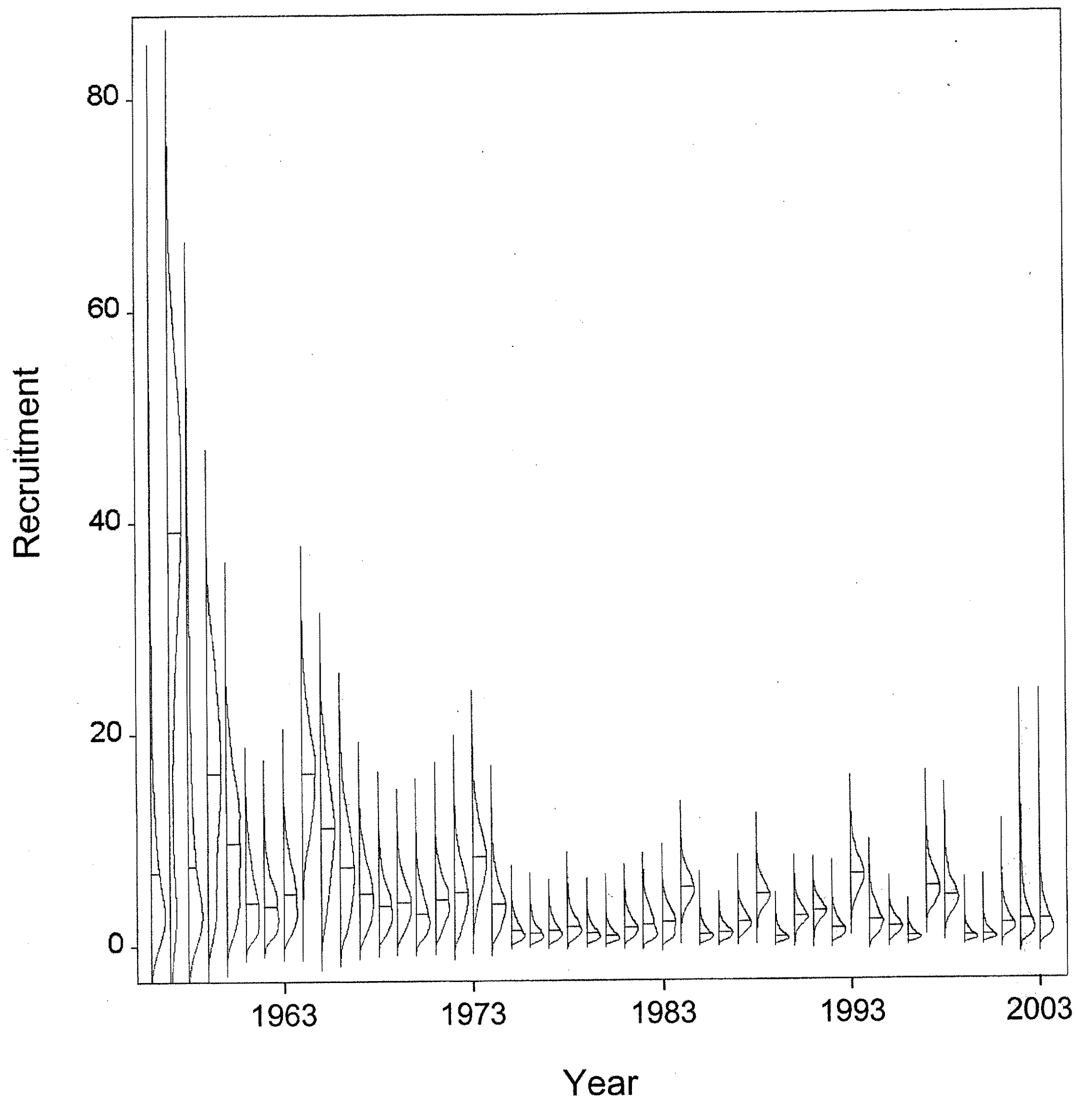


Figure 25. Smoothed posterior densities for estimated recruitment (1956-2003). Horizontal lines indicate the medians, vertical lines the ranges.

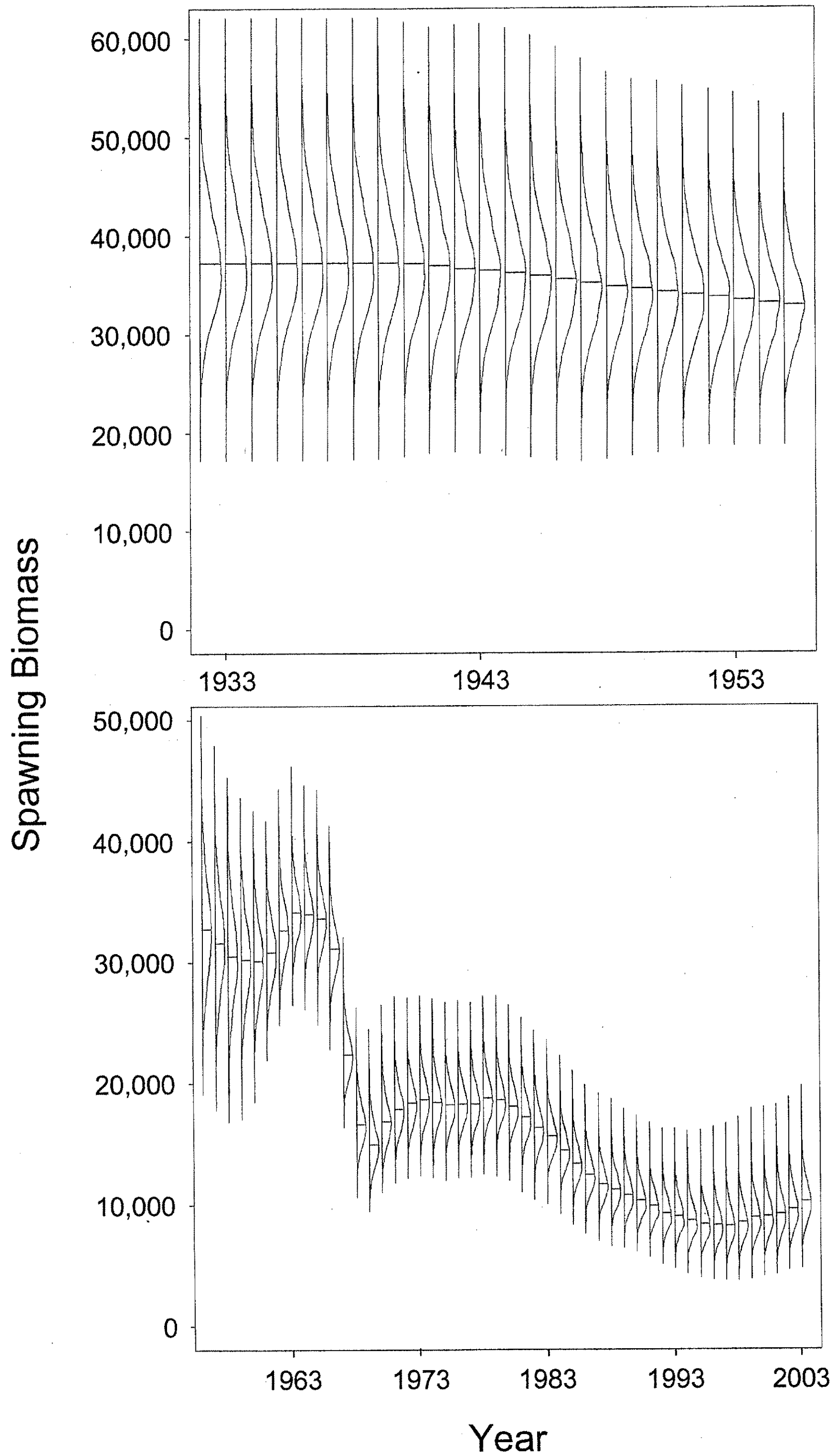


Figure 26. Smoothed posterior densities for estimated spawning biomass for the years prior to exploitation (1932-1955) and thereafter (1956-2003). Horizontal lines indicate the medians, vertical lines the ranges.

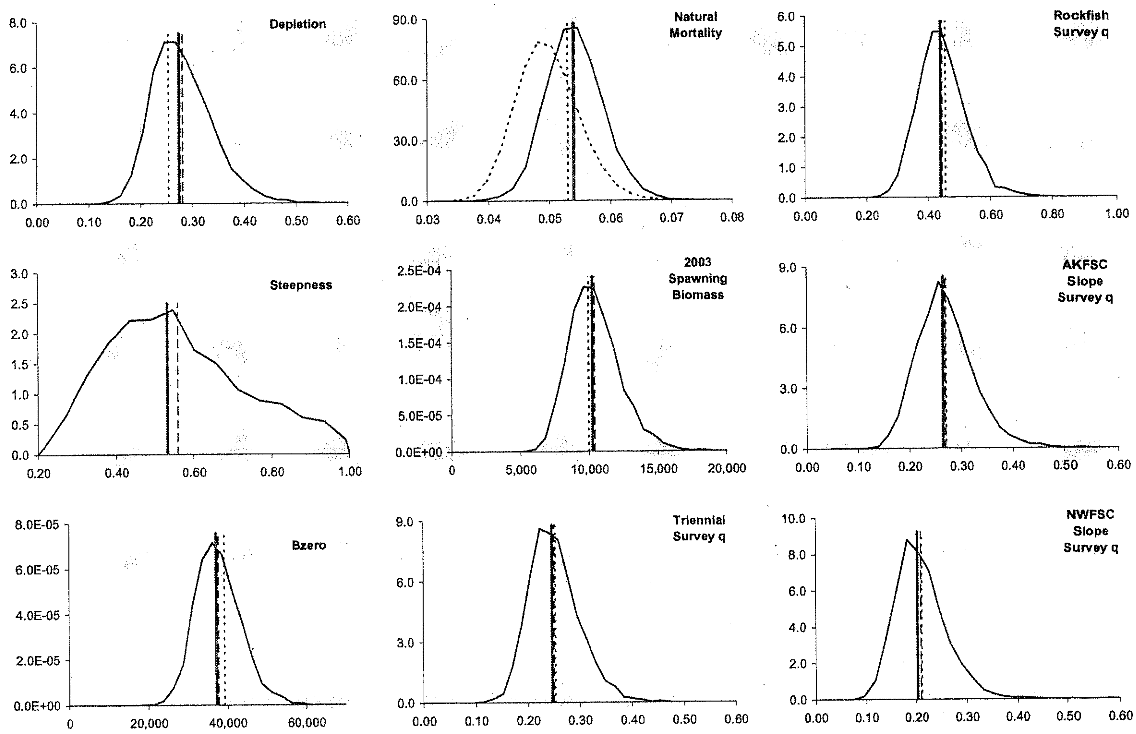


Figure 27. Posterior distributions for key parameters and derived quantities.
The solid and dotted lines indicate respectively the medians and means of the posterior distributions. The short dashes indicate the MPD estimates. For natural mortality, the informative prior, lognormal(0.05,0.1), is shown as a dashed curve.

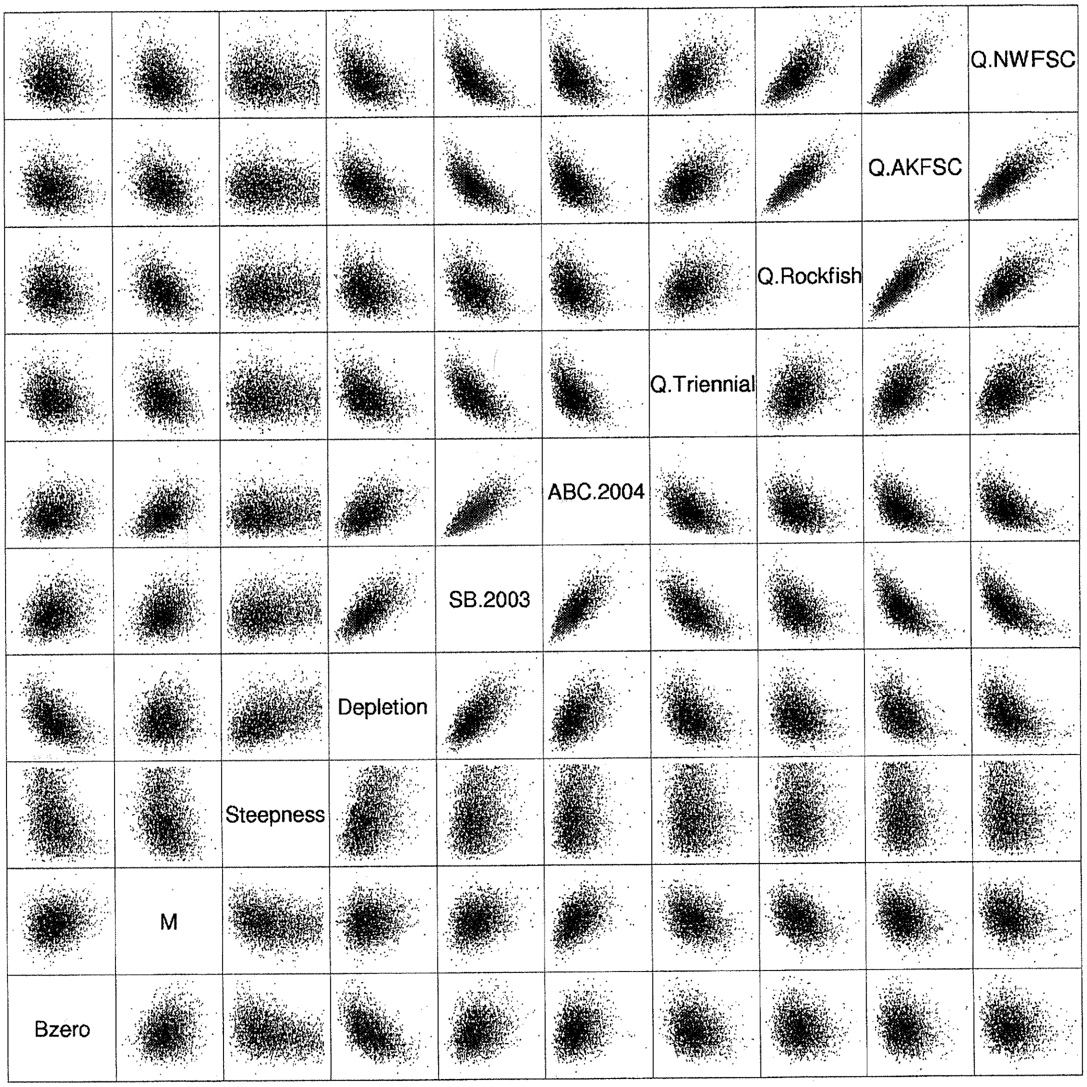


Figure 28. Correlation of key parameters and derived quantities based on 4,000 draws from the posterior distribution.

Appendix 1 Code and input files

Assessment model code

```
  // 2003 West Coast Pacific ocean perch Assessment Model code
  // April 28, 2003
//+==+==+==+==+==+==+==+==+==+==+==+==+==+==+==+==+==+==+==+==+==+==+==
+==+

DATA_SECTION

  !!CLASS ofstream report1("params.dat",ios::app);
  !!CLASS ofstream report2("spbiomass.dat",ios::app);
  !!CLASS ofstream report3("recruitment.dat",ios::app);
  !!CLASS ofstream report4("surv_sel.dat",ios::app);
  //!!CLASS ofstream report5("fish_sel.dat",ios::app);

  !!ad_comm::change_datafile_name("pop1.ctl");
  int Do_Fmort;

  init_int      styr;         // first year of fishery data
  init_int      endyr;        // last year of fishery data
  init_int      recage;       // age at recruitment
  init_int      nages;        // number of ages modeled
  init_number   mat_inflctn; //at age, not by age-index

  int styr_rec;             // first year recruitment modeled (styr -
nages + 2)
  int styr_sp;                      //first year of spawning modeled
(styr_rec - recage)
  int endyr_sp;                     //last year of spawning modeled
(endyr-recage)
  // moved beta steepness prior values
  init_vector   wt(1,nages); // weight at age for age classes modeled
  init_vector   obs_catch(styr,endyr);     // fishery catch for years of
data

  // +==+==+==+ Triennial survey Biomass +==+==+==+ +==+==+==+
  init_int      nyrs_surv; // number of years of triennial survey data
  init_ivector  yrs_surv(1,nyrs_surv);  // actual years of data
  init_vector   obs_surv_biom(1,nyrs_surv); // calculated biomass from
survey
  init_vector   obs_surv_se(1,nyrs_surv); // Standard deviations of
survey obs

  // +==+==+==+ POP survey Biomass +==+==+==+ +==+==+==+
  init_int      nyrs_surv2;          // number of years of POP+slope
survey
  init_ivector  yrs_surv2(1,nyrs_surv2); // actual years survey done
  init_vector   obs_surv_biom2(1,nyrs_surv2); // calc biomass from
survey
  init_vector   obs_surv_se2(1,nyrs_surv2); // Standard devs of survey
obs

  // +==+==+==+ AFSC Slope survey Biomass +==+==+==+ +==+==+==+
  init_int      nyrs_surv3;          // number of years of POP+slope
survey
  init_ivector  yrs_surv3(1,nyrs_surv3); // actual years survey done
```

```
  init_vector   obs_surv_biom3(1,nyrs_surv3); // calc biomass from
survey
  init_vector   obs_surv_se3(1,nyrs_surv3); // Standard devs of survey
obs

  // +==+==+==+ NWFSC Slope survey Biomass +==+==+==+ +==+==+==+
  init_int      nyrs_surv4;         // number of years of POP+slope
survey
  init_ivector  yrs_surv4(1,nyrs_surv4); // actual years survey done
  init_vector   obs_surv_biom4(1,nyrs_surv4); // calc biomass from
survey
  init_vector   obs_surv_se4(1,nyrs_surv4); // Standard devs of survey
obs

  // +==+==+==+ Old CPUE data  +==+==+==+ +==+==+==+
  init_int      nyrs_cpue; // number of years of catch per unit effort
data
  init_ivector  yrs_cpue(1,nyrs_cpue); // actual years of cpue data
  init_vector   obs_cpue(1,nyrs_cpue); // calculated cpue

  // Read in fishery Biased (old) age composition data
  init_int      nyrs_fish_age; // number of years of fishery age data
  init_ivector  yrs_fish_age(1,nyrs_fish_age); // actual years of age
data
  init_vector   nsamples_fish_age(1,nyrs_fish_age); // sample size by
year
  init_matrix   oac_fish(1,nyrs_fish_age,1,12); // observed age
composition

  // Read in new (1999+) fishery age composition data
  init_int      nyrs_fish2_age; // number of years of new fishery age
data
  init_ivector  yrs_fish2_age(1,nyrs_fish2_age); // actual years of age
data
  init_vector   nsamples_fish2_age(1,nyrs_fish2_age); // sample size by
year
  init_matrix   oac_fish2(1,nyrs_fish2_age,1,nages); // observed age
composition

  // Read in Triennial Survey age composition data
  init_int      nyrs_surv_age; // number of years of survey age data
  init_ivector  yrs_surv_age(1,nyrs_surv_age); // actual years of data
  init_vector   nsamples_surv_age(1,nyrs_surv_age); // sample size by
year
  init_matrix   oac_surv(1,nyrs_surv_age,1,nages); // observed age
composition

  // Read in pop and Slope Survey age composition data
  init_int      nyrs_surv2_age; // number of years of survey age data
  init_ivector  yrs_surv2_age(1,nyrs_surv2_age); // actual years of
data
  init_vector   nsamples_surv2_age(1,nyrs_surv2_age); // sample size by
year
  init_matrix   oac_surv2(1,nyrs_surv2_age,1,nages); // observed age
comp

  // Read in fishery size composition data
  init_int      nlenbins; // number of length classes
  init_int      nyrs_fish_size; //number of years of fishery size data
  init_ivector  yrs_fish_size(1,nyrs_fish_size); // actual years of
size data
```

```
  init_vector   nsamples_fish_size(1,nyrs_fish_size); // sample size by
year
  init_matrix   osc_fish(1,nyrs_fish_size,1,nlenbins); // observed size
comp

  // Read in unused fishery size compostion data for comparison
  init_int      nyrs_ufish_size; //number of years of unused fishery
size data
  init_ivector  yrs_ufish_size(1,nyrs_ufish_size); // actual years
unused data
  init_matrix   osc_ufish(1,nyrs_ufish_size,1,nlenbins); // observed
size comp

  // Read in Triennial Survey size composition data
  init_int      nyrs_surv_size; // number of years of survey size data
  init_ivector  yrs_surv_size(1,nyrs_surv_size); // actual years of
data
  init_vector   nsamples_surv_size(1,nyrs_surv_size); // sample size by
year
  init_matrix   osc_surv(1,nyrs_surv_size,1,nlenbins);  //observed size
comp

  // Read in Rockfish and Slope Survey size composition data
  init_int      nyrs_surv2_size; // number of years of survey size data
  init_ivector  yrs_surv2_size(1,nyrs_surv2_size); // actual years of
data
  init_vector   nsamples_surv2_size(1,nyrs_surv2_size); // sample size
by year
  init_matrix   osc_surv2(1,nyrs_surv2_size,1,nlenbins);  //observed
size comp
  init_matrix   sizeage(1,nages,1,nlenbins); // age to length
transition matrix
  init_matrix   ageage(1,nages,1,nages); // empirical ageing error
matrix

  int dim_sel;  // number of selectivity curve changes over years of
data
  int i;
  int ii;
  int j;
  number pii;
  int phase_F55;  // phase to estimate various spawner per recruit
fishing levels

  // =+=+=+=+=+=+=+=+=+=+=+=+=+=+=+=+=
  // Read in control file stuff
  !! ad_comm::change_datafile_name("pop2.ctl"); // another data file

  // switch for combined (=0) or split (=1) survey selectivity
  // for Triennial vs. Rockfish and Slope surveys.
  // init_int    surv_split; // switch for combined (=0) or split (=1)

  init_int    plusgrp; // fishery age plus group switch, 0 or 1
(1=include)
  init_number cv_cpue; // CV for CPUE index
  init_int    SrType;                 // Ricker = 1; B-Holt = 2
  init_number srprior_a;             // parameter for beta steepness
prior
  init_number srprior_b ;             // parameter for beta steepness
prior
  init_int    steeppriorswitch; // 1 for beta (above), 0 for no prior
```

```
  init_int    max_sel_age;      // age class beyond which fishery
selectivity curve flat
  init_int    max_sel_age_surv; // age class beyond which survey
selectivity curve flat
  init_int    Do_Robust_Phase;  // phase at which robust age likelihood
done
  init_int    ph_steepness;     // phase to estimate steepness
  init_number rho;              // rho (serial recruitment correlation)
  init_number sigr;             // SD for S-R relationship
  init_int    ph_M;             // phase to estimate natural mortality
  init_int    ph_sigmar;        // phase to estimate recruitment
variability
  init_int    ph_Fdev;          // phase to estimate deviance in
fishing morality
  init_int    ph_recdev;        // phase to estimate recruitment
deviances

  // selectivity stuff
  init_int surv_switch;               // Type of survey selectivity to
use
  init_int    ph_seldev_fish;   // phase to estimate fishery
selectivity devs
  init_int    ph_surv_sel;      // phase to estimate survey selectivity

  // the following selectivity phases are given values in the local
calcs section
  int         ph_surv_sel_type1 // phase to estimate option 1
selectivity mean
  int         ph_seldev_surv;   // phase to estimate survey selectivity
devs
  int         ph_asym_sel;      // phase to estimate asymptotic
selectivity for survey
  int         ph_sel_a_rso;         // phase for age at full select rso
model option 4
  int         ph_sel_ln_alpha_rso;  // phase for ln_alpha rso model
option 4
  int         ph_sel_beta_rso;      // phase for beta rso model option
4
  int         ph_sel_sfull_col;     // phase for sfull coleraine sel
option
  int         ph_sel_ln_vleft_col;  // phase for the left limb variance
coleraine sel option
  int         ph_sel_ln_vright_col; // phase for the right limb
variance coleraine sel option
  int         ph_sel_peak_syn;  // phase for the ascending peak
synthesis sel option
  int         ph_sel_init_syn;  // phase for the ascending init value
synthesis sel option
  int         ph_sel_infl_syn;  // phase for the ascending inflection
point synthesis sel option
  int         ph_sel_slope_syn; // phase for the ascending slope
synthesis sel option
  int         ph_sel_final_syn; // phase for the descending final value
synthesis sel option
  int         ph_sel_infl2_syn; // phase for the descending inflection
synthesis sel option
  int         ph_sel_slope2_syn;// phase for the descending slope
synthesis sel option

  init_int    ph_fish_sel;      // phase to estimate fishery
selectivity
```

```
  init_int    ph_surv_q;          // phase to estimate triennial survey
catchability
  init_int    group_num;          // number of years between changes in
estimated selectivity curve
  init_number natmortprior;       // mean natural mortality prior value
  init_number cvnatmortprior;     // cv ""
  init_number qprior;             // mean catchability prior value
  init_number cvqprior;           // cv ""
  init_int qpriortype;         // prior type - 0 = noninformative, 1 =
normal, 2 = lognormal.
  init_int qprior_switch;      // determines if on triennial (0) or all
(1)

  vector M_prior(1,6);
  vector q_prior(1,6);

  init_vector lambda(1,20);
  int jj;
//+==+==+==+==+==+==+==+==+==+==+==+==+==+==+==+==+==+==+==+==+==+==+==+==+==
+==+

 LOCAL_CALCS

  // selectivity stuff
  int ii=0;

  // this counts the number of groups over the time series
  for (i=styr;i<endyr;i++)
    {
        if (!(i%group_num))
        {
            ii++;
        }
    };
  dim_sel=ii;  // dim_sel now carries the correct number of groups for
the entire time-series

  styr_rec   = styr - nages + 2;    // Owen corrected(old = styr-
nages+recage-1)
  styr_sp    = styr_rec - recage ;  // First year of spawning biomass
  endyr_sp   = endyr - recage - 1;  // endyr year of (main) spawning
biomass
  phase_F55 = 6;

  // selectivity stuff
  // For now, this is where you turn on and off parameters
  // and select phases within selectivity options
  // this could be moved to the control file

  // Set up the parameter phases for the selectivity option
  if (surv_switch == 1)
    {
      //  turn on the parameters to be used
        ph_surv_sel_type1 = ph_surv_sel;
        //  turn off the parameters for other options
        ph_seldev_surv = -5;
      ph_asym_sel = -5;
        ph_sel_a_rso = -5;
      ph_sel_ln_alpha_rso = -5;
        ph_sel_beta_rso = -5;
        ph_sel_sfull_col = -5;
```

```
    ph_sel_ln_vleft_col = -5;
    ph_sel_ln_vright_col = -5;
      ph_sel_peak_syn = -5;
    ph_sel_init_syn = -5;
    ph_sel_infl_syn = -5;
    ph_sel_slope_syn = -5;
    ph_sel_final_syn = -5;
    ph_sel_infl2_syn = -5;
    ph_sel_slope2_syn = -5;
  };

if (surv_switch == 2)
  {
    //  turn on the parameters to be used
      ph_surv_sel_type1 = ph_surv_sel;
      ph_seldev_surv = ph_surv_sel + 2;
      //  turn off the parameters for other options
    ph_asym_sel = -5;
      ph_sel_a_rso = -5;
    ph_sel_ln_alpha_rso = -5;
      ph_sel_beta_rso = -5;
      ph_sel_sfull_col = -5;
    ph_sel_ln_vleft_col = -5;
    ph_sel_ln_vright_col = -5;
      ph_sel_peak_syn = -5;
    ph_sel_init_syn = -5;
    ph_sel_infl_syn = -5;
    ph_sel_slope_syn = -5;
    ph_sel_final_syn = -5;
    ph_sel_infl2_syn = -5;
    ph_sel_slope2_syn = -5;
  };

if (surv_switch == 3)
  {
      //  turn on the parameters to be used
    ph_asym_sel = ph_surv_sel;
      //  turn off the parameters for other options
      ph_surv_sel_type1 = -5;
      ph_seldev_surv = -5;
      ph_sel_a_rso = -5;
    ph_sel_ln_alpha_rso = -5;
      ph_sel_beta_rso = -5;
      ph_sel_sfull_col = -5;
    ph_sel_ln_vleft_col = -5;
    ph_sel_ln_vright_col = -5;
      ph_sel_peak_syn = -5;
    ph_sel_init_syn = -5;
    ph_sel_infl_syn = -5;
    ph_sel_slope_syn = -5;
    ph_sel_final_syn = -5;
    ph_sel_infl2_syn = -5;
    ph_sel_slope2_syn = -5;
  };

if (surv_switch == 4)
  {
      //  turn on the parameters to be used
      ph_sel_a_rso = -1;
    ph_sel_ln_alpha_rso = ph_surv_sel + 2;
      ph_sel_beta_rso = ph_surv_sel;
```

```
      //  turn off the parameters for other options
      ph_asym_sel = -5;
      ph_surv_sel_type1 = -5;
      ph_seldev_surv = -5;
      ph_sel_sfull_col = -5;
    ph_sel_ln_vleft_col = -5;
    ph_sel_ln_vright_col = -5;
      ph_sel_peak_syn = -5;
    ph_sel_init_syn = -5;
    ph_sel_infl_syn = -5;
    ph_sel_slope_syn = -5;
    ph_sel_final_syn = -5;
    ph_sel_infl2_syn = -5;
    ph_sel_slope2_syn = -5;
  };

if (surv_switch == 5)
  {
      //  turn on the parameters to be used
      ph_sel_sfull_col = ph_surv_sel + 2;
    ph_sel_ln_vleft_col = ph_surv_sel;
    ph_sel_ln_vright_col = ph_surv_sel;
      //  turn off the parameters for other options
      ph_asym_sel = -5;
      ph_surv_sel_type1 = -5;
      ph_seldev_surv = -5;
      ph_sel_a_rso = -5;
    ph_sel_ln_alpha_rso = -5;
      ph_sel_beta_rso = -5;
      ph_sel_peak_syn = -5;
    ph_sel_init_syn = -5;
    ph_sel_infl_syn = -5;
    ph_sel_slope_syn = -5;
    ph_sel_final_syn = -5;
    ph_sel_infl2_syn = -5;
    ph_sel_slope2_syn = -5;
  };

if (surv_switch == 6)
  {
      //  turn on the parameters to be used
      ph_sel_peak_syn = -5;
    ph_sel_init_syn = ph_surv_sel;
    ph_sel_infl_syn = ph_surv_sel + 1;
    ph_sel_slope_syn = ph_surv_sel + 1;
    ph_sel_final_syn = -5;
    ph_sel_infl2_syn = -5;
    ph_sel_slope2_syn = -5;
      //  turn off the parameters for other options
      ph_asym_sel = -5;
      ph_surv_sel_type1 = -5;
      ph_seldev_surv = -5;
      ph_sel_a_rso = -5;
    ph_sel_ln_alpha_rso = -5;
      ph_sel_beta_rso = -5;
      ph_sel_sfull_col = -5;
    ph_sel_ln_vleft_col = -5;
    ph_sel_ln_vright_col = -5;
  };
```

```
//+==+==+==+==+==+==+==+==+==+==+==+==+==+==+==+==+==+==+==+==+==+==+==+==
+==+

 END_CALCS

INITIALIZATION_SECTION

  sel_slp_surv   -0.5
  sel_a50_surv    2.0
  steepness       0.5
  log_Rzero       1.8
  log_avg_rec     1.8
  natmort          .05
  log_avg_F      -1.6
  fish_sel_coffs  -.10

  // New selectivity parameters
  sel_a_rso          23.0
  sel_beta_rso       0.8
  sel_ln_alpha_rso   1.3
  sel_sfull_col      8.0
  sel_ln_vleft_col   5.0
  sel_ln_vright_col  10.0
  sel_peak_syn       22.0
  sel_init_syn       0.7
  sel_infl_syn       15.0
  sel_slope_syn      0.9
  sel_final_syn      0.8
  sel_infl2_syn      19.0
  sel_slope2_syn     0.7
  sel_slp_surv2      -0.5
  sel_a50_surv2      2.0
  sel2_a_rso         23.0
  sel2_beta_rso      0.8
  sel2_ln_alpha_rso  1.3
  sel2_sfull_col     8.0
  sel2_ln_vleft_col   5.0
  sel2_ln_vright_col 10.0
  sel2_peak_syn       22.0
  sel2_init_syn       0.7
  sel2_infl_syn       15.0
  sel2_slope_syn      0.9
  sel2_final_syn      0.8
  sel2_infl2_syn      19.0
  sel2_slope2_syn     0.7

//+==+==+==+==+==+==+==+==+==+==+==+==+==+==+==+==+==+==+==+==+==+==+==+==
+==+

PARAMETER_SECTION

  init_number             log_avg_rec(1);             // log of average
recruitment
  init_number             log_Rzero(1);                     // Unfish
equil recruitment (logged)
  init_number             log_q_cpue(1);              // Log fishery
catchability
  init_number             log_q_surv(ph_surv_q);      // Log survey1
catchability
```

```
  init_number              log_q_surv2(ph_surv_q);       // Log survey2
catchability
  init_number              log_q_surv3(ph_surv_q);       // Log survey3
catchability
  init_number              log_q_surv4(ph_surv_q);       // Log survey4
catchability
  init_bounded_number      natmort(0.01,.2,ph_M);     // Natural
mortality
  init_bounded_number      steepness(0.21,0.99,ph_steepness); // Bounded
SR shape parameter
  //init_bounded_number      sigr(0.1,2.,ph_sigmar);    // SR variance
parameter
  //init_bounded_number      rho(0.0,0.9,ph_rho); // Bounded SR serial
correlation parameter
  init_number              log_avg_F(1);                       // Average
Fishing mortality

  // Deviations from recruitment model in each year
  init_bounded_dev_vector    log_rec_dev(styr_rec,endyr,-
10,10,ph_recdev);

  // Annual effect on fishing (effort implied)
  init_bounded_dev_vector    log_F_devs(styr,endyr,-10,10,ph_Fdev);

  // Selectivity parameters
  // for shelf (triennial) survey
  // options 1 and 2
  // these are actually in log-space
  init_vector      surv_sel_coffs(1,max_sel_age_surv,ph_surv_sel_type1);
// Sel at age coefficients

  // option 2

  // Time changes in survey selectivity
  init_bounded_matrix  sel_devs_surv(1,dim_sel,1,max_sel_age_surv,-
5.,5.,ph_seldev_surv);

  //option 3
  init_bounded_number  sel_slp_surv(-500,3,ph_asym_sel);  // Asymptotic
Selectivity Coef
  init_bounded_number  sel_a50_surv(-500,3.3,ph_asym_sel);  //
Asymptotic Sel Coef

  //option 4
  init_number          sel_a_rso(ph_sel_a_rso); // age at full
selectivity
  init_bounded_number  sel_ln_alpha_rso(-20,20,ph_sel_ln_alpha_rso);
  number               sel_alpha_rso; // this will be the exponentiated
ln_alpha
  init_bounded_number  sel_beta_rso(0.0000001,1,ph_sel_beta_rso);

  //option 5
  init_bounded_number  sel_sfull_col(1,nages,ph_sel_sfull_col); // age
at full selectivity
  init_bounded_number  sel_ln_vleft_col(-15,15,ph_sel_ln_vleft_col); //
ln ascending limb variance
  init_bounded_number  sel_ln_vright_col(-15,15,ph_sel_ln_vright_col);
//ln descending limb variance
  number               sel_vleft_col; //  this will be the
exponentiated ln_vleft
```

```
  number                 sel_vright_col; //  this will be the
exponentiated ln_vright

  //option 6
  init_bounded_number  sel_peak_syn(1,nages,ph_sel_peak_syn);
  init_bounded_number  sel_init_syn(0.000001,1,ph_sel_init_syn);
  init_bounded_number  sel_infl_syn(1,nages,ph_sel_infl_syn);
  init_number          sel_slope_syn(ph_sel_slope_syn);
  init_bounded_number  sel_final_syn(0.000001,1,ph_sel_final_syn);
  init_bounded_number  sel_infl2_syn(1,nages,ph_sel_infl2_syn);
  init_number          sel_slope2_syn(ph_sel_slope2_syn);

  //selectivity parameters for slope and POP survey

  //options 1 and 2
  // these are actually in log-space
  init_vector
surv2_sel_coffs(1,max_sel_age_surv,ph_surv_sel_type1);
  // Sel at age coefficients

  // option 2
  // there are more of these than needed

  // Time changes in survey selectivity
  init_bounded_matrix  sel_devs_surv2(1,dim_sel,1,max_sel_age_surv,-
5.,5.,ph_seldev_surv);


  //option 3
  init_bounded_number  sel_slp_surv2(-500,3,ph_asym_sel);  //
Asymptotic Selectivity Coef
  init_bounded_number  sel_a50_surv2(-500,3.3,ph_asym_sel);  //
Asymptotic Sel Coef

  //option 4
  init_number          sel2_a_rso(ph_sel_a_rso); // age at full
selectivity
  init_bounded_number  sel2_ln_alpha_rso(-20,20,ph_sel_ln_alpha_rso);
  number               sel2_alpha_rso; // this will be the
exponentiated ln_alpha
  init_bounded_number  sel2_beta_rso(0.0000001,1,ph_sel_beta_rso);

  //option 5
  init_bounded_number  sel2_sfull_col(1,nages,ph_sel_sfull_col); // age
at full selectivity
  init_bounded_number  sel2_ln_vleft_col(-15,15,ph_sel_ln_vleft_col);
// ln ascending limb variance
  init_bounded_number  sel2_ln_vright_col(-15,15,ph_sel_ln_vright_col);
//ln descending limb variance
  number               sel2_vleft_col; //  this will be the
exponentiated ln_vleft
  number               sel2_vright_col; //  this will be the
exponentiated ln_vright

  //option 6
  init_bounded_number  sel2_peak_syn(1,nages,ph_sel_peak_syn);
  init_bounded_number  sel2_init_syn(0.000001,1,ph_sel_init_syn);
  init_bounded_number  sel2_infl_syn(1,nages,ph_sel_infl_syn);
  init_number          sel2_slope_syn(ph_sel_slope_syn);
  init_bounded_number  sel2_final_syn(0.000001,1,ph_sel_final_syn);
  init_bounded_number  sel2_infl2_syn(1,nages,ph_sel_infl2_syn);
```

```
  init_number          sel2_slope2_syn(ph_sel_slope2_syn);

  // Fishery Selectivity
  init_bounded_matrix sel_devs_fish(1,dim_sel,1,max_sel_age,-
5.,5.,ph_seldev_fish);
  init_vector  fish_sel_coffs(1,max_sel_age,ph_fish_sel);  //Fishery
sel at age coefs

  matrix esc_surv(1,nyrs_surv_size,1,nlenbins); //--Exp prop at size in
Survey
  matrix eac_surv(1,nyrs_surv_age,1,nages);      //--Exp prop at age in
Survey
  matrix esc_surv2(1,nyrs_surv2_size,1,nlenbins);//--Exp prop at size
in Survey2
  matrix eac_surv2(1,nyrs_surv2_age,1,nages);      //--Exp prop at age
in Survey2
  matrix esc_fish(1,nyrs_fish_size,1,nlenbins); //--Exp prop at size in
Fishery
  matrix esc_ufish(1,nyrs_ufish_size,1,nlenbins); // Exp prop at size
in Fishery
  matrix eac_fish1(1,nyrs_fish_age,1,nages);     // -- Exp prop at age
in Fishery
  matrix eac_fish(1,nyrs_fish_age,1,12);         //-- "" - truncated
  matrix eac_fish2(1,nyrs_fish2_age,1,nages);    //-- """" - 1999+

  vector Fmort(styr,endyr);
  matrix catage(styr,endyr,1,nages);
  vector pred_catch(styr,endyr);
  vector seltmp(1,nages);
  vector p_mature(1,nages);
  vector sp_biom(styr_sp,endyr+1);
  vector tot_biom(styr,endyr+1);
  matrix natage(styr,endyr+1,1,nages);
  matrix Z(styr,endyr,1,nages);
  matrix F(styr,endyr,1,nages);
  matrix S(styr,endyr,1,nages);
  matrix log_surv_sel(styr,endyr,1,nages);
  matrix surv_sel(styr,endyr,1,nages); // this maintains survey
selectivity for years with no survey...
  matrix log_surv2_sel(styr,endyr,1,nages);// added for survey 2
  matrix surv2_sel(styr,endyr,1,nages); // added for survey 2
  matrix log_fish_sel(styr,endyr,1,nages);
  matrix fish_sel(styr,endyr,1,nages);

  number ssqcatch;
  number avgfishsel;
  number avgsurvsel;
  number avgsurv2sel; // added for survey 2
  number alpha;
  number beta;
  number Rzero;
  number surv;

  vector sel_like(1,5);
  vector surv_like(1,5);
  vector age_like(1,7);
  vector rec_like(1,4);
  vector fmort_like(1,3);
  vector Priors(1,6);
  vector offset(1,7); // Offsets for Multinomial age likelihood
  vector offset2(1,7); // Offsets for Robust Likelihood
```

```
number sumtmp;

vector pred_cpue(1,nyrs_cpue);
vector pred_surv(1,nyrs_surv);
vector pred_surv2(1,nyrs_surv2);
vector pred_surv3(1,nyrs_surv3);
vector pred_surv4(1,nyrs_surv4);
vector SRec_Spawn(1,20);
vector SRec_Rec(1,20);

// Parameters for computing SPR rates
init_bounded_number F55(0.01,1.,phase_F55);
init_bounded_number F50(0.01,1.,phase_F55);
init_bounded_number F40(0.01,1.,phase_F55);
number ABC;
number F2003;
vector natage2004(1,nages);
number F2004;
vector natage2005(1,nages);
number totbiom2004;
number totbiom2005;

// Stuff for SPR and yield projections
number sigmaRsq;
number SB0;
number SBF55;
number SBF50;
number SBF40;
number sprpen;
matrix Nspr(1,4,1,nages);

sdreport_number endbiom;
sdreport_number q_surv;
sdreport_number q_surv2;
sdreport_number q_surv3;
sdreport_number q_surv4;
sdreport_number q_cpue;
sdreport_number begbiom;
sdreport_number Depletion;
sdreport_number MSY;
sdreport_number MSYL;
sdreport_number Fmsy;
sdreport_number Fmsy_Fend;
sdreport_number Rmsy;
sdreport_number Bmsy;
sdreport_number Bcur_Bmsy;
sdreport_number Bzero;
number Btotzero; // added 4/28/03 to report total "initial" biomass

number phizero;
number qfix_surv; // added 3/19/03 fix at 1.0 at age 10
number qfix_surv2;
number qfix_surv3;
number qfix_surv4;

sdreport_vector est_rec(styr_rec,endyr);
sdreport_vector est_spb(styr_rec,endyr);
sdreport_vector pred_sd_rec(styr_rec,endyr);

vector pred_rec(styr_rec,endyr);
vector chi(styr_rec,endyr);
```

```
  objective_function_value obj_fun;

//+==+==+==+==+==+==+==+==+==+==+==+==+==+==+==+==+==+==+==+==+==+==+==+==
+==+

PRELIMINARY_CALCS_SECTION

  // Get maturity vector
  // NOTE Females only
  for (j=1; j<=nages; j++)
    {
      //old version
        //p_mature(j)= 0.5/(1.+ mfexp(-2.*(double(j)-
mat_inflctn+recage-1.)));
        //Ian's rewrite to compile in VCC
      p_mature(j)= 0.5 / (1. + mfexp(-2. * (double(j) - mat_inflctn +
double(recage) - 1.)));
    }

  //--Caculate offsets for multinomial and robust likelihoods----------
---
  pii = 3.14159265358979;
  for (i=1; i<=nyrs_surv_age; i++)
    {
      // First make sure that they data are in proportions...
      oac_surv(i)/=sum(oac_surv(i));
      offset=0.;
      offset2=0.;
      // the multinomial value (-LnL) for a perfect fit...
      offset(1) -= nsamples_surv_age(i)*(oac_surv(i) + 0.001) *
log(oac_surv(i) + 0.001 ) ;
      offset2(1) -= nages*log(1.01);
      offset2(1) += 0.5*sum(log(2*pii*(oac_surv(i)-square(oac_surv(i))
+ (0.1/nages))));
    }
  for (i=1; i<=nyrs_surv2_age; i++)
    {
      // First make sure that they data are in proportions...
      oac_surv2(i)/=sum(oac_surv2(i));
      // the multinomial value (-LnL) for a perfect fit...
      offset(2) -= nsamples_surv2_age(i)*(oac_surv2(i) + 0.001) *
log(oac_surv2(i) + 0.001 ) ;
      offset2(2) -= nages*log(1.01);
      offset2(2) += 0.5*sum(log(2*pii*(oac_surv2(i)-
square(oac_surv2(i)) + (0.1/nages))));
    }
  for (i=1; i<=nyrs_fish_age; i++)
    {
    if(plusgrp==1)
      {
      oac_fish(i)/=sum(oac_fish(i));
      offset(3) -= nsamples_fish_age(i)* ((oac_fish(i) + 0.001) *
log(oac_fish(i) + 0.001 )) ;
      offset2(3) -= 12*log(1.01);
      offset2(3) += 0.5*sum(log(2*pii*(oac_fish(i)-square(oac_fish(i))
+ (0.1/12))));// all fixed for including plus group
      }
    else
      {
      oac_fish(i)(1,11)/=sum(oac_fish(i)(1,11));
```

```
      oac_fish(i)(12) = 0;
      offset(3) -= nsamples_fish_age(i)* ((oac_fish(i)(1,11) + 0.001) *
log(oac_fish(i)(1,11) + 0.001 )) ;
      offset2(3) -= 11*log(1.01);
      offset2(3) += 0.5*sum(log(2*pii*(oac_fish(i)(1,11)-
square(oac_fish(i)(1,11)) + (0.1/11))));
      }
    }
  for (i=1; i<=nyrs_surv_size; i++)
    {
      osc_surv(i)/=sum(osc_surv(i));
      offset(4) -= nsamples_surv_size(i)* ((osc_surv(i) + 0.001) *
log(osc_surv(i) + 0.001 )) ;
      offset2(4) -= nlenbins*log(1.01);
      offset2(4) += 0.5*sum(log(2*pii*(osc_surv(i)-square(osc_surv(i))
+ (0.1/nlenbins))));
    }
  for (i=1; i<=nyrs_surv2_size; i++)
    {
      osc_surv2(i)/=sum(osc_surv2(i));
      offset(5) -= nsamples_surv2_size(i)* ((osc_surv2(i) + 0.001) *
log(osc_surv2(i) + 0.001 )) ;
      offset2(5) -= nlenbins*log(1.01);
      offset2(5) += 0.5*sum(log(2*pii*(osc_surv2(i)-
square(osc_surv2(i)) + (0.1/nlenbins))));
    }

  for (i=1; i<=nyrs_fish_size; i++)
    {
      osc_fish(i)/=sum(osc_fish(i));
      offset(6) -= nsamples_fish_size(i)* ((osc_fish(i) + 0.001) *
log(osc_fish(i) + 0.001 )) ;
      offset2(6) -= nlenbins*log(1.01);
      offset2(6) += 0.5*sum(log(2*pii*(osc_fish(i)-square(osc_fish(i))
+ (0.1/nlenbins))));
    }

  for (i=1; i<=nyrs_fish_size; i++)
    {
      osc_ufish(i)/=sum(osc_ufish(i));
    }

  for (i=1; i<=nyrs_fish2_age; i++)
    {
      oac_fish2(i)/=sum(oac_fish2(i));
      offset(7) -= nsamples_fish2_age(i)* ((oac_fish2(i) + 0.001) *
log(oac_fish2(i) + 0.001 )) ;
      offset2(7) -= nages*log(1.01);
      offset2(7) += 0.5*sum(log(2*pii*(oac_fish2(i)-
square(oac_fish2(i)) + (0.1/nages))));
    }

  // Calculations moved from the Data and Parameter sections by Owen:
  Do_Fmort=0;
  q_prior(4)=qpriortype;
  q_prior(5)=qprior;
  q_prior(6)=cvqprior;
  M_prior(4)=2;
  M_prior(5)=natmortprior;
  M_prior(6)=cvnatmortprior;
```

```
  if (ph_surv_q<0) log_q_surv = log(qprior);
  //if (ph_rho <0) rho = 0.; // added 3/3/2003

//+==+==+==+==+==+==+==+==+==+==+==+==+==+==+==+==+==+==+==+==+==+==+==+==
+==+

RUNTIME_SECTION

   maximum_function_evaluations 100,150,300,4000
   convergence_criteria .01,.0001,1e-7

//+==+==+==+==+==+==+==+==+==+==+==+==+==+==+==+==+==+==+==+==+==+==+==+==
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PROCEDURE_SECTION

  Get_Bzero();
  Get_Selectivity();
  Get_Mortality_Rates();
  Get_Numbers_At_Age();
  Get_Catch_at_Age();
  Get_Predicted_Values();
  if (active(F55))
    {
      compute_spr_rates();
      //ABC = ((Depletion-
0.10)/0.30)*F50*fish_sel(endyr)*(elem_prod(natage2004,wt));
      ABC = F50*fish_sel(endyr)*(elem_prod(natage2004,wt));
    }
  if(last_phase())
    {
      get_msy();
      Fmsy_Fend=Fmort(endyr)/Fmsy;
    }
  if (Do_Fmort==1)
    {
      Profile_Fmort();
      exit(1);
    }
  Evaluate_Objective_Function();
  if (mceval_phase())
    {
      MCWrite();
    }

//+==+==+==+==+==+==+==+==+==+==+==+==+==+==+==+==+==+==+==+==+==+==+==+==
+==+

FUNCTION Get_Bzero

  Rzero     =  mfexp(log_Rzero);
  surv      = mfexp(-natmort);
  dvar_matrix natagetmp(styr_rec,styr,1,nages);
  natagetmp(styr_rec,1) = Rzero;

  for (j=2; j<=nages; j++)
    {
      natagetmp(styr_rec,j) = natagetmp(styr_rec,j-1) * surv;
    };
```

```
  natagetmp(styr_rec,nages) /= (1.-surv);
  Bzero   = elem_prod(wt,p_mature)*natagetmp(styr_rec);
  Btotzero = natagetmp(styr_rec)*wt;

  if (SrType==1)  // Ricker
    {
      alpha = log(-4.*steepness/(steepness-1.));
      phizero = Bzero/Rzero;
    }
  else                        // Beverton-Holt
    {
      alpha  =  Bzero * (1. - (steepness - 0.2) / (0.8*steepness) ) /
Rzero;
      beta   = (5. * steepness - 1.) / (4. * steepness * Rzero);
    };

  sp_biom.initialize();
  sp_biom(styr_sp,styr_rec-1) = Bzero;

  for (i=styr_rec;i<styr;i++)
    {
      sp_biom(i) = elem_prod(natagetmp(i), wt) * p_mature;
      natagetmp(i,1)    = mfexp(log_rec_dev(i) + log_Rzero);
      natagetmp(i+1)(2,nages) = ++(natagetmp(i)(1,nages-1)*mfexp(-
natmort ));
      natagetmp(i+1,nages) += natagetmp(i,nages)*mfexp(-natmort);
    };

  natagetmp(styr,1)    = mfexp(log_rec_dev(styr) + log_Rzero); // tried
log_avg_rec - should not make a deifference
  est_rec(styr_rec,styr) = column(natagetmp,1);
  natage(styr)   = natagetmp(styr);
  sp_biom(styr) = elem_prod(natage(styr), wt) * p_mature;

//+==+==+==+==+==+==+==+==+==+==+==+==+==+==+==+==+==+==+==+==+==+==+==+==
+==+

FUNCTION Get_Selectivity

  // Shelf (Triennial) survey
  // which survey selectivity option is turned on?

  if (surv_switch == 1)
    {
      // original Ianelli selectivity function used in model 1c
        // time invariant selectivity function
      avgsurvsel  = log(mean(mfexp(surv_sel_coffs))); //for penalty
used in likelihood
      log_surv_sel(styr)(1,max_sel_age_surv) = surv_sel_coffs;
//assigns coeffs up to max age
        log_surv_sel(styr)(max_sel_age_surv,nages) =
surv_sel_coffs(max_sel_age_surv); //assigns older ages the same as max
age
      log_surv_sel(styr)-=log(mean(mfexp(log_surv_sel(styr))));
//turns these into residuals

      for (i=styr;i<endyr;i++)
          {
          log_surv_sel(i+1)=log_surv_sel(i); // paste values across
years
        };
```

```
      surv_sel=mfexp(log_surv_sel); // exponentiate for use in model
    };

  if (surv_switch == 2)
    {
      // Original Ianelli selectivity model -- time varying
        avgsurvsel  = log(mean(mfexp(surv_sel_coffs))); //for penalty
used in likelihood
      log_surv_sel(styr)(1,max_sel_age_surv) = surv_sel_coffs;
//assigns coeffs up to max age
        log_surv_sel(styr)(max_sel_age_surv,nages) =
surv_sel_coffs(max_sel_age_surv); //assigns older ages the same as max
age
      int ii;
      log_surv_sel(styr)-=log(mean(mfexp(log_surv_sel(styr)))); //turns
these into residuals
        if (active(sel_devs_surv))
        {
          ii=1;
          for (i=styr;i<endyr;i++)
            {
              if (!(i%group_num))
                {

log_surv_sel(i+1)(1,max_sel_age_surv)=log_surv_sel(i)(1,max_sel_age_sur
v)+sel_devs_surv(ii);

log_surv_sel(i+1)(max_sel_age_surv,nages)=log_surv_sel(i+1,max_sel_age_
surv);
                  ii++;
                  log_surv_sel(i+1)-
=log(mean(mfexp(log_surv_sel(i+1))));
                }
              else
                {
                  log_surv_sel(i+1) =log_surv_sel(i);
                  log_surv_sel(i+1)-
=log(mean(mfexp(log_surv_sel(i+1))));
                };
            };
        };
      surv_sel=mfexp(log_surv_sel);
      };

  if (surv_switch == 3)  // Ianelli asymptotic selectivity function
    {
      for (j=1; j<=nages; j++)  //calculate the value over ages
          {
              //calculates the vector of selectivity coefficients for
the first year
              surv_sel(styr,j)=1./(1.+mfexp(-1.*mfexp(sel_slp_surv)*
(double(j)-mfexp(sel_a50_surv))));
          }
        for (i=styr;i<endyr;i++) //copy this value to all years
            {
              //assigns all the subsequent years the same vector of
coefficients
            surv_sel(i+1)=surv_sel(i);
          }
    };
```

```
  if (surv_switch == 4)  // Richards et al. selectivity function
    {
        sel_alpha_rso = mfexp(sel_ln_alpha_rso);
      for (j=1; j<=nages; j++)  //calculate the value over ages
          {
              if (j < sel_a_rso)
                {
                  //calculates the vector of selectivity coefficients
for the first year, ages younger than fully selected
              surv_sel(styr,j)= 1 - (mfexp((log(1 - sel_beta_rso)) +

                                                  (sel_alpha_rso *
(log(((sel_a_rso - double(j)))/(sel_a_rso - 1))))));
                }
              else  //ages >= sel_a_rso
                {
                    surv_sel(styr,j) = 1;
                };
            };
        for (i=styr;i<endyr;i++) //copy this value to all years
            {
              //assigns all the subsequent years the same vector of
coefficients
          surv_sel(i+1)=surv_sel(i);
        };
    };

  if (surv_switch == 5)  // Coleraine selectivity function
    {
        //map the log parameters into normal space
        sel_vleft_col = mfexp(sel_ln_vleft_col);
        sel_vright_col = mfexp(sel_ln_vright_col);
      for (j=1; j<=nages; j++)  //calculate the value over ages
          {
              if (j <= sel_sfull_col)
                {
                    surv_sel(styr,j)= mfexp(-((square(double(j)-
sel_sfull_col))/(sel_vleft_col)));
                  }
              else  //ages >= age at full selectivity
                {
                    surv_sel(styr,j)= mfexp(-((square(double(j)-
sel_sfull_col))/(sel_vright_col)));
                  };
            };
        for (i=styr;i<endyr;i++) //copy this value to all years
            {
              //assigns all the subsequent years the same vector of
coefficients
          surv_sel(i+1)=surv_sel(i);
        };
    };

  if (surv_switch == 6)  // Synthesis selectivity function
    {
      for (j=1; j<=nages; j++)  //calculate the value over ages
          {
              if (j < sel_peak_syn) // ascending limb
                {
                    surv_sel(styr,j)= sel_init_syn +
```

```
                    (1 - sel_init_syn)/((1 / (1 + (mfexp(-1 *
sel_slope_syn * (sel_peak_syn - sel_infl_syn))))) -
                  (1 / (1 + (mfexp(-1 * sel_slope_syn * (1 -
sel_infl_syn)))))) *
                       ((1/(1+mfexp(-1*sel_slope_syn*(double(j)-
sel_infl_syn)))) -
                       (1 / (1 + (mfexp(-1 * sel_slope_syn * (1 -
sel_infl_syn))))));
                  }
            else
              {
                if (j > (sel_peak_syn + 1)) // descending limb
                  {
                     surv_sel(styr,j) = 1 +
                       (sel_final_syn - 1)/((1 / (1 + (mfexp(-1 *
sel_slope2_syn * (nages - sel_infl2_syn))))) -
                    (1 / (1 + (mfexp(-1 * sel_slope2_syn *
((sel_peak_syn+1) - sel_infl2_syn)))))) *
                         ((1/(1+mfexp(-1*sel_slope2_syn*(double(j)-
sel_infl2_syn)))) -
                         (1 / (1 + (mfexp(-1 * sel_slope2_syn *
((sel_peak_syn+1) - sel_infl2_syn))))));
                    }
                  else // between the peaks
                    {
                      surv_sel(styr,j) = 1.0;
                    };
            };
            };

      for (i=styr;i<endyr;i++) //copy this value to all years
            {
              //assigns all the subsequent years the same vector of
coefficients
          surv_sel(i+1)=surv_sel(i);
        };
    };

  // NWFSC, AKFSC Slope + POP survey
  // which survey selectivity option is turned on?

  if (surv_switch == 1)
    {
      // Ianelli selectivity function used in model 1c
        // time invariant selectivity function
      avgsurv2sel  = log(mean(mfexp(surv2_sel_coffs))); //for penalty
used in likelihood
      log_surv2_sel(styr)(1,max_sel_age_surv) = surv2_sel_coffs;
//assigns coeffs up to max age
        log_surv2_sel(styr)(max_sel_age_surv,nages) =
surv2_sel_coffs(max_sel_age_surv); //assigns older ages the same as max
age
      log_surv2_sel(styr)-=log(mean(mfexp(log_surv2_sel(styr))));
//turns these into residuals
      for (i=styr;i<endyr;i++)
          {
          log_surv2_sel(i+1)=log_surv2_sel(i); //paste values across
years
        };
      surv2_sel=mfexp(log_surv2_sel);
    };
```

```
  if (surv_switch == 2)
    {
      //original Ianelli selectivity model -- time varying
        avgsurv2sel  = log(mean(mfexp(surv2_sel_coffs))); //for penalty
used in likelihood
      log_surv2_sel(styr)(1,max_sel_age_surv) = surv2_sel_coffs;
//assigns coeffs up to max age
        log_surv2_sel(styr)(max_sel_age_surv,nages) =
surv2_sel_coffs(max_sel_age_surv); //assigns older ages the same as max
age
      int ii;
      log_surv2_sel(styr)-=log(mean(mfexp(log_surv2_sel(styr))));
//turns these into residuals
        if (active(sel_devs_surv2))
        {
          ii=1;
          for (i=styr;i<endyr;i++)
            {
              if (!(i%group_num))
                {

log_surv2_sel(i+1)(1,max_sel_age_surv)=log_surv2_sel(i)(1,max_sel_age_s
urv)+sel_devs_surv2(ii);

log_surv2_sel(i+1)(max_sel_age_surv,nages)=log_surv2_sel(i+1,max_sel_ag
e_surv);
                  ii++;
                  log_surv2_sel(i+1)-
=log(mean(mfexp(log_surv2_sel(i+1))));
                }
              else
                {
                  log_surv2_sel(i+1) =log_surv2_sel(i);
                  log_surv2_sel(i+1)-
=log(mean(mfexp(log_surv2_sel(i+1))));
                };
            };
        };
      surv2_sel=mfexp(log_surv2_sel);
      };

  if (surv_switch == 3)  //this is the Ianelli asymptotic selectivity
function
    {
      for (j=1; j<=nages; j++)  //calculate the value over ages
          {
              //calculates the vector of selectivity coefficients for
the first year
              surv2_sel(styr,j)=1./(1.+mfexp(-1.*mfexp(sel_slp_surv2)*
(double(j)-mfexp(sel_a50_surv2))));
          }
          for (i=styr;i<endyr;i++) //copy this value to all years
              {
              //assigns all the subsequent years the same vector of
coefficients
            surv2_sel(i+1)=surv2_sel(i);
          }
    };
```

```
  if (surv_switch == 4)  //this is the Richards et al. selectivity
function
    {
        sel2_alpha_rso = mfexp(sel2_ln_alpha_rso);
      for (j=1; j<=nages; j++)  //calculate the value over ages
          {
              if (j < sel2_a_rso)
                {
                  // calculates the vector of selectivity coefficients
for the first year, ages younger than fully selected
              surv2_sel(styr,j)= 1 - (mfexp((log(1 - sel2_beta_rso)) +

                                                    (sel2_alpha_rso *
(log(((sel2_a_rso - double(j)))/(sel2_a_rso - 1))))));
                }
              else  //ages >= sel2_a_rso
                {
                    surv2_sel(styr,j) = 1;
                };
            };
        for (i=styr;i<endyr;i++) //copy this value to all years
            {
              //assigns all the subsequent years the same vector of
coefficients
          surv2_sel(i+1)=surv2_sel(i);
        };
    };

  if (surv_switch == 5)  //this is the Coleraine selectivity function
    {
        //map the log parameters into normal space
        sel2_vleft_col = mfexp(sel2_ln_vleft_col);
        sel2_vright_col = mfexp(sel2_ln_vright_col);
      for (j=1; j<=nages; j++)  //calculate the value over ages
          {
              if (j <= sel2_sfull_col)
                {
                    surv2_sel(styr,j)= mfexp(-((square(double(j)-
sel2_sfull_col))/(sel2_vleft_col)));
                  }
              else  //ages >= age at full selectivity
                {
                    surv2_sel(styr,j)= mfexp(-((square(double(j)-
sel2_sfull_col))/(sel2_vright_col)));
                  };
            };
        for (i=styr;i<endyr;i++) //copy this value to all years
            {
              //assigns all the subsequent years the same vector of
coefficients
          surv2_sel(i+1)=surv2_sel(i);
        };
    };

  if (surv_switch == 6)  //this is the Synthesis selectivity function
    {
      for (j=1; j<=nages; j++)  //calculate the value over ages
          {
              if (j < sel2_peak_syn) // ascending limb
                {
                    surv2_sel(styr,j)= sel2_init_syn +
```

```
                    (1 - sel2_init_syn)/((1 / (1 + (mfexp(-1 *
sel2_slope_syn * (sel2_peak_syn - sel2_infl_syn))))) -
                 (1 / (1 + (mfexp(-1 * sel2_slope_syn * (1 -
sel2_infl_syn)))))) *
                       ((1/(1+mfexp(-1*sel2_slope_syn*(double(j)-
sel2_infl_syn)))) -
                       (1 / (1 + (mfexp(-1 * sel2_slope_syn * (1 -
sel2_infl_syn))))));
                 }
             else
               {
                 if (j > (sel2_peak_syn + 1)) // descending limb
                   {
                       surv2_sel(styr,j) = 1 +
                         (sel2_final_syn - 1)/((1 / (1 + (mfexp(-1 *
sel2_slope2_syn * (nages - sel2_infl2_syn))))) -
                     (1 / (1 + (mfexp(-1 * sel2_slope2_syn *
((sel2_peak_syn+1) - sel2_infl2_syn)))))) *
                           ((1/(1+mfexp(-1*sel2_slope2_syn*(double(j)-
sel2_infl2_syn)))) -
                           (1 / (1 + (mfexp(-1 * sel2_slope2_syn *
((sel2_peak_syn+1) - sel2_infl2_syn))))));
                     }
                   else // between the peaks
                     {
                         surv2_sel(styr,j) = 1.0;
                     };
            };
            };
        for (i=styr;i<endyr;i++) //copy this value to all years
            {
              //assigns all the subsequent years the same vector of
coefficients
          surv2_sel(i+1)=surv2_sel(i);
        };
    };

  // Fishery selectivity function
  avgfishsel                                  =
log(mean(mfexp(fish_sel_coffs)));
  log_fish_sel(styr)(1,max_sel_age)           = fish_sel_coffs;
  log_fish_sel(styr)(max_sel_age,nages)       = fish_sel_coffs(max_sel_age);
  log_fish_sel(styr)                         -=
log(mean(mfexp(log_fish_sel(styr))));
  if (active(sel_devs_fish))
    {
      ii=1;
      for (i=styr;i<endyr;i++)
        {
          if (!(i%group_num))
            {
              log_fish_sel(i+1)(1,max_sel_age)      =
log_fish_sel(i)(1,max_sel_age)+sel_devs_fish(ii);
              log_fish_sel(i+1)(max_sel_age,nages) =
log_fish_sel(i+1,max_sel_age);
              ii++;
              log_fish_sel(i+1) -= log(mean(mfexp(log_fish_sel(i+1))));
            }
          else
            {
              log_fish_sel(i+1)    = log_fish_sel(i);
```

```
               log_fish_sel(i+1)   -=
log(mean(mfexp(log_fish_sel(i+1))));
              }
          }
    }
  else
    {
      for (i=styr;i<endyr;i++)

          {
          log_fish_sel(i+1)=log_fish_sel(i);
        }
    }
  fish_sel=mfexp(log_fish_sel);

//+==+==+==+==+==+==+==+==+==+==+==+==+==+==+==+==+==+==+==+==+==+==+==
+==+

FUNCTION Get_Mortality_Rates

  Fmort =  mfexp(log_avg_F +  log_F_devs);
  //F     = outer_prod(Fmort , fish_sel);
  for (i=styr; i<=endyr; i++)
    F(i) = Fmort(i) * fish_sel(i) ;
  Z=F+natmort;
  S=mfexp(-1.0*Z);

//+==+==+==+==+==+==+==+==+==+==+==+==+==+==+==+==+==+==+==+==+==+==+==
+==+


FUNCTION Get_Numbers_At_Age

  // Now do for next several years
  for (i = styr; i <= endyr; i++)
  {
    natage(i,1)  = mfexp(log_avg_rec + log_rec_dev(i));
    est_rec(i)   = natage(i,1);
    sp_biom(i)   = elem_prod(natage(i),p_mature) * wt;
    tot_biom(i)   = natage(i)*wt;   // Added April 28 to get age 3+
biomass

    // Now graduate for the next year....
    natage(i+1)(2,nages) = ++elem_prod(natage(i)(1,nages-
1),S(i)(1,nages-1));
    natage(i+1,nages)   += natage(i,nages)*S(i,nages);
  }

  natage(endyr+1,1)  = mfexp(log_avg_rec + log_rec_dev(endyr));
  sp_biom(endyr+1)   = elem_prod(natage(endyr+1),p_mature) * wt;
  tot_biom(endyr+1)  = natage(endyr+1)*wt;

  natage2004(1) = mfexp(log_avg_rec);
  F2003= 377/(fish_sel(endyr)*elem_prod(natage(endyr+1),wt));
  natage2004(2,nages) = ++elem_prod(natage(endyr+1)(1,nages-1),mfexp(-
 (F2003*fish_sel(endyr)(1,nages-1)+natmort)));
  natage2004(nages)+= natage(endyr+1,nages)*mfexp(-
 (F2003*fish_sel(endyr)(nages)+natmort));
  totbiom2004 = natage2004*wt;

  natage2005(1) = mfexp(log_avg_rec);
```

```
  F2004= 335/(fish_sel(endyr)*elem_prod(natage(endyr+1),wt));
  natage2005(2,nages) = ++elem_prod(natage2004(1,nages-1),mfexp(-
(F2004*fish_sel(endyr)(1,nages-1)+natmort)));
  natage2005(nages)+= natage2004(nages)*mfexp(-
(F2004*fish_sel(endyr)(nages)+natmort));
  totbiom2005 = natage2005*wt;



  dvar_vector Stmp(styr_rec, endyr) ;
  Stmp = sp_biom(styr_rec-recage, endyr-recage).shift(styr_rec);
  est_spb = Stmp;
  pred_rec = SRecruit(Stmp);

//+==+==+==+==+==+==+==+==+==+==+==+==+==+==+==+==+==+==+==+==+==+==+==+==
+==+


FUNCTION Get_Catch_at_Age

  for (i=styr; i<=endyr; i++)
  {
    pred_catch(i)=0.;

    //--Baranov equation here
    for (j = 1 ; j<= nages; j++)
      catage(i,j) = natage(i,j)*F(i,j)*(1.-S(i,j))/Z(i,j);
    pred_catch(i) = catage(i)*wt;
  }

//+==+==+==+==+==+==+==+==+==+==+==+==+==+==+==+==+==+==+==+==+==+==+==+==
+==+

FUNCTION Get_Predicted_Values

  q_surv=mfexp(log_q_surv);
  q_surv2=mfexp(log_q_surv2);
  q_surv3=mfexp(log_q_surv3);
  q_surv4=mfexp(log_q_surv4);
  q_cpue=mfexp(log_q_cpue);

  for (i=1;i<=nyrs_surv;i++)
    {
      pred_surv(i)=q_surv * elem_prod(surv_sel(yrs_surv(i)),
natage(yrs_surv(i))) * wt;
    };

  for (i=1;i<=nyrs_cpue;i++)
    pred_cpue(i)=q_cpue * elem_prod(fish_sel(yrs_cpue(i)),
natage(yrs_cpue(i))) * wt;

  for (i=1;i<=nyrs_surv2;i++)
    pred_surv2(i)=q_surv2 * elem_prod(surv2_sel(yrs_surv2(i)),
natage(yrs_surv2(i))) * wt;

  for (i=1;i<=nyrs_surv3;i++)
    pred_surv3(i)=q_surv3 * elem_prod(surv2_sel(yrs_surv3(i)),
natage(yrs_surv3(i))) * wt;

  for (i=1;i<=nyrs_surv4;i++)
```

```
    pred_surv4(i)=q_surv4 * elem_prod(surv2_sel(yrs_surv4(i)),
natage(yrs_surv4(i))) * wt;

  for ( i=1;i<=nyrs_surv_age;i++)
    eac_surv(i) =
elem_prod(surv_sel(yrs_surv_age(i)),natage(yrs_surv_age(i)))/
    (surv_sel(yrs_surv_age(i)) * natage(yrs_surv_age(i)))*ageage ;

  for ( i=1;i<=nyrs_surv_size;i++)
    esc_surv(i) =
elem_prod(surv_sel(yrs_surv_size(i)),natage(yrs_surv_size(i)))/
    (surv_sel(yrs_surv_size(i)) * natage(yrs_surv_size(i))) * sizeage;

  for ( i=1;i<=nyrs_surv2_age;i++)
    eac_surv2(i) =
elem_prod(surv2_sel(yrs_surv2_age(i)),natage(yrs_surv2_age(i)))/
    (surv_sel(yrs_surv2_age(i)) * natage(yrs_surv2_age(i)))*ageage ;

  for ( i=1;i<=nyrs_surv2_size;i++)
    esc_surv2(i) =
elem_prod(surv2_sel(yrs_surv2_size(i)),natage(yrs_surv2_size(i)))/
                              (surv2_sel(yrs_surv2_size(i)) *
natage(yrs_surv2_size(i))) * sizeage;

  for ( i=1;i<=nyrs_fish_age;i++) // changed this to accommodate
ageerror matrix
    {
    eac_fish1(i)=
catage(yrs_fish_age(i))/sum(catage(yrs_fish_age(i)))*ageage;
      if(plusgrp==1)
        {
          eac_fish(i)(1,11) = eac_fish1(i)(1,11);
          eac_fish(i)(12) = sum(eac_fish1(i)(12,23));
        }
      else
        {
          eac_fish(i)(1,11) =
eac_fish1(i)(1,11)/sum(eac_fish(i)(1,11));
        }
    }
  for ( i=1;i<=nyrs_fish_size;i++)
    esc_fish(i)  =
catage(yrs_fish_size(i))/sum(catage(yrs_fish_size(i))) * sizeage;

  for ( i=1;i<=nyrs_ufish_size;i++)
    esc_ufish(i)  =
catage(yrs_ufish_size(i))/sum(catage(yrs_ufish_size(i))) * sizeage;

  for ( i=1;i<=nyrs_fish2_age;i++)
    eac_fish2(i)  =
catage(yrs_fish2_age(i))/sum(catage(yrs_fish2_age(i))) * ageage;

  begbiom  = natage(styr)*wt;
  endbiom  = natage(endyr)*wt;
  Depletion=sp_biom(endyr+1)/Bzero; // - changed from /sp_biom(styr)

  if(sd_phase())
    {
      for ( j=1;j<nages;j++)
        {
          i = styr+1-j;
```

```
          pred_sd_rec(i) = natage(styr,j)*mfexp(natmort*double(j-1));
        }
      // natage(styr,nages) = mfexp(log_Rzero - natmort * (nages-1) ) /
(1. - surv);
      for ( i=styr;i<=endyr;i++)
        {
          pred_sd_rec(i) = natage(i,1);
        }
    }

  qfix_surv = q_surv*surv_sel(2000,8);
  qfix_surv2 = q_surv2*surv2_sel(2000,8);
  qfix_surv3 = q_surv3*surv2_sel(2000,8);
  qfix_surv4 = q_surv4*surv2_sel(2000,8);


//+==+==+==+==+==+==+==+==+==+==+==+==+==+==+==+==+==+==+==+==+==+==+==+==
+==+

FUNCTION compute_spr_rates

  // Compute SPR Rates and add them to the likelihood for Females
  SB0=0.;
  SBF55=0.;
  SBF50=0.;
  SBF40=0.;
  for (i=1;i<=4;i++)
    Nspr(i,1)=1.;

  for (j=2;j<nages;j++)
    {
      Nspr(1,j) = Nspr(1,j-1)*mfexp(-1.*natmort);
      Nspr(2,j) = Nspr(2,j-1)*mfexp(-1.*(natmort+F55*fish_sel(endyr,j-
1)));
      Nspr(3,j) = Nspr(3,j-1)*mfexp(-1.*(natmort+F50*fish_sel(endyr,j-
1)));
      Nspr(4,j) = Nspr(4,j-1)*mfexp(-1.*(natmort+F40*fish_sel(endyr,j-
1)));
    }

  Nspr(1,nages) = Nspr(1,nages-1)*mfexp(-1.*natmort)/(1.-mfexp(-
1.*natmort));
  Nspr(2,nages) = Nspr(2,nages-1)*mfexp(-1.*
(natmort+F55*fish_sel(endyr,nages-1)))/
                              (1.-mfexp(-
1.*(natmort+F55*fish_sel(endyr,nages))));
  Nspr(3,nages) = Nspr(3,nages-1)*mfexp(-1.*
(natmort+F50*fish_sel(endyr,nages-1)))/
                              (1.-mfexp(-
1.*(natmort+F50*fish_sel(endyr,nages))));
  Nspr(4,nages) = Nspr(4,nages-1)*mfexp(-1.*
(natmort+F40*fish_sel(endyr,nages-1)))/
                              (1.-mfexp(-
1.*(natmort+F40*fish_sel(endyr,nages))));

  for (j=1;j<=nages;j++)
    {
      // Kill them off till april (0.25)
      SB0    += Nspr(1,j)*p_mature(j)*wt(j)*mfexp(-0.25*natmort);
      SBF55  += Nspr(2,j)*p_mature(j)*wt(j)*mfexp(-
0.25*(natmort+F55*fish_sel(endyr,j)));
```

```
      SBF50   += Nspr(3,j)*p_mature(j)*wt(j)*mfexp(-
0.25*(natmort+F50*fish_sel(endyr,j)));
      SBF40   += Nspr(4,j)*p_mature(j)*wt(j)*mfexp(-
0.25*(natmort+F40*fish_sel(endyr,j)));
    }

  sprpen     = 300.*square(SBF55/SB0-0.55);
  sprpen    += 300.*square(SBF50/SB0-0.5);
  sprpen    += 300.*square(SBF40/SB0-0.4);


  //
+==+==+==+==+==+==+==+==+==+==+==+==+==+==+==+==+==+==+==+==+==+==+==+==+=
=+

FUNCTION Surv_Likelihood

  // -Likelihood due to survey biomass index-
  surv_like=0.;
  // change to a log_normal likelihood for the survey biomass series
fitting

  for (i=1; i<=nyrs_surv; i++)
    // the old normal likelihood
    //surv_like(1)+=lambda(13)*square((obs_surv_biom(i)-pred_surv(i)
))/
  //(2.*obs_surv_se(i)*obs_surv_se(i));
      // the lognormal likelihood
    surv_like(1)+=lambda(13)*square((log(obs_surv_biom(i))-
log(pred_surv(i))))/
                    (2.*
(log(1+(obs_surv_se(i)/obs_surv_biom(i))*(obs_surv_se(i)/obs_surv_biom(
i))))*

(log(1+(obs_surv_se(i)/obs_surv_biom(i))*(obs_surv_se(i)/obs_surv_biom(
i)))));

  for (i=1; i<=nyrs_surv2; i++)
    // the old normal likelihood
    //surv_like(2)+=lambda(14)*square((obs_surv_biom2(i)-pred_surv2(i)
))/
  //(2.*obs_surv_se2(i)*obs_surv_se2(i));
      // the lognormal likelihood
      surv_like(2)+=lambda(14)*square((log(obs_surv_biom2(i))-
log(pred_surv2(i))))/
                    (2.*
(log(1+(obs_surv_se2(i)/obs_surv_biom2(i))*(obs_surv_se2(i)/obs_surv_bi
om2(i))))*

(log(1+(obs_surv_se2(i)/obs_surv_biom2(i))*(obs_surv_se2(i)/obs_surv_bi
om2(i)))));

  for (i=1; i<=nyrs_surv3; i++)// added in surv3 without changing param
    // the old normal likelihood
    // surv_like(3)+=lambda(14)*square((obs_surv_biom3(i)-pred_surv3(i)
))/
  //(2.*obs_surv_se3(i)*obs_surv_se3(i));
      // the lognormal likelihood
    surv_like(3)+=lambda(14)*square((log(obs_surv_biom3(i))-
log(pred_surv3(i))))/
```

```
                         (2.*
(log(1+(obs_surv_se3(i)/obs_surv_biom3(i))*(obs_surv_se3(i)/obs_surv_bi
om3(i))))*

(log(1+(obs_surv_se3(i)/obs_surv_biom3(i))*(obs_surv_se3(i)/obs_surv_bi
om3(i)))));

  for (i=1; i<=nyrs_surv4; i++)// added in surv4 without changing param
    // the old normal likelihood
    //surv_like(4)+=lambda(14)*square((obs_surv_biom4(i)-pred_surv4(i)
))/
  //(2.*obs_surv_se4(i)*obs_surv_se4(i));
      // the lognormal likelihood
    surv_like(4)+=lambda(14)*square((log(obs_surv_biom4(i))-
log(pred_surv4(i))))/
                         (2.*
(log(1+(obs_surv_se4(i)/obs_surv_biom4(i))*(obs_surv_se4(i)/obs_surv_bi
om4(i))))*

(log(1+(obs_surv_se4(i)/obs_surv_biom4(i))*(obs_surv_se4(i)/obs_surv_bi
om4(i)))));


  for (i=1; i<=nyrs_cpue; i++)
    // got rid of log(cv_cpue) so not neg

      surv_like(5)+=lambda(15)*square((log(obs_cpue(i))-
log(pred_cpue(i)) ))/ (2.*cv_cpue*cv_cpue);
    // logLike=square(log(observed)-log(expected))/(2*square(cv)) +
log(cv)+  0.5*log(2*pi);
  //
+==+==+==+==+==+==+==+==+==+==+==+==+==+==+==+==+==+==+==+==+==+==+==+=
=+

FUNCTION Multinomial_Likelihood

  //-Likelihood due to Age compositions--------------------------------
  age_like=0.;
  for (i=1; i <= nyrs_surv_age; i++)
    age_like(1) -= nsamples_surv_age(i)*(oac_surv(i) + 0.001) *
log(eac_surv(i) + 0.001);
  for (i=1; i <= nyrs_surv2_age; i++)
    age_like(2) -= nsamples_surv2_age(i)*(oac_surv2(i) + 0.001) *
log(eac_surv2(i) + 0.001 ) ; // added for slope survey
  for (i=1; i <= nyrs_fish_age; i++)
    {
    if(plusgrp==1)
      {
      age_like(3) -= nsamples_fish_age(i)*(oac_fish(i) + 0.001) *
log(eac_fish(i) + 0.001 ) ; // fixed for plus group inclusion
    }
    else
      {
      age_like(3) -= nsamples_fish_age(i)*(oac_fish(i)(1,11) + 0.001) *
log(eac_fish(i)(1,11) + 0.001 ) ;
    }
  }

  //-Likelihood due to survey size compositions------------------------
--------
  for (i=1; i <= nyrs_surv_size; i++)
```

```
    age_like(4) -= nsamples_surv_size(i)*(osc_surv(i) + 0.001) *
log(esc_surv(i) + 0.001 ) ;
  for (i=1; i <= nyrs_surv2_size; i++)
    age_like(5) -= nsamples_surv2_size(i)*(osc_surv2(i) + 0.001) *
log(esc_surv2(i) + 0.001 ) ; // added for slope survey

  //-Likelihood due to fishery size compositions-----------------------
---------
  for (i=1; i <= nyrs_fish_size; i++)
    age_like(6) -= nsamples_fish_size(i)*(osc_fish(i) + 0.001) *
log(esc_fish(i) + 0.001 ) ;

  // - Likelihood due to fishery new (1999+) age compostions-----------
--------
  for (i=1; i <= nyrs_fish2_age; i++)
    age_like(7) -= nsamples_fish2_age(i)*(oac_fish2(i) + 0.001) *
log(eac_fish2(i) + 0.001 ) ;

  age_like(1)-=offset(1);
  age_like(2)-=offset(2);
  age_like(3)-=offset(3);
  age_like(4)-=offset(4);
  age_like(5)-=offset(5);
  age_like(6)-=offset(6);
  age_like(7)-=offset(7);
  //
+==+==+==+==+==+==+==+==+==+==+==+==+==+==+==+==+==+==+==+==+==+==+==+=
=+

FUNCTION Compute_Rec_Like

  rec_like.initialize();
  sigmaRsq    = sigr*sigr;
  chi = log(est_rec+1e-8)- log(pred_rec+1e-8);
  //chi += sigmaRsq/2. ;// To adjust for bias...
  if (rho>0)
  {
    for (i=styr_rec;i<styr;i++)
      rec_like(1)    += (square( chi(i) ) / (2*sigmaRsq)) + log(sigr);
    chi += sigmaRsq/2. ;// To adjust for bias...
    for (i=styr;i<=endyr;i++)
      rec_like(1) += square(chi(i)- rho*chi(i-1)) /sqrt(1.-
rho*rho)/(2.*sigmaRsq) + log(sigr);
  }
  else
  {
    for (i=styr_rec;i<styr;i++)
      rec_like(1)    += (square( chi(i) ) / (2*sigmaRsq)) + log(sigr);
    chi += sigmaRsq/2. ;// To adjust for bias...
    for (i=styr;i<=endyr;i++)
      rec_like(1)    += (square( chi(i)) / (2*sigmaRsq)) + log(sigr);
  }
  if (!last_phase() ) // Recruitment variability: EARLY PHASES ONLY
    rec_like(2)  = 1. * norm2(log_rec_dev) ;
  else
  {
    rec_like(1) *= lambda(4) ;
    rec_like(2)  = 0.0 * norm2(log_rec_dev) ;
  }
```

```
//+==+==+==+==+==+==+==+==+==+==+==+==+==+==+==+==+==+==+==+==+==+==+==
+==+

FUNCTION Sel_Like

  sel_like.initialize(); //Set vector equal to zero for initialization

  //this will only be turned on in options 1 and 2
  if((surv_switch == 1) || (surv_switch == 2))
    {
      if (surv_switch == 2) //If time changes on, then do 2nd
differencing for curvature penalty on subsequent years
        {
          //--This is for limiting the dome-shapedness
          for (i=1978;i<= endyr;i++) //may need to remove specific year
                {
              if (!(i%group_num))
                for (j=1;j<nages;j++)
                  if (log_surv_sel(i,j)>log_surv_sel(i,j+1))
                    sel_like(1) +=lambda(8)*square(log_surv_sel(i,j)-
log_surv_sel(i,j+1));
            };
          sel_like(2) +=lambda(9)/group_num*norm2(sel_devs_surv);
          sel_like(3)
+=lambda(10)/dim_sel*norm2(first_difference(first_difference(log_surv_s
el(styr))));
          for (i=styr;i<endyr;i++)
            if (!(i%group_num))
                  {
               sel_like(4)
+=lambda(10)/dim_sel*norm2(first_difference(first_difference(log_surv_s
el(i+1))));
              };
            }
      else  //otherwise only first year mtr
        {
          sel_like(3)
+=lambda(10)*norm2(first_difference(first_difference(log_surv_sel(styr)
)));
        };
    };

  // Now for surv2
  if((surv_switch == 1) || (surv_switch == 2))
    {
      if (surv_switch == 2) //If time changes on, then do 2nd
differencing for curvature penalty on subsequent years
        {
          //--This is for limiting the dome-shapedness
          for (i=1978;i<= endyr;i++) //may need to remove specific year
                {
              if (!(i%group_num))
                for (j=1;j<nages;j++)
                  if (log_surv2_sel(i,j)>log_surv2_sel(i,j+1))
                    sel_like(1) +=lambda(8)*square(log_surv2_sel(i,j)-
log_surv2_sel(i,j+1));
            };
          sel_like(2) +=lambda(9)/group_num*norm2(sel_devs_surv2);
```

```
          sel_like(3)
+=lambda(10)/dim_sel*norm2(first_difference(first_difference(log_surv2_
sel(styr))));
          for (i=styr;i<endyr;i++)
            if (!(i%group_num))
                  {
                sel_like(4)
+=lambda(10)/dim_sel*norm2(first_difference(first_difference(log_surv2_
sel(i+1))));
              };
            }
      else  //otherwise only first year mtr
        {
          sel_like(3)
+=lambda(10)*norm2(first_difference(first_difference(log_surv2_sel(styr
))));
        };
    };

  // Fishery selectivity
  if (active(sel_devs_fish))
    {
      //--This is for limiting the dome-shapedness
      for (i=styr;i<= endyr;i++)
        {
              if (!(i%group_num))
            {
              for (j=8;j<nages;j++)
                {
                  if (log_fish_sel(i,j)>log_fish_sel(i,j+1))
                        {
                      sel_like(1) +=lambda(8)*square(log_fish_sel(i,j)-
log_fish_sel(i,j+1));
                      };
                };
                };
        };
      sel_like(2) +=lambda(9)/group_num*norm2(sel_devs_fish);
      sel_like(4)
+=lambda(10)/dim_sel*norm2(first_difference(first_difference(log_fish_s
el(styr))));

      for (i=styr;i<endyr;i++)
      if (!(i%group_num))
        {
          sel_like(4)
+=lambda(10)/dim_sel*norm2(first_difference(first_difference(log_fish_s
el(i+1))));
        };
    }
  else
    {
      sel_like(4)
+=lambda(11)*norm2(first_difference(first_difference(log_fish_sel(styr)
)));
    };

//+==+==+==+==+==+==+==+==+==+==+==+==+==+==+==+==+==+==+==+==+==+==+==+==
+==+

FUNCTION Fmort_likelihood
```

```
  fmort_like.initialize();
  fmort_like(1) = .001 * lambda(5) *  norm2(log_F_devs);

  //This is to make the initial comp not stray too far from then
subsequent (early phases)
  if (current_phase()<3 )
    {
      fmort_like(2) = 10.0*norm2(Fmort-.2);
    };

//+==+==+==+==+==+==+==+==+==+==+==+==+==+==+==+==+==+==+==+==+==+==+==+==
+==+

FUNCTION Evaluate_Objective_Function

  //-Likelihood function------------------------------------------------
  Surv_Likelihood();          //-surv Deviations
  Sel_Like();                         // Call likelihood due to
selectivity penalties
                                            // this gets called
regardless of selectivity option
  Fmort_likelihood();
  ssqcatch  = norm2(log(obs_catch+.01)- log(pred_catch+.01));    //
Total catch biomass
  Compute_Rec_Like();

  if (current_phase() < Do_Robust_Phase)
    Multinomial_Likelihood(); // Age and Size Likelihoods
  else
    Robust_Likelihood(); // Robust Age and Size Likelihoods

  //--Priors -------------------------------------------
  if (active(natmort))
    Priors(1) = prior(natmort,   M_prior);

  // Beta prior on steepness...
  if (active(steepness))
    {
      if(steeppriorswitch == 1)
      {
        dvariable steeptmp;
        steeptmp = (steepness - .199999999) /.80000001;
        Priors(2) = -((srprior_a-1.)*log(steeptmp) + (srprior_b-
1)*log(1.-steeptmp));
    }
  }

  if (active(log_q_surv))
      {
      if(surv_switch==1)
            {
            if(qprior_switch==0)
                  Priors(3) = prior(qfix_surv,     q_prior);
            else
                  Priors(3) = .25*(prior(qfix_surv, q_prior)+
prior(qfix_surv2, q_prior)+ prior(qfix_surv3, q_prior)+
prior(qfix_surv4, q_prior));
      }
      else
            {
```

```
          if(qprior_switch==0)
               Priors(3) = prior(q_surv,    q_prior);
          else
               Priors(3) = .25*(prior(q_surv, q_prior)+
prior(q_surv2, q_prior)+ prior(q_surv3, q_prior)+ prior(q_surv4,
q_prior));
      }
  }

  // Put all components together
  obj_fun += lambda(1) *  ssqcatch ;
  obj_fun += lambda(3) *  sum(age_like);
  obj_fun += lambda(2) *  sum(surv_like);
  obj_fun += sum(rec_like);
  obj_fun += sum(fmort_like);
  obj_fun += lambda(6) *  sum(sel_like);  //add all the sel_like
components mult by lambda(6) = 1
  obj_fun += sum(Priors);
  obj_fun += 10. *square(avgfishsel);

  // this ensures the coefficients average to zero (in log space), so
the avg original sel is = 1
  // the code seems to run without this constraint, the difference
absorbed in q?
  if ((surv_switch == 1) || (surv_switch == 2)) // only use this in
selectivity switch 1 or 2
    {
      obj_fun += 10. *(square(avgsurvsel)+square(avgsurv2sel));
    };

  obj_fun += sprpen;


//+==+==+==+==+==+==+==+==+==+==+==+==+==+==+==+==+==+==+==+==+==+==+==
+==+

FUNCTION Robust_Likelihood

  // following Coleraine model following Fournier et al. (1998,1990)
  age_like.initialize();
  double rf       = .1/nages;
  double nlb      = .1/nlenbins; // for sizes
  dvar_matrix vc = rf+elem_prod(eac_surv,1-eac_surv);
  dvar_matrix lc = mfexp(-
mean(nsamples_surv_age)*elem_div(square(eac_surv-oac_surv),2*vc));
  age_like(1)    -= sum(log(lc+.01));
  age_like(1)    += 0.5*sum(log(2*pii*vc));
  dvar_matrix vc2 = rf+elem_prod(eac_surv2,1-eac_surv2);
  dvar_matrix lc2 = mfexp(-
mean(nsamples_surv2_age)*elem_div(square(eac_surv2-oac_surv2),2*vc2));
  age_like(2)    -= sum(log(lc2+.01));
  age_like(2)    += 0.5*sum(log(2*pii*vc2));

  //age_like(1)    -=
0.5*nyrs_surv_age*nages*log(mean(nsamples_surv_age));
  //age_like(2)    -=
0.5*nyrs_surv_age*nages*log(mean(nsamples_surv2_age));
  dvar_matrix vfc(1,nyrs_fish_age,1,12);
  dvar_matrix lfc(1,nyrs_fish_age,1,12);
  if(plusgrp==1)
    {
```

```
    vfc = (0.1/12)+elem_prod(eac_fish,1-eac_fish);// fixed to include
plus group
    lfc = mfexp(-mean(nsamples_fish_age)*elem_div(square(eac_fish-
oac_fish),2*vfc));
    }
  else
    {
    for(i=1;i<=nyrs_fish_age;i++)
      {
      vfc(i)(1,11) = (0.1/11)+elem_prod(eac_fish(i)(1,11),1-
eac_fish(i)(1,11));
        vfc(i)(12) = 1/(2*pii);
      lfc(i)(1,11) = mfexp(-
mean(nsamples_fish_age)*elem_div(square(eac_fish(i)(1,11)-
oac_fish(i)(1,11)),2*vfc(i)(1,11)));
      lfc(i)(12) = .99;
      }
    }
  age_like(3)   -= sum(log(lfc+.01));
  age_like(3)   += 0.5*sum(log(2*pii*vfc));
  //age_like(3)   -=
0.5*nyrs_fish_age*11.*log(mean(nsamples_fish_age));
  dvar_matrix vss = nlb+elem_prod(esc_surv,1-esc_surv);
  dvar_matrix lss = mfexp(-
mean(nsamples_surv_size)*elem_div(square(esc_surv-osc_surv),2*vss));
  age_like(4)   -= sum(log(lss+.01));
  age_like(4)   += 0.5*sum(log(2*pii*vss));
  dvar_matrix vss2 = nlb+elem_prod(esc_surv2,1-esc_surv2);
  dvar_matrix lss2 = mfexp(-
mean(nsamples_surv2_size)*elem_div(square(esc_surv2-
osc_surv2),2*vss2));
  age_like(5)   -= sum(log(lss2+.01));
  age_like(5)   += 0.5*sum(log(2*pii*vss2));
  //age_like(5)   -=
0.5*nyrs_surv_size*nlenbins*log(mean(nsamples_surv_size));
  dvar_matrix vs = nlb+elem_prod(esc_fish,1-esc_fish);
  dvar_matrix ls = mfexp(-
mean(nsamples_fish_size)*elem_div(square(esc_fish-osc_fish),2*vs));
  age_like(6)   -= sum(log(ls+.01));
  age_like(6)   += 0.5*sum(log(2*pii*vs));
  //age_like(6)   -=
0.5*nyrs_fish_size*nlenbins*log(mean(nsamples_fish_size));
  dvar_matrix vfc2 = rf+elem_prod(eac_fish2,1-eac_fish2);
  dvar_matrix lfc2 = mfexp(-
mean(nsamples_fish2_age)*elem_div(square(eac_fish2-oac_fish2),2*vfc2));
  age_like(7)   -= sum(log(lfc2+.01));
  age_like(7)   += 0.5*sum(log(2*pii*vfc2));

  age_like(1)   -= offset2(1);
  age_like(2)   -= offset2(2);
  age_like(3)   -= offset2(3);
  age_like(4)   -= offset2(4);
  age_like(5)   -= offset2(5);
  age_like(6)   -= offset2(6);
  age_like(7)   -= offset2(7);

//+==+==+==+==+==+==+==+==+==+==+==+==+==+==+==+==+==+==+==+==+==+==+==+==
+==+

FUNCTION get_msy
```

```
  /*Function calculates used in calculating MSY and MSYL for a
designated component
  of the population, given values for stock recruitment and
selectivity...
  Fmsy is the trial value of MSY example of the use of "funnel" to
reduce the amount
  of storage for derivative calculations */
  dvariable Fdmsy;
  dvariable Stmp;
  dvariable Rtmp;
  double df=1.e-5;
  dvariable F1=log(.03);
  dvariable F2;
  dvariable F3;
  dvariable FF;
  dvariable yld1;
  dvariable yld2;
  dvariable yld3;
  dvariable dyld;
  dvariable dyldp;
  seltmp =  fish_sel(endyr);
  // Newton Raphson stuff to go here

  for (int ii=1;ii<=15;ii++)
    {
      F2     = F1 + df*.5;
      F3     = F2 - df;
      //F1    = double(ii)/400;
      FF = mfexp(F1);
      yld1   = msy(FF, Stmp,Rtmp);
      FF = mfexp(F2);
      yld2   = msy(FF,Stmp,Rtmp);
      FF = mfexp(F3);
      yld3   = msy(FF,Stmp,Rtmp);
      dyld   = (yld2 - yld3)/df;                          // First
derivative (to find the root of this)
      dyldp  = (yld2 + yld3 - 2.*yld1)/(.25*df*df);   // Second
derivative (for Newton Raphson)
      if (dyldp!=0.)
        F1    -= dyld/dyldp;
    }

  // Reset funnel variable
  Fdmsy     = mfexp(F1);
  Fmsy      = Fdmsy;
  MSY       = msy(Fmsy,Stmp,Rtmp);
  Bmsy      = Stmp;
  MSYL      = Stmp/Bzero;
  Bcur_Bmsy= sp_biom(endyr+1)/Bmsy;
  Rmsy      = Rtmp;

//+==+==+==+==+==+==+==+==+==+==+==+==+==+==+==+==+==+==+==+==+==+==+==+==
+==+

FUNCTION Profile_Fmort

  // population, given values for stock recruitment and selectivity...
  // Fmsy is the trial value of MSY example of the use of "funnel" to
reduce
  // the amount of storage for derivative calculations
  dvariable Stmp;
```

```
  dvariable Rtmp;
  dvariable F1;
  dvariable yld1;
  seltmp =  fish_sel(endyr);

    for (jj=3;jj>=-3;jj--)
  {
    for (int kk=1;kk<=nages;kk++)
      if (kk+jj>=1 && kk+jj<=nages) seltmp(kk) = fish_sel(endyr,kk+jj);
    // Re normalize seltmp to have mean value of 1...
    seltmp /= mean(seltmp);
    for (int ii=1;ii<=100;ii++)
      {
        F1    = double(ii-1)/750.;
        yld1   = msy(F1, Stmp,Rtmp);
        if (yld1<0)
          cout <<-jj<<" " <<F1<<" "<< 0 <<" "<<0<<" "<<0<<" "<< endl;
        else
          cout <<-jj<<" " <<F1<<" "<< Stmp <<" "<<yld1<<" "<<Rtmp<<"
"<< endl;
      }
  }

  seltmp =  fish_sel(endyr);
  log_avg_rec = 0.;
  SrType=3;
  for (int jj=3;jj>=-3;jj--)
  {
    for (int kk=1;kk<=nages;kk++)
      if (kk+jj>=1 && kk+jj<=nages) seltmp(kk) = fish_sel(endyr,kk+jj);
    // Re normalize seltmp to have mean value of 1...
    seltmp /= mean(seltmp);
    for (int ii=1;ii<=100;ii++)
    {
      F1    = double(ii-1)/750.;
      yld1   = msy(F1, Stmp,Rtmp);
      if (yld1<0)
        cout <<-jj<<" " <<F1<<" "<< 0 <<" "<<0<<" "<<0<<" "<< endl;
      else
        cout <<-jj<<" " <<F1<<" "<< Stmp <<" "<<yld1<<" "<<Rtmp<<" "<<
endl;
    }
  }

//+==+==+==+==+==+==+==+==+==+==+==+==+==+==+==+==+==+==+==+==+==+==+==+==
+==+

FUNCTION dvariable msy(dvariable& Ftmp, dvariable& Stmp,dvariable&
Rtmp)


   dvariable yield;
   dvariable phi;
   dvariable Req;
   dvar_vector Ntmp(1,nages);
   dvar_vector Ctmp(1,nages);

   // dvar_vector seltmp  = fish_sel(endyr);
   dvar_vector Fatmp   = Ftmp*seltmp;
   dvar_vector Ztmp    = Fatmp+ natmort;
   dvar_vector survtmp = mfexp(-Ztmp);
```

```
  Ntmp(1) = 1.;
  for ( j=1 ; j < nages; j++ )
    Ntmp(j+1)  =   Ntmp(j) * survtmp(j); // Begin numbers in the next
year/age class
  Ntmp(nages)  /= (1.- survtmp(nages));
  //for ( j=1 ; j <= nages; j++ ) Ctmp(j)     = Ntmp(j) * Fatmp(j) *
(1. - survtmp(j)) / Ztmp(j);
  Ctmp     = elem_prod(Ntmp , elem_div(elem_prod(Fatmp , (1. -
survtmp)) , Ztmp));
  yield  = wt * Ctmp; //phi    = elem_prod(Ntmp , wttmp) * p_mature; //
Kill these off till april as well!

  phi    = elem_prod(  Ntmp , p_mature ) * wt; // Equilibrium
Spawners/Recruit at this Fishing mortality //Req    = Requil(phi);
  Req    = Requil(phi);
  yield *= Req;
  Stmp   = phi*Req;
  Rtmp   = Req;
  return yield;

//+==+==+==+==+==+==+==+==+==+==+==+==+==+==+==+==+==+==+==+==+==+==+==
+==+

FUNCTION dvariable Requil(dvariable& phi)

  dvariable RecTmp;
  switch (SrType)
    {
      case 1:
        //RecTmp =  (log(phi)+alpha) / (beta*phi); //RecTmp =
(log(phi)/alpha + 1.)*beta/phi;
        cout << "phi,phizero " << phi << " " << phizero << endl;
        RecTmp =  Bzero * (alpha + log(phi) - log(phizero) ) /
(alpha*phi);
        break;
      case 2:
        RecTmp =  (phi-alpha)/(beta*phi);
        break;
      case 3:
        RecTmp =  mfexp(log_avg_rec);
        break;
    }
  return RecTmp;

//+==+==+==+==+==+==+==+==+==+==+==+==+==+==+==+==+==+==+==+==+==+==+==
+==+

FUNCTION MCWrite

  report1 << obj_fun << " " << steepness << " " << rho << " " <<
natmort <<
                    " " << q_surv << " " << Bcur_Bmsy << " " <<
Depletion <<
                    " " << MSY <<" "<< MSYL << " " << Fmsy << " " <<
Bmsy  <<
                    " " << q_surv2 << " " << q_surv3 << " " << q_surv4
<< " " <<
                    endbiom << " " << begbiom << " " << sp_biom(endyr)
<< " " <<
              Bzero << " " << sigr << " " << Rzero << " " <<
log_avg_rec <<
```

```
                " " << F55 << " " << F50 << " " << F40 << " " <<
endl;

  report2 << sp_biom << endl;

  report3 << column(natage,1) << endl;

  report4 << extract_row(surv_sel,1956) << " " <<
extract_row(surv2_sel,1956) << endl;

  //report5 << extract_row(fish_sel,1956) << endl;

//+==+==+==+==+==+==+==+==+==+==+==+==+==+==+==+==+==+==+==+==+==+==+==
+==+

FUNCTION dvariable SRecruit(const dvariable& Stmp)
  RETURN_ARRAYS_INCREMENT();
  dvariable RecTmp;
  switch (SrType)
    {
      case 1:
        //RecTmp = Stmp * mfexp( alpha  - Stmp * beta) ; //Ricker form
        RecTmp = (Stmp / phizero) * mfexp( alpha * ( 1. - Stmp / Bzero
)) ; //Ricker form from Dorn
        break;
      case 2:
        RecTmp = Stmp / ( alpha + beta * Stmp);        //Beverton-Holt
form
        break;
      case 3:
        RecTmp = mfexp(log_avg_rec);                         //Avg
recruitment
        break;
    }
  RETURN_ARRAYS_DECREMENT();
  return RecTmp;

//+==+==+==+==+==+==+==+==+==+==+==+==+==+==+==+==+==+==+==+==+==+==+==
+==+

FUNCTION dvar_vector SRecruit(const dvar_vector& Stmp)

  RETURN_ARRAYS_INCREMENT();
  dvar_vector RecTmp(Stmp.indexmin(),Stmp.indexmax());
  switch (SrType)
    {
      case 1:
        //RecTmp = elem_prod(Stmp ,mfexp( alpha - Stmp * beta));
//Ricker form
        RecTmp = elem_prod((Stmp / phizero) , mfexp( alpha * ( 1. -
Stmp / Bzero  ))) ; //Ricker form from Dor
        break;
      case 2:
        RecTmp = elem_prod(Stmp , 1. / ( alpha + beta * Stmp));
//Beverton-Holt form
        break;
      case 3:
        RecTmp = mfexp(log_avg_rec);   //Avg recruitment
        break;
    }
```

```
  RETURN_ARRAYS_DECREMENT();
  //cout <<RecTmp<<endl;
  return RecTmp;

//+==+==+==+==+==+==+==+==+==+==+==+==+==+==+==+==+==+==+==+==+==+==+==+==
+==+

REPORT_SECTION

  report << "Estimated Catch and Observed" << endl;
  report << pred_catch << endl;
  report << obs_catch << endl << endl;

  report << "Estimated Survival at age" << endl;
  report << S << endl;
  report << "Estimated N at age" << endl;
  report << natage << endl;
  report << "selectivity survey, fishery" << endl;
  if(surv_switch==1)
    {
    report << surv_sel/surv_sel(2000,8) << endl << endl;
    report << surv2_sel/surv2_sel(2000,8)  << endl << endl;
  }
  else
    {
    report << surv_sel << endl << endl;
    report << surv2_sel  << endl << endl;
  }
  report << endl << fish_sel << endl << endl;

  report << "observed fishery P at size and unused observed fishery p
at size" << endl;
  report << yrs_ufish_size(1,13) << " ; " << yrs_fish_size << " ; "<<
yrs_ufish_size(14) << endl;
  for (i=1;i<=13;i++)
      {
      report << osc_ufish(i) << endl;
      }
  report << osc_fish << endl;
  report << osc_ufish(14) << endl;
  report << "Predicted fishery P at size" << endl;
  for (i=1;i<=13;i++)
      {
      report << esc_ufish(i) << endl;
      }
  report << esc_fish << endl;
  report << esc_ufish(14)  << endl << endl;

  report << "Fishery Observed P at age"<< endl;
  report << yrs_fish_age << endl;
  for (i=1;i<=nyrs_fish_age;i++)
    if(plusgrp==1)
      {
        report << oac_fish(i)<< endl;
      }
    else
      {
        report << oac_fish(i)(1,11) << endl;
      }
   report << "Fishery Predicted P at age" << endl;
   for (i=1;i<=nyrs_fish_age;i++)
```

```
  if(plusgrp==1)
    {
      report << eac_fish(i) << endl;
    }
  else
    {
      report << eac_fish(i)(1,11) << endl;
    }
report << "Survey Observed P at age" << endl;
report << yrs_surv_age << endl;
report << oac_surv << endl;
report << "Survey Predicted P at age" << endl;
report << eac_surv << endl << endl;

report << "observed Triennial survey P at size" << endl;
report << yrs_surv_size << endl;
report << osc_surv << endl;
report << "Predicted survey P at size" << endl;
report << esc_surv << endl << endl;

report << "observed POP and Slope survey P at size" << endl;
report << yrs_surv2_size << endl;
report << osc_surv2 << endl;
report << "Predicted survey P at size" << endl;
report << esc_surv2 << endl << endl;

report << "Triennial Survey Biomass " << endl;
report << "Year:      ";
report << yrs_surv << endl;
report << "Predicted:    ";
report << pred_surv << endl;
report << "Observed:    ";
report << obs_surv_biom << endl << endl;

report << "POP and Slope Survey Biomass " << endl;
report << "Year:      ";
report << yrs_surv2 << endl;
report << yrs_surv3 << endl;
report << yrs_surv4 << endl;
report << "Predicted:    ";
report << pred_surv2 << endl;
report << pred_surv3 << endl;
report << pred_surv4 << endl;
report << "Observed:    ";
report << obs_surv_biom2 << endl;
report << obs_surv_biom3 << endl;
report << obs_surv_biom4 << endl << endl;

report << "CPUE Index ";
report << yrs_cpue  << endl;
report << "Predicted:  CPUE ";
report << pred_cpue << endl;
report << "Observed:    ";
report << obs_cpue  << endl << endl;

report << "Fmort " << endl;
report << Fmort << endl;
report << "Spawners " << endl;
report << sp_biom(styr,endyr+1) << endl;
report << "Proportion Mature, Avg wt " << endl;
report << p_mature << endl << wt << endl;
```

```
  report << "Catch_wt_likelihood "<< lambda(1)*ssqcatch << endl;
  report << "Survey_Likelihood "<< lambda(2)*surv_like(1) << endl;
  report << "Survey_Likelihood "<< lambda(2)*surv_like(2)  << endl;
  report << "Survey_Likelihood "<< lambda(2)*surv_like(3) << endl;
  report << "Survey_Likelihood "<< lambda(2)*surv_like(4) << endl; //
added
  report << "Survey_Likelihood "<< lambda(2)*surv_like(5) << endl; //
added
  report << "Age_Likelihood    "<< lambda(3)*age_like(1) << endl;
  report << "Age_Likelihood    "<< lambda(3)*age_like(2) << endl;
  report << "Age_Likelihood    "<< lambda(3)*age_like(3) << endl;
  report << "Age_Likelihood    "<< lambda(3)*age_like(4) << endl;
  report << "Age_Likelihood    "<< lambda(3)*age_like(5) << endl;
  report << "Sel_Likelihood    "<< lambda(6)*sel_like(1) << endl;
  report << "Sel_Likelihood    "<< lambda(6)*sel_like(2) << endl;
  report << "Sel_Likelihood    "<< lambda(6)*sel_like(3) << endl;
  report << "Sel_Likelihood    "<< lambda(6)*sel_like(4) << endl;
  report << "Sel_Likelihood    "<< lambda(6)*sel_like(5) << endl;
  report << "Fmort_Likelihood  "<< fmort_like(1) << endl;
  report << "Fmort_Likelihood  "<< fmort_like(2) << endl;
  report << "Fmort_Likelihood  "<< fmort_like(3) << endl;
  report << "Rec_Likelihood    "<< lambda(4)*rec_like(1) << endl;
  report << "Rec_Likelihood    "<< lambda(4)*rec_like(2) << endl;
  report << "Rec_Likelihood    "<< lambda(4)*rec_like(3) << endl;
  report << "Rec_Likelihood    "<< lambda(4)*rec_like(4) << endl;
  report << "Prior_Likelihood  "<< Priors(1) << endl;
  report << "Prior_Likelihood  "<< Priors(2) << endl;
  report << "Prior_Likelihood  "<< Priors(3) << endl;

  //--Priors ------------------------------------------
  report << "Stock Recruit "<< endl << " 0 0 " << endl;
  for (i=1;i<=30;i++)
    {
      sumtmp=double(i)*Bzero/28;
      report << sumtmp<<" "<< SRecruit(sumtmp) << endl;
    }
  dvar_vector yrs_rec(styr_rec,endyr);
  yrs_rec.fill_seqadd(double(styr_rec),1);

  report << yrs_rec << endl;
  report << sp_biom(styr_rec-recage,endyr-recage) << endl;
  report << est_rec << endl << pred_rec << endl;
  if (last_phase())
    {
      report << "Fmsy MSY MSYL Bmsy" << endl;
      report << Fmsy << " " << MSY << " " << MSYL << " " << Bmsy << " "
<< endl;
      report << "Alpha and Beta" << endl;
      report << alpha << " " << beta << " " << Bmsy << " " << endl;
    }
  report << "SBF0 SBF55 Spawners, recruits" << endl;
  report << SB0 << " " << SBF55 << endl << Bzero << " " <<
sp_biom(styr-2,endyr-3) << endl;
  for (i=styr;i<=endyr;i++)
      report << " " << natage(i,1) << " ";
  report << endl;

  report << "2003 spawning biomass " << sp_biom(endyr+1) << endl;
  report << "Unfished spawning biomass " << Bzero << endl;
  report << "Bmsy " << Bmsy << endl;
  report << "msy " << MSY << endl;
```

```
  report << "msyl " << MSYL << endl;
  report << "F2002/Fmsy " << Fmsy_Fend << endl;
  report << "Natural Mortality " << natmort << endl;
  report << "Steepness " << steepness << endl;
  report << "Rho " << rho << endl;
  if(surv_switch==1)
    report << "survey q's " << qfix_surv << " " << qfix_surv2 << " " <<
qfix_surv3 << " " << qfix_surv4 << endl;
  else
    report << "survey q's " << q_surv << " " << q_surv2 << " " <<
q_surv3 << " " << q_surv4 << endl;

  report << "ssq catch " << ssqcatch << endl;
  report << "age likelihoods " << age_like << endl;
  report << "survey likelihoods " << surv_like << endl;
  report << "recruitment likelihoods " << rec_like << endl;
  report << "fishery mortality likelihood " << fmort_like << endl;
  report << "selectivity likelihoods " << sel_like << endl;
  report << "probabilities from priors " << Priors << endl;
  report << "log average fishery selectivity " << avgfishsel << endl;
  report << "log average shelf survey selectivity " << avgsurvsel <<
endl;
  report << "log average slope survey selectivity " << avgsurv2sel <<
endl;
  report << "sprpen " << sprpen << endl;
  report << "Depletion " << Depletion << endl;
  report << "Multinomial offsets" << offset << endl;
  report << "Robust offsets" << offset2 << endl;
  report << "Type of survey selectivity " << surv_switch << endl;
  report << "Years of slope ages" << endl;
  report << yrs_surv2_age << endl;
  report << "Observed slope ages" << endl;
  report << oac_surv2 << endl;
  report << "Predicted slope ages" << endl;
  report << eac_surv2 << endl;
  report << "Objective_function " << obj_fun << endl;
  report << "Plus_group_switch " << plusgrp << endl;
  report << "S-R_Function_switch " << SrType << endl;
  report << "Q_Prior_Type " << qpriortype << endl;
  report << "SigmaR " << sigr << endl;

  report << "years of new fishery age data " << yrs_fish2_age << endl;
  report << "expected and observed new fishery age data" << endl;
  report << eac_fish2 << endl << endl;
  report << oac_fish2 << endl << endl;

  report << "total target biomass " << endl << Btotzero << endl;
  report << "beginning biomass " << endl << begbiom << endl;
  report << "ending biomass " << endl << endbiom << endl;
  report << "3+ biomass 1956-2003 " << endl << tot_biom << endl;
  report << "catch at age 1956-2002 " << endl << catage << endl;
  report << "ABC" << endl << ABC << endl;
  report << "total biomass 2004, 2005" << endl;
  report << totbiom2004 << " " << totbiom2005 << endl;

//+==+==+==+==+==+==+==+==+==+==+==+==+==+==+==+==+==+==+==+==+==+==+==+==
+==+

TOP_OF_MAIN_SECTION
```

```
  gradient_structure::set_MAX_NVAR_OFFSET(1000);  //maximum number of
depdendent variables of 400 exceeded
  gradient_structure::set_NUM_DEPENDENT_VARIABLES(800);
  gradient_structure::set_GRADSTACK_BUFFER_SIZE(100000);
  gradient_structure::set_CMPDIF_BUFFER_SIZE(1000000);
  arrmblsize=900000;

//+==+==+==+==+==+==+==+==+==+==+==+==+==+==+==+==+==+==+==+==+==+==+==
+==+

GLOBALS_SECTION

  #include <admodel.h>

  //=+=+=+=+=+=+=+=+=+=+=+=+ PRIOR GENERAL FUNCTION
=+=+=+=+=+=+=+=+=+=+=+=+
  dvariable prior (dvariable parameter_value, dvector& prior_dat)
  {
  RETURN_ARRAYS_INCREMENT();
  dvariable prior_value;
  int switch_temp=prior_dat(4);
  double pi = 3.1415926358979;
  switch (switch_temp)
    {
      case 0: //uniform
        //do nothing
        prior_value=0;
        break;
      case 1: //normal
        //check if really log normal
        if (prior_dat(5)==0)
              prior_value = square((prior_dat(5))-(parameter_value))/
                             (2*square(prior_dat(6))) +
log(prior_dat(6))+  0.5*log(2*pi);
        else
              prior_value = square((prior_dat(5))-(parameter_value))/

      (2*square(prior_dat(6)*prior_dat(5))) +
log(prior_dat(6)*prior_dat(5))+  0.5*log(2*pi);
        break;
      case 2: //lognormal
        prior_value = square(log(prior_dat(5))-log(parameter_value))/
                             (2*square(prior_dat(6)))+
log(prior_dat(6))+  0.5*log(2*pi);
        break;
      default:
        cout << "No such prior: "<< prior_dat(4) << " Will be uniform";
        break;
    }
  RETURN_ARRAYS_DECREMENT();
  return(prior_value);
  }
```

Input file 1

```
# Westcoast POP data file  April 28, 2003

# Begin year, endyr
1956  2002

# Recrument lag (age  of  first age group)
3

# Number  of  age groups
23

# Maturity  inflection  age   (8)
8

# Wts at age 3 4 5 6 7 8 9 10  11  12  13  14  15  16  17  18  19  20
21  22  23  24  25
169.1051  240.6028  317.2732  395.9663  474.1622  549.9697  622.0596
689.5722  752.0223
809.21  861.1457  907.9877  949.9927  987.4781  1020.7938 1050.301
1076.3584 1099.3113
1119.4864 1137.1872 1152.6927 1166.2567 1178.1084

# Catch
# 1956  1957  1958  1959  1960  1961  1962  1963  1964  1965  1966
1967  1968
# 1969  1970  1971  1972  1973  1974  1975  1976  1977  1978  1979
1980  1981
# 1982  1983  1984  1985  1986  1987  1988  1989  1990  1991  1992
1993  1994
# 1995  1996  1997  1998  1999  2000  2001  2002
# Include nom. and unsp. POP; assume 16% of catch bycatch for 1981-
present, and
# 5% of domestic previously. Use Jean Rogers' updated estimates of
foreign catch # 1965-1976.
# Estimate of 2002 catch = average of two previous years.
2231 2442 1587 1958 2364 4149 5793 6788 5807 8063 18761 13289 7262
1197 2177 1951 1558 2145 1800 1152 1677 1242 2120 1952  1965  1720
1242 2215 1959 1792 1653 1305 1645 1706 1230 1659 1306  1500  1176
965  938  751  739  593  171  307  239

# Triennial survey
# Number  of  surveys (added 2001)
9

# Years of survey
1977  1980  1983  1986  1989  1992  1995  1998  2001

# Observed survey biomass and standard errors
14245     6468      6733      2797      9384      7669     4603     7668
2853
5140.652  3195.805  1913.711  1198.778  4361.926  3688.12 2255.47
2411.934899 1257.5

# all equal
# 2000 2000 2000 2000 2000 2000 2000 2000 2000
```

```
# Number of POP
2

# Years of POP survey
1979  1985

# Observed POP survey biomass and standard errors
16044  10696
4744.941 2146.44

# all equal
# 2000 2000

# AFSC Slope  Surveys
# Number  of AFSC Slope  Surveys
6

# Years of  survey
1992 1996 1997 1999 2000 2001

# Observed AFSC survey biomass and standard errors
6971    4730    2146   8857    2465    9675
2627.4  1443.8  826.4  4509.1  1278.3  7546.5

# all equal
#2000 2000 2000 2000 2000 2000


# Number  of NWFSC Slope  Surveys
4

# Years of NWFSC survey
1999 2000 2001 2002

# Observed NWFSC survey biomass and standard errors
2651    2556    5269    3770
1353.1  1448.7  2414.1  2089.0

# all equal
# 2000 2000 2000 2000

# Number of fishery CPUE years
18

# CPUE  Index Years
1956  1957  1958  1959  1960  1961  1962  1963  1964  1965  1966
1967  1968  1969  1970  1971  1972  1973

# CPUE Index 2000000
0.4    0.3   0.32  0.29  0.28  0.31  0.29  0.34  0.35  0.55  0.47
0.3   0.17  0.178 0.175 0.203390321 0.19840584  0.114393158

# Fishery
# Number of years fishery Age comp data available
15

# Years
1966  1967  1968  1969  1970  1971  1972  1973  1974  1975  1976  1977
1978  1979  1980
```

```
# 17 28 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39
40
0 0 0 0 0 0 0 0 0 0 0 2 2 5 20  11  16  39  86  154 177 214 217 941
0 0 0 0 0 0 0 0 0 1 0 2 0 3 1 3 5 22  39  72  115 160 202 223 951
0 0 0 0 0 0 0 0 0 0 0 0 2 6 7 15  26  74  107 175 245 288 317 312 1156
0 0 0 0 0 0 0 0 0 1 0 1 2 8 12  27  56  84  159 234 306 413 450 369 981
0 1 0 0 0 0 0 0 0 1 0 3 9 4 25  35  52  127 207 344 389 413 464 492 1943
0 0 0 0 0 0 0 0 0 0 1 3 1 7 7 22  40  55  161 248 357 369 430 463 1840
0 0 0 0 0 0 0 0 0 0 0 1 1 2 13  21  48  82  141 223 303 372 400 302 1196
0 0 0 0 0 0 0 0 0 0 0 1 1 1 4 7 9 6 11  20  44  61  59  51  241
0 0 0 0 0 0 0 0 0 0 0 1 0 0 2 10  12  23  33  61  82  115 120 105 234
0 0 0 0 0 0 0 0 0 0 0 0 1 4 13  25  47  45  68  72  95  100 115 75  238
0 0 0 0 0 0 0 0 0 0 0 0 2 2 10  24  33  35  63  87  128 114 107 65  186
0 0 0 0 0 0 0 1 1 2 7 11  14  42  58  55  94  121 146 143 150 142 121
455
0 0 0 0 0 0 0 4 3 9 13  35  54  107 101 133 164 181 177 209 208 200 173
424
0 0 0 0 1 2 0 1 4 4 14  20  23  27  60  98  123 151 147 135 139 119 101
307

#Unused Fishery size data (where exists age data) for comparison to
fits
#Number of years of data
14


#Years of data
1968 1969 1970 1971 1972 1973 1974 1975 1976  1977 1978 1979 1980
1999


#comparison data
0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 8 13  39  50  54  50  41  38  97
0 0 0 0 0 0 0 0 0 0 0 1 1 4 7 15  22  77  110 170 177 167 144 318
0 0 0 0 0 0 0 0 0 0 1 0 0 1 10  31  31  74  116 146 168 91  92  50  144
0 0 0 0 0 0 0 0 0 0 1 1 0 8 9 60  118 259 431 517 516 347 265 212 961
0 1 0 0 0 1 2 1 2 2 7 13  22  41  53  89  226 356 448 526 402 322 232
955
0 0 0 0 3 4 0 2 6 7 7 19  34  34  51  74  177 285 446 516 474 393 258
669
0 0 0 0 0 0 0 1 2 3 8 4 4 4 11  60  135 341 562 687 634 506 365 931
0 0 0 0 0 0 0 0 1 1 6 15  30  22  30  39  64  146 200 379 388 386 300
876
0 0 0 0 0 0 1 0 2 1 4 14  41  47  79  50  83  112 164 272 357 309 262
732
0 0 0 0 0 0 1 2 1 1 4 3 15  31  70  146 163 159 151 193 308 323 319
1105
0 0 0 0 0 1 0 1 2 14  10  27  26  57  86  130 188 270 316 353 438 494
509 1616
0 0 0 0 0 0 0 0 0 0 1 2 1 3 14  19  41  92  171 233 292 282 241 835
0 0 0 0 0 1 0 0 0 0 1 1 1 3 8 28  39  106 160 258 329 373 370 1523
0 0 0 0 0 0 1 2 2 13  33  31  41  34  9 43  66  107 145 159 143 140 97
365

# Number  of Triennial survey size  comp  years
5


# Years
1977 1980 1983 1986 1995
```

```
# Sample  Size
25 25 25 25 25

# data
2584  6140  43904 27326 39782 60688 111235  76141 67469 71551 123024
137833  147907  188555  434441  787543  1065585 924884  641234  649319
764075  788588  938366  7431350
0 3679  2620  4929  1602  19007 16276 70625 58952 75296 112373  112882
185941  317137  291127  423489  217998  237176  293713  267499  377084
365442  360172  2902115
1473  23991 81723 112702  39004 48154 66084 89355 61353 92155 59602
56398 34134 57269 55976 44155 84491 91813 179254  264220  358488
456473  592849  4300601
6506  53295 41690 104521  83053 33164 41216 36240 55261 101218  289455
248178  276130  341303  272989  184777  229861  170925  264174  96217
138885  190770  172037  860253
2906 11052 15612 12741 13768 15787 41237 55680 150256  295345  282386
220504  114244  193641  142663  149017  111459  169644  205715  369945
497226  553446  385388  1828881


# Number of slope survey size comp years
5


# years 1xpop, 4xAFSC
1979 1996 1997 1999 2000

# sample size
25 25 25 25 25


#data
3117  7630  0 5123  5490  14459 27669 62293 75040 113413  164058
285927  325469  251458  443636  725956  1366737 2156232 2242299 2073524
1642703 1525133 1436646 3916376
0.000545883 0.001587818 0.012074275 0.012952897 0.009216671 0.003261842
      0.000929738 0.000624344 0.001057719 0.002473756 0.003559574
      0.008113279 0.050649006 0.044189142 0.081811212 0.031712932
      0.041568258 0.036459437 0.060271182 0.075347444 0.095830634
      0.108081505 0.1128124   0.204869054
0.002945144 0      0.007085336 0.012975624 0.045278491 0.047122312
      0.114912033 0.171458375 0.225992313 0.076018705 0.023561156
      0.005890289 0.004863574 0.015743406 0.020306108 0.038435209
      0.020168079 0.012769241 0.036505619 0.028982356 0.025075904
      0.025156636 0.01670957  0.022044518
0      0     0     0.002672647 0     0.004230858 0.002672647 0.011552594
      0.017440576 0.013737546 0.026112599 0.022837714 0.024021736
      0.028888425 0.019831463 0.024863938 0.064659819 0.110150525
      0.141455973 0.159970542 0.104483774 0.101755315 0.052362501
      0.062764155
0.002194043 0.001244728 0.001244728 0.016627654 0.01038538  0
      0.000648547 0.001858893 0.000648547 0     0     0.001210346
      0.001945641 0.001858893 0.02783832  0.038168572 0.090194851
      0.171351924 0.130416005 0.122006234 0.168400319 0.091497348
      0.038125381 0.082133645

# Size  age transition
9.2109E-06  0.001079748 0.011657379 0.066160987 0.198036027 0.313395584
0.262498953 0.116321595 0.02721869  0.003353133 0.000216721 7.32235E-06
1.28881E-07 1.17798E-09 5.57554E-12 1.36557E-14 0 0 0 0 0 0 0 0
```

1.82275E-11 2.72482E-08 1.66962E-06 5.58508E-05 0.001022726 0.010281257
0.056899331 0.173802131 0.293597363 0.274556239 0.142113922 0.040665725
0.006419035 0.000557461 2.65604E-05 6.92306E-07 9.84541E-09 7.62039E-11
3.20299E-13 0 0 0 0 0
0 2.63567E-13 5.29131E-11 6.02374E-09 3.89691E-07 1.43548E-05
0.000301749 0.00362788 0.025003452 0.098994015 0.225567713 0.296167575
0.224168686 0.097768925 0.02454019 0.003538401 0.000292459 1.38252E-05
3.72938E-07 5.72817E-09 4.99961E-11 2.4758E-13 0 0
0 0 2.9976E-15 7.6128E-13 1.15133E-10 1.02732E-08 5.41676E-07
1.69059E-05 0.000312885 0.003440158 0.022511263 0.087817158 0.204528475
0.284686142 0.23691735 0.11785397 0.035013738 0.00620419 0.000654599
4.10524E-05 1.52749E-06 3.36591E-08 4.3849E-10 3.38718E-12
0 0 0 3.33067E-16 8.10463E-14 1.2881E-11 1.24979E-09 7.41568E-08
2.69453E-06 6.0043E-05 0.000821753 0.006917715 0.035870485 0.114715784
0.226511451 0.276332572 0.208323571 0.097024917 0.027895724 0.004945508
0.000539926 3.62485E-05 1.49428E-06 3.83568E-08
0 0 0 0 2.22045E-16 4.75175E-14 6.74749E-12 6.04234E-10 3.41475E-08
1.21927E-06 2.75389E-05 0.000393946 0.003573514 0.020579011 0.075315455
0.17534042 0.259846513 0.245204886 0.147332292 0.056343226 0.013703326
0.002117516 0.000207669 1.34319E-05
0 0 0 0 0 5.55112E-16 1.03806E-13 1.18362E-11 8.76158E-10 4.2126E-08
1.31685E-06 2.679E-05 0.000355066 0.003068824 0.017312826 0.063806999
0.153746899 0.242347668 0.249976695 0.168731913 0.074510376 0.021513844
0.004058589 0.000542151
0 0 0 0 0 0 4.55191E-15 5.77427E-13 4.93773E-11 2.81337E-09 1.06894E-07
2.71064E-06 4.59143E-05 0.000519932 0.003939293 0.019984169 0.067927405
0.154796267 0.236610675 0.242644147 0.166944752 0.077046435 0.023840708
0.005697482
0 0 0 0 0 0 4.44089E-16 6.52811E-14 5.88396E-12 3.61953E-10 1.51992E-08
4.35988E-07 8.5491E-06 0.000114674 0.00105296 0.006622695 0.02854887
0.084392974 0.171156731 0.238230634 0.227606206 0.149260276 0.067172692
0.025832286
0 0 0 0 0 0 1.11022E-16 1.52101E-14 1.35369E-12 8.40635E-11 3.64111E-09
1.10065E-07 2.32337E-06 3.42687E-05 0.000353381 0.002549135 0.012869562
0.045493893 0.112652853 0.195472902 0.237727193 0.202653901 0.121083536
0.069106938
0 0 0 0 0 0 0 6.43929E-15 5.40012E-13 3.22701E-11 1.37201E-09 4.15229E-08 8.94974E-07 1.37451E-05 0.000150493 0.001175212 0.006548412
0.026045994 0.073974823 0.150074244 0.217526622 0.225296993 0.166740067
0.132452456
0 0 0 0 0 0 0 4.44089E-15 3.36065E-13 1.86916E-11 7.53224E-10 2.20034E-08 4.66158E-07 7.16543E-06 7.9947E-05 0.000647716 0.00381195
0.016301602 0.050671228 0.114514624 0.188205485 0.224974761 0.195609414
0.20517562
0 0 0 0 0 0 0 4.32987E-15 2.96874E-13 1.5016E-11 5.59804E-10 1.53856E-08 3.11858E-07 4.66361E-06 5.14717E-05 0.000419412 0.002523912
0.011219811 0.036853693 0.089466632 0.160553249 0.213018096 0.208969127
0.276919605
0 0 0 0 0 0 1.11022E-16 5.66214E-15 3.42948E-13 1.55483E-11 5.27637E-10
1.34074E-08 2.55185E-07 3.63919E-06 3.88981E-05 0.000311709 0.001873183
0.00844345 0.028553309 0.072455732 0.137990604 0.197263643 0.211687571
0.341377993
0 0 0 0 0 0 1.11022E-16 9.21485E-15 4.84723E-13 1.95146E-11 5.96649E-10
1.38579E-08 2.44579E-07 3.28099E-06 3.34632E-05 0.000259545 0.001531208
0.006872501 0.023470767 0.061001445 0.120676214 0.1817308 0.208347755
0.396072763
0 0 0 0 0 0 3.33067E-16 1.70974E-14 7.93698E-13 2.82361E-11 7.73215E-10
1.63014E-08 2.64659E-07 3.30967E-06 3.18874E-05 0.000236743 0.001354688
0.005975487 0.020320727 0.053283574 0.107744023 0.168031217 0.202120402
0.440897658

```
0 0 0 0 0 0 6.66134E-16 3.58602E-14 1.44162E-12 4.52461E-11 1.10669E-09
2.11006E-08 3.13676E-07 3.63642E-06 3.28817E-05 0.000231952 0.00127665
0.005483168 0.018379195 0.048084258 0.098199474 0.156563528 0.194882067
0.476862854
0 0 0 0 0 0 1.77636E-15 7.99361E-14 2.80875E-12 7.77943E-11 1.69882E-09
2.92546E-08 3.97342E-07 4.25733E-06 3.59901E-05 0.000240084 0.00126396
0.005252191 0.017227582 0.044609041 0.091196203 0.147206074 0.187625621
0.505338568
0 0 0 0 0 1.11022E-16 4.77396E-15 1.86073E-13 5.71732E-12 1.40028E-10
2.7333E-09  4.25289E-08 5.27565E-07 5.21827E-06 4.11619E-05 0.000258962
0.001299557 0.005202466 0.016615406 0.042338133 0.086080662 0.139658512
0.18081613  0.527683219
0 0 0 0 0 3.33067E-16 1.32117E-14 4.41536E-13 1.19189E-11 2.58919E-10
4.52819E-09 6.37641E-08 7.23067E-07 6.60372E-06 4.858E-05 0.000287891
0.001374479 0.00528712  0.016386906 0.040925794 0.082366103 0.133592323
0.174628019 0.54509539
0 0 0 0 0 9.99201E-16 3.59712E-14 1.05316E-12 2.50663E-11 4.84807E-10
7.62019E-09 9.73502E-08 1.01096E-06 8.53497E-06 5.8585E-05  0.000326982
0.00148404  0.005477404 0.016441184 0.040136691 0.079693834 0.128709039
0.169087051 0.558575539
0 0 0 0 1.11022E-16 3.10862E-15 9.68114E-14 2.49312E-12 5.25903E-11
9.09413E-10 1.28933E-08 1.49887E-07 1.4289E-06  1.11717E-05 7.16395E-05
0.000376819 0.001625865 0.005754759 0.01671005  0.039806445 0.077799194
0.124757327 0.164149725 0.568935411
0 0 0 0 3.33067E-16 9.21485E-15 2.55684E-13 5.81091E-12 1.09176E-10
1.69553E-09 2.17679E-08 2.31049E-07 2.02771E-06 1.4715E-05  8.83062E-05
0.000438256 0.001798828 0.006106491 0.017145386 0.039817187 0.076485602
0.121533218 0.159745484 0.576824244

# Normal ageing error matrix
0.9954    0.0046    0.0000    0.0000    0.0000    0.0000
          0.0000    0.0000    0.0000    0.0000    0.0000
          0.0000    0.0000    0.0000    0.0000    0.0000
          0.0000    0.0000    0.0000    0.0000    0.0000
          0.0000    0.0000
0.0254    0.9492    0.0254    0.0000    0.0000    0.0000
          0.0000    0.0000    0.0000    0.0000    0.0000
          0.0000    0.0000    0.0000    0.0000    0.0000
          0.0000    0.0000    0.0000    0.0000    0.0000
          0.0000    0.0000
0.0000    0.0591    0.8818    0.0591    0.0000    0.0000
          0.0000    0.0000    0.0000    0.0000    0.0000
          0.0000    0.0000    0.0000    0.0000    0.0000
          0.0000    0.0000    0.0000    0.0000    0.0000
          0.0000    0.0000
0.0000    0.0000    0.0964    0.8071    0.0964    0.0000
          0.0000    0.0000    0.0000    0.0000    0.0000
          0.0000    0.0000    0.0000    0.0000    0.0000
          0.0000    0.0000    0.0000    0.0000    0.0000
          0.0000    0.0000
0.0000    0.0000    0.0004    0.1318    0.7356    0.1318
          0.0004    0.0000    0.0000    0.0000    0.0000
          0.0000    0.0000    0.0000    0.0000    0.0000
          0.0000    0.0000    0.0000    0.0000    0.0000
          0.0000    0.0000
0.0000    0.0000    0.0000    0.0017    0.1627    0.6712
          0.1627    0.0017    0.0000    0.0000    0.0000
          0.0000    0.0000    0.0000    0.0000    0.0000
          0.0000    0.0000    0.0000    0.0000    0.0000
          0.0000    0.0000
```

0.0000	0.0000	0.0000	0.0000	0.0046	0.1881
	0.6146	0.1881	0.0046	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000			
0.0000	0.0000	0.0000	0.0000	0.0000	0.0095
	0.2078	0.5653	0.2078	0.0095	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000			
0.0000	0.0000	0.0000	0.0000	0.0000	0.0002
	0.0164	0.2222	0.5224	0.2222	0.0164
	0.0002	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000			
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0006	0.0248	0.2321	0.4850	0.2321
	0.0248	0.0006	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000			
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0013	0.0344	0.2382	0.4521
	0.2382	0.0344	0.0013	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000			
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0026	0.0444	0.2414
	0.4232	0.2414	0.0444	0.0026	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000			
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0001	0.0045	0.0545
	0.2422	0.3975	0.2422	0.0545	0.0045
	0.0001	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000			
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0003	0.0070
	0.0642	0.2412	0.3746	0.2412	0.0642
	0.0070	0.0003	0.0000	0.0000	0.0000
	0.0000	0.0000			
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0006
	0.0101	0.0732	0.2389	0.3542	0.2389
	0.0732	0.0101	0.0006	0.0000	0.0000
	0.0000	0.0000			
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0011	0.0138	0.0814	0.2357	0.3357
	0.2357	0.0814	0.0138	0.0011	0.0000
	0.0000	0.0000			
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0001	0.0019	0.0179	0.0888	0.2318
	0.3191	0.2318	0.0888	0.0179	0.0019
	0.0001	0.0000			
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0002	0.0029	0.0223	0.0952
	0.2274	0.3039	0.2274	0.0952	0.0223
	0.0029	0.0002			

0.0000 0.0000 0.0000 0.0000 0.0000 0.0000
0.0000 0.0000 0.0000 0.0000 0.0000
0.0000 0.0000 0.0004 0.0042 0.0268
0.1008 0.2227 0.2901 0.2227 0.1008
0.0268 0.0046
0.0000 0.0000 0.0000 0.0000 0.0000 0.0000
0.0000 0.0000 0.0000 0.0000 0.0000
0.0000 0.0000 0.0000 0.0006 0.0058
0.0314 0.1055 0.2179 0.2775 0.2179
0.1055 0.0379
0.0000 0.0000 0.0000 0.0000 0.0000 0.0000
0.0000 0.0000 0.0000 0.0000 0.0000
0.0000 0.0000 0.0000 0.0001 0.0010
0.0076 0.0360 0.1094 0.2130 0.2659
0.2130 0.1541
0.0000 0.0000 0.0000 0.0000 0.0000 0.0000
0.0000 0.0000 0.0000 0.0000 0.0000
0.0000 0.0000 0.0000 0.0000 0.0002
0.0015 0.0096 0.0405 0.1126 0.2080
0.2552 0.3724
0.0000 0.0000 0.0000 0.0000 0.0000 0.0000
0.0000 0.0000 0.0000 0.0000 0.0000
0.0000 0.0000 0.0000 0.0000 0.0000
0.0000 0.0003 0.0015 0.0062 0.0177
0.0371 0.9372

Input file 2

```
# April 28, 2003 version pop2.ctl

# Fishery age plus group inclusion - 1 = yes, 0 = no
1

# cv for CPUE (old = 0.2)
0.2

# SR function - 1 = Ricker, 2 = Bev-Holt
2

# beta parameters for steepness prior
# old(2.01,2.07),base(2,2), new Bev-holt (4.33,2.03), new Ricker
(2.32,3.00)
4.33 2.03

#steepness prior switch - 0 = uniform prior, 1 = beta prior (above)
0

# Max selectivity age class for fishery (base = 12, old = 20)
12

# Max selectivity age class for survey (base = 10, old = 8)
10

# Phase to do robust age and size likelihood if phase reached (changed
to 7)
7

# steepness phase (7)
7


# Rho value (0.0, other - 0.5)
0.0

#Sigma R value (1.0, other = 0.76 = old)
1.0

# natural mortality M phase (6)
6

# sigma r (recruitment variance) phase
-1

# F deviance phase
2
```

```
# Recruitment deviance phase (3)
3

# Survey selectivity type switch -> 1 = Original Ianelli, with no
selectivity change over time
#                                                        2 = Original
Ianelli, with time-varying deviations
#                                                        3 = Original
Ianelli, asymptotic selectivity function
#                                                        4 = Richards,
Schnute and Olsen asymptotic
#                                                        5 = Coleraine
double normal
#                                    6 = Synthesis double logistic
1

# selectivity deviance phase (fish)
3

# survey selectivity phase -- This is the phase to begin whatever
selectivity option is turned on
4

# fishery selectivity phase
2

# survey catchability phase (5)
5

# groupnum (changed to 6 so last 2 years in a larger group of 4)
6

# Natural mortality prior mean (.05, other = .55)
0.05

# Natural mortality prior cv (0.1, other = 0.25)
0.1

# q prior mean (base = 0.79 other = 0.98)
0.98

#q prior cv (base = 0.68 other = 0.45)
0.45

#q prior type = 0 = uniform in log space, 1 = normal, 2 = lognormal
(old =2)
0

# q prior switch - 0 = on triennial (shelf) survey only, 1 = on all
0

# Vector of lambdas (100 1 1 1 0.0 1 12 20 20 20 50 20 1 1 1 1 1 1 1 1)
100 1 1 1 0.1 1 12 20 20 20 50 20 1 1 1 1 1 1 1 1
```

Darkblotched Rockfish (*Sebastes crameri*) 2003 Stock Status Update

Jean Beyer Rogers
Fishery Resource Analysis and Monitoring Division
National Marine Fisheries Service
Northwest Fisheries Science Center
2032 South East Oregon State University Drive
Newport, Oregon 97365-5275

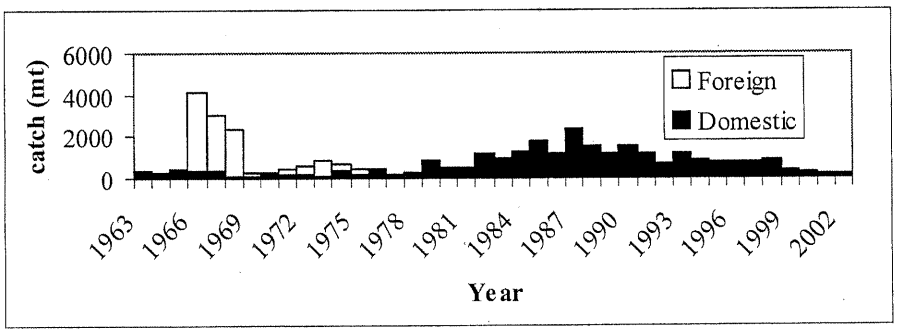
Executive Summary

Stock

The assessment covers the population of darkblotched rockfish (*Sebastes crameri*) off the Pacific west coast United States between Mexico and Canada. The actual stock probably crosses the Canadian border.

Catches

Estimated catch has declined in recent years with increasing management restrictions.



Year	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
Catch (mt)	1188	857	721	730	747	842	359	226	171	129

Data and assessment

The last full assessment used the length-based stock synthesis model to assess the population through 1999 (Rogers et al. 2000, STAR 2000). A 2001 update of that assessment added 2000 AFSC slope survey and available 2000 fishery data (Methot and Rogers 2001). This update further adds 2001 AFSC slope and shelf survey data and fishery data through 2002. Although the 2001 update refit only recruitments, the SSC currently prefers that update models refit all parameters. Results presented in this summary are from a model refitting all parameters estimated in the full assessment.

Unresolved problems and uncertainties

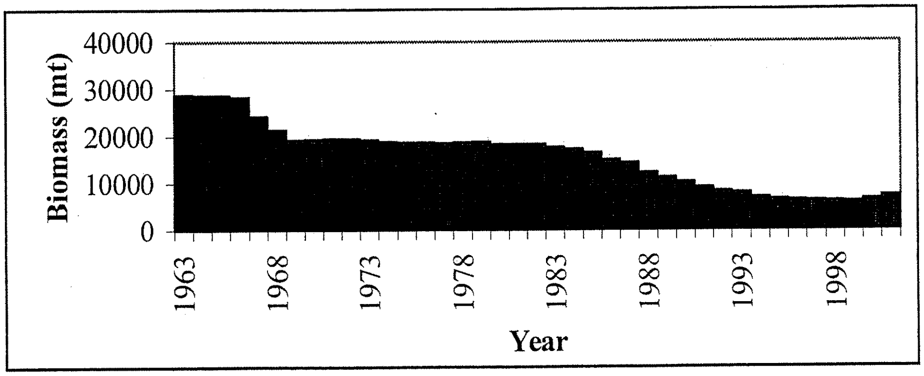
Three sources of uncertainty affect fixed values or model structure, which is beyond the scope of an update. Aging of ototliths for this update had different aging error and possibly aging bias. Also, newly published indirect estimates of darkblotched rockfish natural mortality indicate it may be underestimated in the model (Gunderson et al. 2003). Finally, NWFSC slope survey data from 1999-2002 were not included in this update because they differed from the AFSC slope survey in both selectivity and catchability. Exploratory models with either higher natural mortality or the NWFSC survey as a separate index increased spawning biomass relative to unfished levels. In both cases, however, the models fit extremely high 2000 and 2001 recruitments and very low early recruitments.

Reference points

Reference points as of 2002 are: ABC = fmsy proxy at F50% and OY = 70% prob of rebuilding to Bmsy by 2047.

Stock biomass

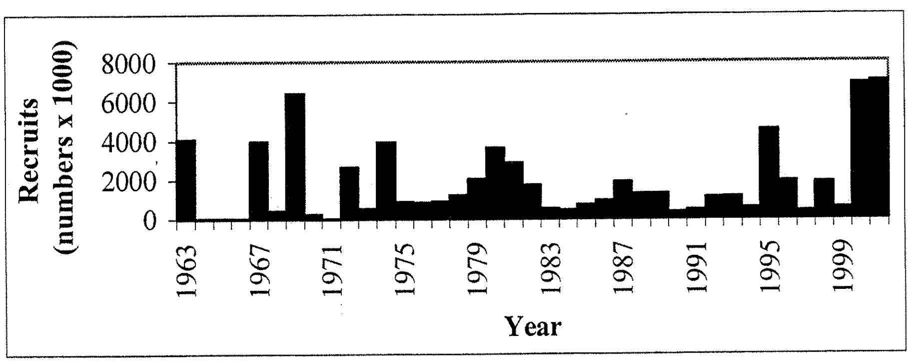
Biomass (mt) of age 1+ fish at the start of the year declined until 1999 and then increased.



Year	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
Biomass (mt)	8210	7861	6986	6542	6339	6200	6110	5940	6404	7266

Recruitment

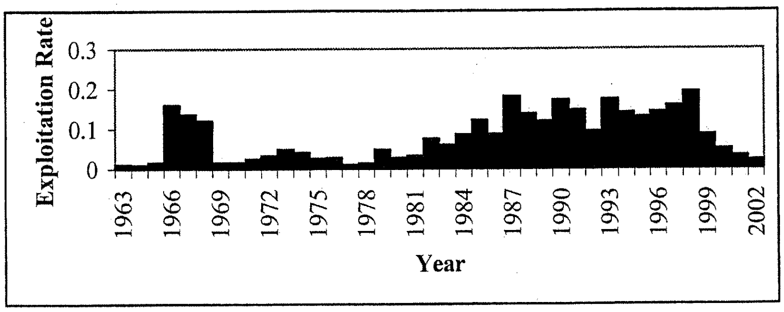
Recent increase in biomass is partly due to estimates of high 2000 and 2001 age 1 recruitments.



Year	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
Recruits (#x 1000)	1099	1138	577	4562	1942	408	1850	572	6898	7041

Exploitation status

The estimated exploitation rate (catch/biomass available to fishermen) has progressively dropped since 1998.



Year	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
Exploitation	0.17	0.14	0.13	0.14	0.16	0.19	0.09	0.05	0.03	0.02

Management performance

Darkblotched rockfish was first assigned an individual species optimum yield (OY) in 2001 based on the 2000 stock assessment. That OY was modified in 2002, following the 2001 update and rebuilding plan. Estimated catch was above the OY in 2001, but below OY in 2002.

	Limits			Actual
	Catch		Landings	Landings
Year	ABC	OY	OY	
2001	302-349	130	109	161
2002	187	168	135	103

Forecasts

Updated rebuilding analyses predict OY catch and exploitable biomass will continue to increase over the next three years, given 70% probability of rebuilding the stock in the maximum allowable time. The three values below reflect progressive inclusion of 2000 and 2001 recruitment estimates (2000 includes only the 2000 estimate, 2001 includes both the 2000 and 2001 estimates). This indicates risk from possible overestimation of those recruitments due to limited data.

Type		OY (mt)			Expoitable Biomass (mt)		
Ending Year		1999	2000	2001	1999	2000	2001
Year							
	2004	192	299	391	6785	7451	7638
	2003	201	333	455	7052	8259	8848
	2005	208	362	519	7283	8941	10059

Recommendations

1) Information on 2000 and 2001 recruitments should be carefully monitored. High estimates for both the 1995 and 1998 recruits were later reduced when more information was received.

2) A full assessment should be conducted if the SSC decides the assessment should use a higher estimate for natural mortality or include NWFSC slope survey data.

3) Changes in aging criteria should be further explored and resolved.

Additional sources of information

Gunderson, D.R., M. Zimmerman, D.G. Nichol, and K.Pearson. 2003. Indirect estimates of natural mortality rate for arrowtooth flounder (*Atheresthes stomias*) and darkblotched rockfish (*Sebastes crameri*). Fish. Bull. 101:175-182.

Rogers, J.B., R.D. Methot, T.L. Builder, K. Piner, and M. Wilkins. 2000. Status of the Darkblotched Rockfish (*Sebastes crameri*) Resource in 2000. Appendix: Status of the Pacific coast groundfish fishery through 2000 and recommended acceptable biological catches for 2001. Pacific Fishery Management Council, 7700 NE Ambassador Place, Suite 200, Portland, OR 97201.

STAR 2000. Darkblotched rockfish panel meeting report. Status of the Pacific Coast Groundfish Fishery through 2000 and Recommended Acceptable Biological Catches for 2001, Stock Assessment and Fishery Evaluation. Pacific Fishery Management Council, 7700 NE Ambassador Place, Suite 200, Portland, OR 97201.

Methot, R. and J.B. Rogers. 2001. Rebuilding analysis for darkblotched rockfish. Pacific Fishery Management Council, 7700 NE Ambassador Place, Suite 200, Portland, OR 97201.

Introduction

The last full assessment of darkblotched rockfish (*Sebastes crameri*) stock off the coasts of California, Oregon, and Washington was conducted in 2000, using data available through 1999 (Rogers et al. 2000)(Fig.1). The stock assessment model selected by the STAR panel (Model 2) had a single fishery and three Alaska Fisheries Science Center (AFSC) surveys: slope, shelf, and Pacific Ocean Perch (P.o.p.)(STAR 2000, Rogers et al. 2000). Selectivities were fit separately for each data source. The fishery was estimated to catch all larger fish, but the three surveys selected only part of the larger fish. Catchability for each survey (proportion of the stock sampled at fully selected sizes) was freely fit, with no prior assumptions. No stock recruitment relationship was assumed. One-year old recruitments were estimated for 1963-1998, with 1999 recruitment fixed at an assumed level.

A 2001 update of Model 2 is the basis of the current darkblotched rockfish rebuilding plan (Methot and Rogers 2001). The update added 2000 Alaska Fisheries Science Center (AFSC) slope survey data and some fishery data (Fig.1). Selectivities and survey catchabilities were fixed at the values estimated in the full assessment. Only recruitments were re-estimated, with 2000 and 2001 recruitments fixed at an assumed level. The 2001 update model will be referred to in this document as Model 3 (Table 1).

The primary purpose of this document is to update the 2001 model currently used by managers (based on personal communications with Stephen Ralston- Scientific and Statistical Committee(SSC) and Richard Methot- lead author of the 2001 model). This new update includes data through 2002, adding 2001 AFSC slope and shelf survey indices as well as fishery data (Fig.1). Updates include more recent data, but keep fixed values and model structure the same.

Although the 2001 update refit only recruitments, current SSC update policy requires refitting all parameters estimated in the full assessment (Stephen Ralston, SSC, pers. comm.). Therefore for this update, a model refitting only recruitments (Model 7) was compared to a model refitting all parameters estimated in the full assessment (Model 6) (Table 1).

Exploratory models are also presented for comparison. The Pacific Fishery Management Council requires that an update use the best available scientific data (SSC, 2002). Incorporating some new information required changes to Model 2 fixed values or structure. Results from those models were presented to help the SSC determine need for a future full assessment.

Documentation of updated data sources

Catch

Revised 1963-2001 catch estimates resulted in an increase of 1246 mt. Domestic landings decreased 342 mt, while foreign catch increased 1579 mt (Table 2). Discard was added to landings in 2001 and 2002, using limited entry rates assumed by the Pacific Fishery Management Council.

A report was issued in January 2003 presented initial data and summary analyses for the 2001-2002 NWFSC west coast groundfish observer program. That report indicates darkblotched rockfish discard may be higher than the assumed 16%-20%. It did not, however, present percent discard estimates for the fishery as a whole and NWFSC recommends not using the information in 2003 assessments.

Trawling closure in 100-250 fm north of 40 10' in 2002 (Table 3) did not greatly change the distribution of darkblotched rockfish landings north and south of that border (Fig. 2). Based on survey length distributions, the closure should have prevented catch of most fish > 22 cm fl (Fig. 3), the size ordinarily available to commercial gear mesh. Landings location may not reflect catch location.

AFSC Survey Indices

AFSC conducted both shelf (triennial) and slope surveys in 2001 (Table 4). Both 2001 estimates were higher than in the previous survey years, but also had greater standard deviations (Table 5). Shelf and slope data overlap only in 100-200 fm bottom depth and the shelf survey extends further south.

Length Compositions

All length compositions are in Table 6 and 7 and recent length compositions are in displayed in Fig. 4-6.

Method of deriving fishery length compositions for years with length data from all three states (1996-2002) was altered in this update. Previously, length samples were combined without any weighting by landings (Rogers et al. 2000). New fishery length data, however, indicated differences between states. California1999 lengths included smaller fish than in the previously-available Oregon and Washington 1999 data. In 2001 and 2002, Washington had smaller fish than Oregon and California. Although Washington landings were a small percentage of the total (Fig. 2), that state contributed 29% of the length samples in 2001 and 43% in 2002. To prevent bias from unequal sampling rates, state length compositions were weighted by state landings before combining into a single composition.

Some length frequencies previously treated as combined-sex were divided by sex based on available information. Since unsexed Washington fish had a smaller influence on the length compositions, and new data from other states also had some unsexed fish, they were divided into males and females using the sexed proportion for that age or length bin. Previously combined-sex length frequencies for 1985 P.o.p. survey and 1991 slope survey were also divided using that methodology.

Age Compositions

Darkblotched rockfish aging conducted in 2002 (Fig. 1, 4-6; Tables 8-9) indicated a change in age-length relationship and aging error. Plotting newly-aged fish with the age-length relationship used in the assessment (Table 10) indicated larger sizes for the younger ages (Fig. 7). Coefficient of variation (CV) in age between readings was also greatly reduced for those ages (Fig. 8), although most otoliths were read by the same two readers. Along with this were reduced CV in length at age, with females 9% at age 1 and 2% at age 40 versus the previous 10% and 7%, respectively and males at age 40 2% versus 5% previously. Reasons for this change are currently being explored, but a preliminary investigation suggests an unintended shift in aging criteria between aging time periods. Since the age-length relationship and aging error in the 2000 model did not reflect otoliths aged in 2002, the model could not fit both the new length and age frequencies. New age frequencies were therefore not included in the update models.

Model Description

A comparison of the full assessment model (Model 2) and the 2001 update model (Model 3) is included in Table 11. The model selected by the STAR panel in the last full assessment fit 57 parameters, including 36 yearly recruitments (1963-1998), while the 2001 update fit only background recruitment and 1963-1999 yearly recruitments. Model 2 fixed only the last yearly recruitment, while Model 3 fixed the last two recruitments. Although there was no stock-recruitment relationship in either model, in the 2001 update, recruitments in 1964, 1965, and 1971 were restricted by the lower bound of 10,000 fish.

This update extended the ending year of the models to 2002 without changing fixed values or model structure. Model 7 updated Model 3 by fitting background recruitment and yearly recruitments in 1963-2000. Model 6 updated Model 2 by re-fitting selectivities, survey catchabilites, background recruitment and yearly recruitments in 1963-2001.

Rebuilding analysis utilized the "environmental hypothesis" alternative (Methot and Rogers, 2001), which is the basis of the current OY. In the current rebuilding plan, virgin recruitment was determined from the long-term average (1963-1996), while recruitment during rebuilding was taken from recent (1983-1996) recruitments. The 1998 age composition was supplied to the rebuilding analysis (recruits after 1998 were estimated by re-sampling 1983-1996 recruitments). In this update, those ranges were extended in incremental steps to include more recent recruitments.

Results

A comparison of update model results for Model 6 (full refitting) versus Model 7 (recruitment refitting) are presented in Table 11 and Fig. 9. Model 6 estimated higher recruitments for 1995, 1998, and 2000 (Fig. 9) and higher ending biomass (Table 11). Refitting all parameters improved the fit to fishery lengths, shelf survey index, shelf survey lengths, and slope survey age and lengths, as indicated by relative log-likelilhood values for Model 6 versus Model 7 (Table 11). The SSC committee reviewing this update preferred Model 6 over Model 7, so that model is presented in further detail.

Fits of Model 6 estimates to selected data are in Fig. 10. Estimates of the shelf and slope survey indices reflected the slight 2001 upturn in the data. The model estimated fishery length compositions very well but did not fit the high modes for 33-34 cm females and 32 cm males in the survey compositions. Those sizes roughly correspond to 8-9 year old fish (1993-1994 recruits) given the months when the surveys occur (Table 10). Fishery selectivity for those sizes was high, but survey catchability relatively low (Fig. 11).

When survey catchabilities and selectivities were refit (Model 6), the shelf survey catchability was near 1.0 for 3-5 year old fish (Fig.11). Selected series of those ages in the years of the shelf survey are outlined in Table 13. Age 3-5 year old fish in the 2001 shelf survey corresponded to the 1997-1998 recruits. High catchability resulted in reduced recruitment estimates for those years. Age 3-5 year old fish in the earliest shelf survey (1977) were ages 27-29 in the 2001 survey. The model estimated there no fish of those ages fish in the 2001 population.

The model could not account for the lack of larger, older fish in the fishery in recent years based solely on catch. As the new fishery data indicated even fewer of those fish, the model explained this by estimating very low recruitments in early years, very high recruitments in the most recent years, and the high shelf survey catchability for 3-5 year old fish in the triennial survey (Table 12).

It should be noted that although the STAR panel chose a model which freely fit the data there were bounds on selectivity parameters and yearly recruitments. When those bounds were reached, it affected results. In both the 2001 and this update, the shelf survey descending inflection hit the lower bound, preventing further reduction of selectivity of larger fish. Size at the transition between ascending and descending selectivity was fixed at the approximate length composition mode for each type of survey (Rogers et al. 2000). Setting transition at a smaller size would have resulted in a more rounded curve without hitting the descending inflection bound, but higher catchability at maximum selection. Recruitments were bounded by a minimum of 10,000 fish, but in the 2000 full assessment, that bound was not limiting. In both the 2001 update and this update, recruitments in a few early years were forced to have the minimum value (Tables 11,12).

Uncertainty Analysis

A retrospective analysis for Model 6 shows the effects of first changing and then extending the data (Table 11, 13). Model 4 is the 2001 update model (Model 3) with selectivities and survey catchabilities refit (Table 1). Estimated 2001 ending biomass would have been reduced in the 2001 update with full refitting (Table 11). Shelf and Pacific ocean perch survey catchability would have increased and slope survey decreased, and some changes would have been made to survey selectivities (Table 11,13). Model 5 is Model 4 with revised catches and length compositions (Table 1). Data revisions further reduced the 2001 ending biomass and slightly increased the shelf and slope survey catchabilities (Table 11). All selectivities changed slightly (Table 13). Extending the data to 2002 (Model 6) then decreased shelf and slope survey catchabilites, increased P.o.p survey catchability, and slightly changed survey selectivities (Table 11, 13).

The SSC requested two additional model runs which were variations of Model 6 (Table 14). One model assumed catch was double the landings in 2000-2002, based on higher discard rates in recent years, as indicated by the preliminary observer report. In order to fit the same survey information and fishery length compositions given higher catch, estimates of ending biomass and 2000 and 2001 recruitments increased slightly. The other run tested the effect of weighting 1996-2002 fishery length compositions by state landings. Using unweighted length compositions decreased the ending biomass and lower recent recruitment estimates.

Rebuilding Projections

Rebuilding analyses were used to estimate 2004 OY at varying levels of probability of rebuilding within maximum allowed times (Table 15). Effect of progressively including 1997-1999, 2000, and 2001 recruitment estimates were also explored for Model 6. This is useful in assessing risk associated with overestimating the high 2000 and 2001 recruitments, which are based on limited data.

Progressive inclusion of recruitment estimates affected three types of input to the rebuilding analyses. Those types included last estimated age composition, recruitments resampled to predicting future recruitments, and estimates of virgin recruitment. When the last age composition supplied was 1999, then recruits after 1999 were estimated within the rebuilding analyses by resampling recruits during specified earlier time periods (1983-1996 or 1983-1999). Virgin recruitment was estimated using either average recruitment in 1963-1996 or 1963-1999. When the last year was 2000, then recruits after 2000 were estimated by resampling recruits from 1983-2000 and virgin recruitment was the average of 1963-2000 recruitments. Finally, when the last year was 2001, recruits after 2001 were estimated by resampling recruits from 1983-2001 and virgin recruitment was the average of 1963-2001 recruitments. Comparative age compositions for 1999, 2000, and 2001 are shown in Table 12. Adding the 2000 recruitment estimate and then both 2000 and 2001 recruitment estimates progressively increased the OY and biomass (Table 15).

For comparable models, Model 6 estimated higher OY than did Model 7 (Table 15). This was likely due to the higher 1995, 1998, and 2000 recruitment estimates in Model 6. Model 7 did not estimate 2001 recruitment.

Ten year projections of OY given 70% probability of rebuilding (as presently used to estimate OY) indicated progressive increases for all comparisons (Table 16). OY predictions for Model 6 without including 2000 and 2001 recruitment estimates are slightly less than predictions of OY given the current rebuilding plan (based on Model 3) (Table 16).

Exploratory Models

Incorporating some new information required changes in fixed parameters or model structure. That information is presented so that the SSC may assess need for a full assessment. Results of exploratory models incorporating potential changes are presented if they substantially change results.

Fishery Selectivity

Further information indicates selectivity for the fishery may have changed over time. Recent management changes may have affected selectivity, but this is not clearly shown. Foreign fisheries in 1966-1976 probably selected smaller fish than the domestic fishery during the same time period (Rogers in press). Foreign catch in 1966-1968 was primarily Soviet Union (100% in 1967, 72% in 1968, 63% in 1969). That country apparently used very small codend mesh. There were reports of 2 inch codend mesh in 1966 and 1967 (Jewell et al. 1966,USBCF 1967). At the end of 1968, they agreed to minimum codend mesh size of 2.4-2.8 in (ITFC 1969). Allowing different selectivity in early foreign catch years or recent years, however, greatly change the results.

Natural Mortality

A recent publication provided indirect estimates of natural mortality (M) for darkblotched rockfish (Gunderson et al. 2003) which were higher than the 0.05 estimate used in the assessments (Table 3). They estimated variance associated with two indirect methods of estimating M. One estimate of M was based on a linear relationship with reproductive effort as measured by GSI (ovary weight/somatic body weight) (Gunderson 1997). Average size of mature females was estimated at 42.7 cm, resulting in M = 0.107 with a 95% confidence interval of 0.07-0.144. An estimate of M = 0.05 would require an average size of 32.4 cm. The second method was based on correlation between M and K (von Bertalanffy growth parameter). A value of K = 0.1852 (based on both sexes combined) resulted in M = 0.296 (0.27-0.32). Gunderson et al. (2003) acknowledged this result may be an over-estimate. A lower K would reduce M.

Changing M to 0.107 raised the relative spawning stock but degraded model fit to the data (Table 17). In the last full assessment, M fit best between 0.04 and 0.05 (Rogers et al. 2000). Increasing M also further increased recent recruitments and deceased early recruitments (Figure 12).

NWFSC Slope Survey

The 2001 update model did not include the Northwest Fisheries Science Center (NWFSC) slope survey information (Methot and Rogers 2001). It was not part of the last full assessment (Rogers et al. 2000). The survey began in 1998, but rockfish catch was not sorted until 1999, and darkblotched rockfish biological samples not taken until 2000. Lengths and otoliths were taken as time permitted (Dan Kamikawa, NWFSC, Newport, OR, pers comm.), with 53% of darkblotched catches sampled in 2000, 83% in 2001, and 100% in 2002. In 2002, lengths were also taken on two catches not utilized in the index because the net belly ripped. The most fish sampled in any tow was 164.

Comparison of the NWFSC and AFSC slope surveys indicates they cannot be combined into a single index for darkblotched rockfish. Helser et al. (in review) combined the surveys for sablefish, thornyheads, and Dover sole using a generalized linear mixed model, treating vessel as a random variable. For those species, vessel coefficients were small, separate NWFSC and AFSC biomass estimates and CV were similar, and there was no evidence of pronounced and consistent differences in length compositions between the two surveys. For darkblotched rockfish, a similar model indicated the AFSC survey had lower probability of encountering a positive tow and once encountering fish had lower catch rates (Thomas Helser, NWFSC, Seattle, WA, pers. comm.). In addition, biomass estimates and CV were substantially different for 2000 (Table 5), and NWFSC length compositions for comparable areas and years included larger fish (Fig. 13).

Graphing shows some of the commercial vessels used by the NWFSC consistently had more positive tows, and some commercial vessels had more large catches (adjusted for differences in swept area)(Fig. 14). Four of the largest catches occurred in 2000, resulting in the very high estimated biomass and CV. Large catches were in less than 200 fm and no catches were deeper than 282 fm, although the survey sampled to 700 fm.

Most large fish (> 35 cm fl) were from a few large tows (Fig. 15). In 2000, almost all large fish came from the largest tow, in which measured fish averaged 39 cm. In 2002, a large catch (third largest in all years) contained most of the larger fish. It was excluded from the index because the net belly tore. Larger fish sampled averaged 42.7 ^{0} N latitude with gear depth averaging 173 fm. Only one large fish was caught deeper than 205 fm and none south of 38 ^{0} 66' N.

Including a NWFSC slope survey index had the greatest effect on the model results (Table 17). Spawning stock was estimated to be at target level, but fit to the other data was overall degraded (Table 17). Recent recruitment estimates were extremely high and early recruitments very low (Fig. 12). Length and age compositions utilized in the index show a dramatic decline in the proportion of large fish from 2000 to 2002 (Fig. 16). Very high recruitments help the model fit that decline. Removing the unusual 2000 survey, which was affected by an extremely large catch of large fish, or fixing recent recruitments at levels comparable to those estimated for earlier years substantially reduced current biomass estimates.

Acknowledgments

As always, Richard Methot was very helpful in utilizing his model. The aging laboratory spent many hours on the otoliths. Tom Hesler produced results from the model relating the two

slope surveys. Mark Wilkins, Bob Lauth, and Owen Hammel produced the survey indices, lengths, and age compositions. Will Daspit and Brenda Erwin.helped supply data.

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Table 1. Comparison of models referred to in this paper (not including sensitivity runs and exploratory models).

Fitted	Model	Description
all	1	STAT team model in original assessment (Rogers et al. 2000)
all	2	STAR panel model in original assessment (Rogers et al. 2000)
recruitments	3	Updated Model 2 - used in rebuilding analyses (Methot and Rogers 2001)
all	4	Model 3 with all parameters refit
all	5	Model 4 with catch and length compositions revised
all	6	Model 5 extended and updated to 2002
recruitments	7	Model 3 with new data and extended to 2002

Table 2. Changes in estimated catch (mt) of darkblotched rockfish by year for the Pacific west coast. Catch used in the 2001 updated model (Methot and Rogers 2001) is listed under "2001 model". Catch used in this update is under "2003 model". Domestic landings for 1963-1982 in both models are referenced in Rogers et al. 2000. In 2001 model, domestic landings for 1983-1998 in 2001 model are PacFIN - 4/12/2000 for1983-1998 and 5/2001 for 1999 and 2000, 2001 landings = OY for that year, and foreign catch is 10% of Pacific ocean perch foreign catch in Ianelli et al. (2000). For 2003 model, 1983-2002 landings are from PacFIN - 3/20/03 and foreign catch is from Rogers (in press).

year	2001 model			2003 model				Change
	Domestic	Foreign	Catch	Domestic	Foreign	%discard	Catch	
1963	315		315	315			315	0
1964	246		246	246			246	0
1965	436	38	474	436			436	-38
1966	355	2050	2405	355	3807		4162	1757
1967	338	3320	3659	338	2706		3044	-615
1968	103	1878	1982	103	2288		2391	409
1969	123	436	560	123	153		276	-284
1970	129	444	573	129	149		278	-295
1971	159	479	639	159	278		437	-202
1972	203	400	603	203	374		577	-26
1973	59	315	374	59	768		827	453
1974	363	106	469	363	346		709	240
1975	165	120	285	165	293		458	173
1976	344	115	459	344	118		462	3
1977	194		195	194			194	-1
1978	254		254	254			254	0
1979	851		851	851			851	0
1980	471		471	471			471	0
1981	543		543	543			543	0
1982	1217		1217	1217			1217	0
1983	872		872	925			925	53
1984	1286		1286	1288			1288	2
1985	1787		1787	1757			1757	-30
1986	1277		1277	1172			1172	-105
1987	2375		2375	2347			2347	-28
1988	1692		1692	1540			1540	-152
1989	1295		1295	1184			1184	-111
1990	1427		1427	1550			1550	123
1991	1189		1189	1149			1149	-40
1992	680		680	666			666	-14
1993	1199		1199	1188			1188	-11
1994	860		860	857			857	-3
1995	721		721	721			721	0
1996	707		707	730			730	23
1997	797		797	747			747	-50
1998	890		890	842			842	-48
1999	326		326	359			359	33
2000	239		239	226			226	-13
2001	130		130	161		16%	171	41
2002				103		20%	129	

Table 3. Cumulative two month landings limits for trawl slope rockfish complex (includes darkblotched rockfish). Limits N of $40^{0}10'$ do not include Pacfic ocean perch, those to the south do not include splitnose rockfish. L.E. = Limited Entry, O.A. = Open Access. Sm. Footrope = bottom trawl net required to have footrope no larger than 8" in diameter. * = two one-month-limits combined.

Year	Area	Period	L.E.	O.A.	No trawling	Sm. Footrope
2000	N of $40^{0}10'$	Jan-Dec	3,000	500		for shelf rockfish
		July-Oct	5,000	500		
		Nov.-Dec	3,000	500		
	S of $40^{0}10'$	Jan-June	3,000	500		
		July-Aug	7,000	1000		
		Sept-Dec	20000*	3000		
2001	N of $40^{0}10'$	Jan-June	1,500	500		for shelf rockfish
		July-Oct 1	2,000	500		for shelf rockfish
		Oct 2-Dec	0	0		for shelf rockfish
	S of $40^{0}10'$	Jan-June	14,000	5,000		
		July-Dec	25,000	5,000		
2002	N of $40^{0}10'$	Jan-Aug	1,800	25%of sablefish/trip	100-250 fm	
		Sept	600	25%of sablefish/trip	0-250 fm	
		Oct	▼	25%of sablefish/trip	100-250 fm	<100 fm
		Nov.-Dec	1,800	25%of sablefish/trip	100-250 fm	<100 fm
	36^{0}-$40^{0}10'$	Jan-April	50,000	10,000		
		May-Aug	5,000	5,000		
		Sept-Oct	600	1,800		
		Nov.-Dec	1,800	1,800		
	S of 36^{0}	Jan-Aug	50,000	10,000		
		Sept-Oct	25,000	10,000		
		Nov.-Dec	40,000	10,000		

Table 4. Comparison of surveys utilized for information on darkblotched rockfish.

Survey	Year	Vessel	dates	Latitudes	Depths	Gear	knots	min	period	Len	Age
Shelf (Triennial)	77	P.Raider/Tor./Com./D.S. Jordan	7/4-9/27	34°00'-Border	50-250	roller	3	30	day	Y	
	80	Pat San Marie/Mary Lou	7/12-9/28	36°48'-49°15'	30-200	roller	3	30	day	Y	Y
	83	WarriorII/Nordfjord	7/7-10/3	36°48'-49°15'	30-200	roller	3	30	day	Y	Y
	86	Alaska/Pat San Marie	7/9-9/30	36°48'-Border	30-200	roller	3	30	day	Y	Y
	89	Pat San Marie/Alaska	7/7-9/29	34°30'-49°40'	30-200	roller	3	30	day	Y	N
	92	Alaska/Green Hope	7/12-10/7	34°30'-49°40'	30-200	roller	3	30	day	Y	N
	95	Alaska/Vesteraalen	6/8-9/6	34°30'-49°40'	30-275	roller	3	30	day	Y	Y
	98	Dominator/Vesteraalen	6/1-8/9	34°30'-49°40'	30-275	roller	3	30	day	Y	Y
	1	Sea Storm/Frosti	6/1-8/27	34°30'-49°40'	30-275	roller	4	30	day	Y	Y
P,o.p	79	C. Horizon-Wash./New Life-Or.	4/18-5/2	44°37'-Border	90-260	roller	3	30	day	Y	N
	85	Marathon	4/3-5/28	44°37'-Border	90-260	roller	3	30	day	Y	N
Slope	88 (91)	Miller Freeman	11/28-12/14	44°05'-45°30'	100-700	mudsweep	2	30	24 hr	Y	N
	90 (91)	Miller Freeman	10/26-11/15	40°30'-43°00'	100-700	mudsweep	2	30	24 hr	Y	N
	92 (91)	Miller Freeman	10/17-11/12	45°30'-Border	100-700	mudsweep	2	30	24 hr	Y	N
	93 (91)	Miller Freeman	10/14-11/8	43°00'-45°30'	100-700	mudsweep	2	30	24 hr	Y	N
	95 (95)	Miller Freeman	10/30-11/16	40°30'-43°00'	100-700	modmudsw	2.3	30	24 hr	Y	N
	96 (95)	Miller Freeman	10/28-11/13	43°00'-Border	100-700	modmudsw	2.3	30	24 hr	Y	N
	97 (97)	Miller Freeman	10/20-11/25	34°30'-Border	100-700	modmudsw	2.3	30	24 hr	Y	N
	99 (99)	Miller Freeman	10/14-11/19	34°30'-Border	100-700	modmudsw	2.3	30	24 hr	Y	N
	0 (00)	Miller Freeman	10/10-11/9	34°30'-Border	100-700	modmudsw	2.3	30	24 hr	Y	Y
	1 (01)	Miller Freeman		34°30'-Border	100-700	modmudsw	2.3	30	24 hr	Y	Y
NWFSC slope	99	S.Eagle,C.Jack,M.Leona, B.Horizon	7/3-9/24	35°-48°10'	100-700	Aberdeen	2.2	15	day	N	N
	0	S.Eagle,C.Jack,Excalibur,C.Pride	7/3-9/23	35°-48°07'	100-700	Aberdeen	2.2	15	day	Y	Y
	1	S.Eagle,C.Jack,Excalibur,L.Stalker	7/2-9/28	35°-48°08'	100-700	Aberdeen	2.2	15	day	Y	Y
	2	S.Eagle,C.Jack,Excalibur,M.Julie	6/25-9/24	32°51'-48°07'	100-700	Aberdeen	2.2	15	day	Y	Y

Table 5. Biomass index estimates in mt with standard deviations in parentheses. The AFSC indices were used in the 2000 assessment and are included in the update. The 1991 Slope - Super Year summed 1992 U.S. Vancouver and northern Columbia with an average of 1988 and 1993 central Columbia, 1993 southern Columbia, and 1990 Eureka. The 1995 Slope - Super Year summed 1996 U.S. Vancouver and central Columbia with 1995 southern Columbia and Eureka. The NWFSC index is included in an exploratory model.

Years	Surveys			
	AFSC Shelf	**AFSC P.o.p.**	**AFSC Slope- Super Years**	**NWFSC Slope**
	$36^0$48'-US Borde 30-200 fm	**$44^0$70'-$47^0$30' 90-260 fm**	**$40^0$30-U.S. Border 100-700 fm**	**$34^0$30-U.S. Border 100-700 fm**
1977	3835 (739)			
1979		4555 (947)		
1980	3647 (928)			
1983	8970 (2740)			
1985		5595 (1085)		
1986	7350 (2348)			
1989	3081 (533)			
1991			4623 (1933)	
1992	6846 (3012)			
1993				
1995	5218 (3122)		1664 (866)	
1996				
1997			1223 (607)	
1998	2560 (463)			
1999			3064 (1995)	2054 (810)
2000			891 (279)	13359 (8043)
2001	2875 (1329)		2087 (697)	2159 (881)
2002				2485 (677)

Table 6. Fishery length compositions.

Source	Year	sex	Fish	Samp	adj #	Lower Limit of Length Bin (cm)														
						6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
fishery	1978	2	263	26	200	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
fishery		1				0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
fishery	1979	2	86	11	64	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
fishery		1				0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
fishery	1980	2	221	33	200	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5
fishery		1				0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
fishery	1981	2	198	30	198	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
fishery		1				0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
fishery	1982	2	759	59	200	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
fishery		1				0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
fishery	1983	2	792	115	200	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
fishery		1				0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
fishery	1984	2	1995	162	200	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
fishery		1				0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
fishery	1985	2	3167	208	200	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
fishery		1				0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
fishery	1986	2	2437	145	200	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
fishery		1				0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
fishery	1987	2	2704	124	200	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
fishery		1				0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
fishery	1988	2	1337	92	200	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
fishery		1				0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
fishery	1989	2	1107	92	200	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
fishery		1				0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
fishery	1990	2	973	92	200	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
fishery		1				0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
fishery	1991	2	964	77	200	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
fishery		1				0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.0	0.1
fishery	1992	2	429	49	200	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
fishery		1				0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
fishery	1993	2	566	56	200	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.2
fishery		1				0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
fishery	1994	2	796	53	200	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
fishery		1				0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
fishery	1995	2	926	60	200	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
fishery		1				0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
fishery	1996	2	2097	132	200	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
fishery		1				0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
fishery	1997	2	2142	112	200	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
fishery		1				0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
fishery	1998	2	2244	121	200	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
fishery		1				0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
fishery	1999	2	1543	79	200	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
fishery		1				0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
fishery	2000	2	2055	88	200	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
fishery		1				0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.1	0.0	0.0	0.0	0.0
fishery	2001	2	3082	127	200	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1
fishery		1				0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1
fishery	2002	2	2608	111	200	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
fishery		1				0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Table 6. (Cont.)

Year	sex	21	22	23	24	25	26	27	28	29	30	31	32	33	35	37	39	41	43	45	47	49	51+
1978	2	0.0	0.0	0.0	0.0	0.4	1.0	4.2	1.9	3.4	2.7	3.4	1.1	6.1	7.6	8.0	6.8	6.1	5.3	1.1	0.4	0.0	0.0
	1	0.0	0.0	0.0	0.8	1.1	1.0	0.4	2.3	0.4	0.4	1.1	2.3	5.3	9.9	10.3	4.6	0.8	0.0	0.0	0.0	0.0	0.0
1979	2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.2	1.2	2.3	1.2	3.5	8.1	8.1	3.5	5.8	2.3	3.5	2.3	0.0	0.0	0.0
	1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.2	3.5	0.0	1.2	2.3	11.6	3.5	12.8	11.6	5.8	1.2	2.3	0.0	0.0	0.0
1980	2	0.0	0.0	0.0	0.5	0.5	0.0	0.0	1.8	2.2	1.4	1.4	5.3	7.2	8.7	6.7	6.3	6.8	5.0	2.7	0.9	0.0	0.9
	1	0.0	0.0	0.5	0.0	0.0	0.0	0.5	0.0	0.5	0.5	0.0	4.7	8.2	14.4	9.1	2.7	0.5	0.0	0.0	0.0	0.0	0.0
1981	2	0.0	0.0	0.0	0.0	0.5	0.0	0.5	1.0	0.0	0.0	1.0	0.5	2.5	5.6	6.1	18.0	16.1	11.1	5.6	1.0	0.0	0.0
	1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5	0.0	1.0	1.5	8.1	10.1	8.2	1.0	0.0	0.0	0.0	0.0	0.0
1982	2	0.0	0.1	0.0	0.1	0.4	0.3	1.3	0.5	0.9	1.2	2.5	2.8	4.5	8.0	10.8	11.9	7.8	4.5	2.2	0.3	0.9	0.3
	1	0.0	0.0	0.1	0.4	0.3	0.7	0.1	1.1	0.5	1.2	0.9	1.7	5.3	12.6	8.2	3.6	0.8	0.7	0.3	0.1	0.1	0.1
1983	2	0.0	0.0	0.0	0.1	1.1	1.5	0.9	1.5	1.3	1.0	1.4	1.5	3.0	4.5	8.5	9.3	10.4	6.8	3.2	0.6	0.3	0.1
	1	0.0	0.0	0.1	0.1	0.6	0.5	1.0	0.9	1.4	0.8	2.0	0.9	4.5	8.5	10.0	7.4	2.9	0.6	0.4	0.0	0.0	0.3
1984	2	0.0	0.0	0.0	0.1	0.3	0.4	0.6	1.8	2.2	2.7	2.9	2.5	4.8	5.4	9.0	9.4	7.8	4.9	1.8	0.5	0.1	0.0
	1	0.0	0.0	0.0	0.0	0.2	0.5	0.7	1.1	2.5	1.6	2.2	2.3	7.2	11.3	7.7	4.5	0.7	0.3	0.1	0.0	0.0	0.1
1985	2	0.0	0.0	0.2	0.2	0.3	0.4	1.3	1.1	1.7	2.6	4.0	3.2	6.3	5.5	6.4	7.5	5.6	3.1	1.1	0.2	0.1	0.0
	1	0.0	0.1	0.1	0.3	0.4	0.8	1.0	1.1	2.2	2.4	3.1	4.0	8.2	11.6	8.0	3.5	1.2	0.4	0.3	0.1	0.1	0.0
1986	2	0.0	0.0	0.0	0.0	0.1	0.2	0.7	0.5	1.3	2.0	2.9	4.9	10.3	6.6	6.5	7.5	6.4	2.6	0.9	0.2	0.0	0.0
	1	0.0	0.0	0.1	0.0	0.2	0.4	0.6	1.2	1.3	3.0	4.6	5.0	10.1	9.5	7.1	2.9	0.4	0.0	0.0	0.0	0.0	0.0
1987	2	0.0	0.0	0.0	0.2	0.1	0.1	0.1	0.2	0.7	1.2	2.1	3.2	9.3	8.8	9.1	6.2	3.5	1.4	0.5	0.1	0.1	0.0
	1	0.0	0.0	0.1	0.1	0.1	0.1	0.2	0.4	0.7	2.0	4.2	5.3	14.1	13.3	8.8	2.5	0.6	0.1	0.0	0.0	0.0	0.0
1988	2	0.0	0.0	0.1	0.1	0.1	0.3	0.4	0.4	0.7	0.7	0.9	1.7	8.5	12.2	8.7	8.9	4.9	1.2	0.3	0.2	0.0	0.0
	1	0.0	0.0	0.0	0.0	0.1	0.0	0.7	0.4	0.8	1.2	1.3	3.3	14.1	14.0	9.3	3.7	0.7	0.0	0.1	0.0	0.0	0.0
1989	2	0.0	0.0	0.0	0.1	0.2	0.4	0.5	0.7	1.2	0.8	1.7	2.4	7.0	13.1	8.5	6.8	4.9	2.9	1.1	0.0	0.0	0.0
	1	0.0	0.0	0.1	0.0	0.2	0.2	1.0	0.5	0.7	1.1	1.5	3.3	13.1	13.9	7.8	3.6	0.7	0.0	0.0	0.1	0.0	0.0
1990	2	0.0	0.0	0.0	0.0	0.0	0.8	1.1	1.2	0.7	1.2	1.3	2.6	7.4	8.5	9.1	8.9	3.9	3.5	1.4	0.4	0.2	0.0
	1	0.0	0.0	0.0	0.0	0.0	0.2	0.3	0.5	1.4	2.1	2.6	2.8	13.0	11.2	8.5	3.7	1.2	0.2	0.0	0.0	0.0	0.0
1991	2	0.0	0.4	0.1	0.5	1.2	0.9	0.7	1.0	2.3	2.0	2.6	2.5	4.1	6.4	6.6	9.6	6.0	6.8	3.0	1.3	0.1	0.0
	1	0.0	0.0	0.1	0.6	0.3	1.1	1.6	1.0	1.3	2.0	1.7	2.1	8.4	10.2	5.8	4.0	0.7	0.3	0.0	0.0	0.0	0.0
1992	2	0.0	0.0	0.0	0.5	0.0	0.7	0.7	0.7	1.9	1.2	2.4	2.3	5.0	5.4	9.2	11.1	8.4	4.6	1.6	0.2	0.0	0.0
	1	0.0	0.0	0.0	0.5	0.0	0.0	0.7	1.6	1.9	3.2	1.3	2.1	5.5	11.0	9.4	5.2	0.9	0.3	0.0	0.5	0.0	0.0
1993	2	0.2	0.0	0.4	0.4	0.4	0.0	1.1	1.2	1.5	2.5	3.5	3.4	3.3	6.5	7.8	6.8	3.7	1.1	0.7	0.4	0.2	0.0
	1	0.2	0.0	0.0	0.0	0.0	0.4	0.0	2.4	1.7	3.5	3.9	3.6	13.0	13.6	8.0	3.3	1.1	0.2	0.0	0.0	0.0	0.0
1994	2	0.0	0.1	0.3	0.4	0.3	0.1	0.1	0.5	1.0	2.2	3.0	4.2	8.0	6.7	7.3	9.0	5.4	4.5	1.3	0.6	0.0	0.0
	1	0.0	0.0	0.0	0.0	0.0	0.3	0.1	0.7	1.4	2.6	3.0	4.9	9.0	11.2	7.4	3.7	0.7	0.0	0.0	0.1	0.0	0.0
1995	2	0.0	0.0	0.1	0.2	0.2	0.7	0.5	0.1	1.0	1.3	2.2	3.6	8.0	7.7	9.3	9.8	8.0	3.8	1.4	0.3	0.0	0.0
	1	0.0	0.1	0.1	0.0	0.3	0.2	0.9	0.3	1.1	1.2	3.4	4.1	9.5	11.2	7.2	2.0	0.0	0.1	0.0	0.0	0.0	0.0
1996	2	0.0	0.0	0.1	0.1	0.6	0.9	1.5	2.4	1.5	1.2	2.1	2.5	6.7	6.3	6.1	6.0	4.9	2.7	1.7	0.7	0.1	0.0
	1	0.0	0.0	0.2	0.5	0.8	1.3	1.0	1.6	2.0	3.1	3.3	5.2	11.7	11.4	6.5	1.7	1.2	0.1	0.1	0.1	0.0	0.0
1997	2	0.0	0.3	0.6	1.4	1.7	1.6	1.7	2.4	2.9	3.0	3.1	6.0	5.8	5.2	5.7	4.8	3.6	2.7	1.8	0.6	0.0	0.0
	1	0.0	0.0	0.2	0.0	1.0	1.7	1.0	1.1	2.7	3.7	3.3	3.5	9.1	7.6	4.9	3.6	1.2	0.5	0.0	0.0	0.0	0.0
1998	2	0.1	0.2	0.2	0.5	0.7	0.9	1.3	1.5	1.7	1.5	2.6	2.4	6.1	7.8	9.5	6.9	6.8	3.4	1.4	0.4	0.0	0.0
	1	0.1	0.3	0.5	0.5	0.7	1.7	2.0	1.3	1.4	1.8	2.4	3.9	10.1	8.8	5.3	2.3	0.8	0.0	0.0	0.2	0.1	0.0
1999	2	0.1	0.5	0.3	0.5	1.8	2.7	4.8	2.8	3.7	4.8	3.7	3.2	5.0	4.7	5.6	4.4	3.9	2.9	1.6	0.8	0.2	0.0
	1	0.1	0.1	0.6	0.5	1.5	3.4	2.7	2.7	2.6	3.6	1.9	2.1	6.5	5.7	5.1	2.3	0.5	0.0	0.0	0.0	0.0	0.0
2000	2	0.0	0.0	0.2	0.3	0.5	1.0	1.6	3.2	3.2	4.1	4.9	4.5	5.3	5.1	4.8	4.7	4.0	2.4	1.4	0.2	0.2	0.0
	1	0.0	0.1	0.1	0.6	0.2	1.0	2.0	3.3	4.1	4.8	3.9	4.8	8.7	6.2	4.6	2.6	0.6	0.2	0.1	0.1	0.0	0.0
2001	2	0.1	0.1	0.0	0.1	0.5	0.7	1.4	2.8	3.7	4.6	6.1	5.9	8.7	5.4	3.9	3.4	2.7	2.1	1.1	0.4	0.0	0.0
	1	0.0	0.1	0.0	0.0	0.3	0.5	1.7	3.2	3.9	5.9	5.3	5.2	7.9	5.7	3.4	1.8	1.0	0.2	0.0	0.0	0.0	0.0
2002	2	0.1	0.3	1.0	1.3	0.8	1.0	0.7	1.7	1.9	2.9	4.3	5.2	11.6	6.5	3.9	4.3	2.8	2.7	0.7	0.2	0.1	0.0
	1	0.2	0.4	0.9	1.1	0.9	1.0	1.2	1.7	2.4	3.6	5.0	5.6	10.2	7.4	3.4	1.0	0.3	0.0	0.0	0.0	0.0	0.0

Table 7. Darkblotched rockfish expanded survey length compositions in percentages (males+females for each year = 100%). For sex, 1 = males; 2 = females; 3 = unsexed. Adj # = # fish * sqrt(# samples)/sqrt(20)) or 200, whichever is less.

Source	Year	sex	Fish	Samp	adj #	Lower Limit of Length Bin (cm)														
						6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
triennial	1977	2	3492	59	200	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.4	0.8	1.1
triennial		1				0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.8	1.4	1.0
triennial	1980	2	656	11	200	0.0	0.0	0.0	0.0	0.0	0.1	0.2	0.4	0.0	0.1	0.2	0.4	0.6	1.5	0.1
triennial		1				0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.3	0.2	0.3	0.2	0.8	0.9	1.5	0.8
triennial	1983	2	4438	43	200	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.2	0.1	0.2	0.4	2.0	3.8	2.2	2.8
triennial		1				0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.4	0.2	0.2	0.5	2.0	3.1	3.1	2.5
triennial	1986	2	1834	38	200	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.4	1.3	0.9	0.6	0.3	0.8	1.8	1.5
triennial		1				0.1	0.0	0.0	0.0	0.1	0.0	0.3	0.5	1.0	0.8	0.5	0.3	0.3	1.1	1.6
triennial	1989	2	3054	85	200	0.0	0.0	0.0	0.0	0.0	0.1	0.6	4.1	6.9	3.0	0.5	1.6	3.5	6.3	3.2
triennial		1				0.0	0.0	0.0	0.1	0.0	0.2	0.9	4.0	6.8	4.7	0.8	1.4	4.3	5.8	3.3
triennial	1992	2	1452	34	200	0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.1	0.3	0.3	0.1	0.0	0.2	1.9	4.0
triennial		1				0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.1	0.5	0.3	0.1	0.4	1.8	2.9
triennial	1995	2	2407	109	200	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.9	2.5	1.2	0.2	0.1	0.6	1.3	0.9
triennial		1				0.0	0.0	0.0	0.0	0.0	0.1	0.4	1.3	2.5	1.4	0.2	0.2	0.5	1.1	1.9
triennial	1998	2	2943	110	200	0.0	0.0	0.0	0.0	0.0	0.2	0.9	0.8	0.4	0.1	0.7	1.2	0.8	1.6	2.5
triennial		1				0.0	0.0	0.0	0.0	0.0	0.7	1.3	1.1	0.1	0.2	0.6	1.4	1.1	1.1	3.3
triennial	2001	2	2980	184	200	0.0	0.0	0.0	0.0	0.1	0.2	1.5	3.7	2.3	0.6	0.3	1.2	3.9	8.7	8.4
triennial		1				0.0	0.0	0.0	0.0	0.0	0.2	1.1	3.0	2.0	0.8	0.3	1.1	4.2	7.8	7.6
pop	1979	2	1070	16	100	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
pop		1				0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.4
pop	1985	2	3603	42	200	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.2	1.2
pop		1				0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	1.3
slope	1991	2	1322	58	100	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.3	0.7
slope		1				0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.3	0.7	1.0
slope	1995	2	725	48	100	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.2	0.4	0.3	0.4	1.3
slope		1				0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.1	0.3	0.5	0.5	0.4	1.0
slope	1997	2	313	20	200	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	1.0	3.0	3.4
slope		1				0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.5	2.9	7.5
slope	1999	2	228	26	200	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.1	0.1	0.0	0.0
slope		1				0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	1.0
slope	2000	2	223	20	200	0.0	0.0	0.0	0.0	0.2	0.0	0.0	0.0	0.0	0.2	0.3	0.0	0.0	0.4	0.8
slope		1				0.0	0.0	0.0	0.0	0.2	0.0	0.0	0.0	0.4	0.3	0.9	0.3	0.0	0.0	0.0
slope	2001	2	324	14	200	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	2.8
slope		1				0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	1.0
slopenw	2000	2	325	26	200	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.1	0.2	0.0
slopenw		1				0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.5	0.2	0.0	0.0	0.1
slopenw	2001	2	499	45	200	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.0	0.6	0.8	2.4	4.3
slopenw		1				0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.4	0.0	0.0	0.2	0.6	0.4	2.2	3.3
slopenw	2002	2	1028	56	200	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.1	0.5	2.1	1.2	1.1
slopenw		1				0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.0	0.3	1.0	1.7	0.5

Table 7. Continued.

Year	sex	21	22	23	24	25	26	27	28	29	30	31	32	33	35	37	39	41	43	45	47	49	51+
1977	2	1.0	2.2	4.1	4.7	3.5	1.7	2.7	2.9	1.7	3.4	1.9	2.6	6.4	3.9	1.3	1.0	0.8	0.8	0.9	0.6	0.6	0.5
	1	1.1	1.9	4.3	4.4	2.8	2.8	3.5	2.5	2.5	2.2	2.4	2.5	4.6	2.3	2.3	1.7	0.7	0.2	0.2	0.1	0.0	0.0
1980	2	0.9	1.2	1.3	3.9	4.5	5.2	5.5	5.4	2.5	1.4	3.2	2.9	5.6	2.9	3.4	2.1	0.8	0.9	0.5	0.0	0.0	0.0
	1	0.6	0.7	1.0	0.8	1.7	2.5	2.0	3.9	2.8	3.1	3.8	2.7	3.4	4.7	3.3	0.0	0.3	0.0	0.0	0.0	0.0	0.0
1983	2	3.0	4.3	3.9	3.5	3.4	4.1	2.4	1.5	0.5	0.6	0.6	0.4	0.7	0.8	0.9	2.1	2.2	1.2	0.5	0.1	0.0	0.0
	1	3.7	6.5	5.5	4.0	3.8	3.7	2.6	1.1	0.5	0.8	0.4	0.4	0.7	2.3	2.1	0.9	0.2	0.1	0.0	0.0	0.0	0.0
1986	2	0.7	0.6	1.1	1.7	2.0	3.2	3.3	2.5	4.5	4.1	3.7	3.1	4.9	2.4	1.2	0.9	1.0	0.7	0.4	0.2	0.1	0.0
	1	0.7	0.6	1.5	1.5	1.9	4.2	3.7	3.8	6.4	4.1	4.6	3.4	2.8	1.9	0.5	1.0	0.6	0.2	0.0	0.0	0.0	0.0
1989	2	3.6	1.3	2.0	1.9	1.7	1.6	1.3	0.9	0.8	0.8	0.9	0.3	0.9	0.8	0.6	0.5	0.4	0.0	0.1	0.0	0.0	0.0
	1	2.4	1.5	1.7	1.1	1.6	1.1	1.4	1.0	1.1	1.1	0.5	0.6	1.0	0.4	0.3	0.3	0.1	0.1	0.0	0.0	0.0	0.0
1992	2	2.5	0.6	1.1	1.6	2.9	2.5	4.6	9.6	7.1	4.5	2.6	0.8	0.8	0.1	0.1	0.0	0.0	0.1	0.1	0.0	0.0	0.0
	1	2.9	1.1	0.7	3.1	2.6	1.9	9.3	11.1	7.7	3.1	0.9	0.3	0.2	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1995	2	0.9	1.0	2.6	4.5	3.8	2.4	2.4	1.7	1.3	1.6	0.9	0.8	2.1	3.2	3.3	2.9	3.7	2.3	0.9	0.4	0.0	0.0
	1	1.2	1.1	2.8	4.7	4.0	2.4	1.6	1.4	1.1	0.9	1.5	1.5	5.2	5.9	3.6	0.6	0.1	0.1	0.0	0.0	0.0	0.0
1998	2	4.7	7.7	8.2	3.6	3.2	2.9	2.7	1.9	1.1	0.6	0.4	0.3	0.6	0.5	0.1	0.0	0.3	0.0	0.0	0.0	0.0	0.0
	1	5.4	8.2	7.5	5.2	3.4	2.9	2.8	1.8	0.8	0.7	0.8	0.6	0.9	0.1	0.2	0.0	0.0	0.0	0.0	0.0	0.1	0.0
2001	2	2.3	0.2	0.4	0.4	0.8	0.9	0.9	0.5	1.1	0.5	2.5	3.1	10.7	0.7	0.4	0.6	0.2	0.2	0.0	0.1	0.0	0.0
	1	2.8	0.4	0.2	0.4	0.6	0.7	0.8	0.4	0.6	0.7	2.2	1.5	2.3	0.4	0.3	0.0	0.1	0.0	0.0	0.0	0.0	0.0
1979	2	1.1	2.1	1.4	2.0	5.5	5.1	4.0	4.9	6.1	5.4	2.9	1.7	2.1	2.4	2.5	0.6	0.3	0.2	0.2	0.0	0.1	0.0
	1	0.7	2.4	1.9	3.6	1.7	2.6	4.0	5.8	6.9	5.1	2.6	1.6	4.3	3.6	1.1	0.8	0.4	0.0	0.0	0.0	0.0	0.0
1985	2	1.1	0.8	2.1	4.3	3.4	3.2	4.5	5.8	4.6	4.3	3.0	3.2	2.6	0.4	0.5	0.5	0.5	0.1	0.1	0.1	0.0	0.0
	1	1.7	1.2	2.1	4.0	3.6	3.8	6.4	6.9	5.8	6.4	4.9	1.5	1.9	0.6	0.5	0.1	0.0	0.0	0.0	0.0	0.0	0.0
1991	2	0.9	0.8	1.5	2.1	2.2	3.9	5.7	5.8	8.0	2.9	3.8	2.7	1.6	0.8	0.2	0.1	0.0	0.0	0.1	0.0	0.0	0.0
	1	1.4	0.6	1.3	2.3	4.2	4.6	9.0	8.1	6.5	4.3	3.8	2.0	2.4	1.4	0.9	0.4	0.1	0.0	0.0	0.0	0.0	0.0
1995	2	1.7	1.3	1.3	1.0	1.5	1.3	1.5	1.5	3.4	2.7	3.9	2.6	7.9	8.6	3.0	0.5	0.6	0.2	0.3	0.0	0.1	0.1
	1	1.6	1.4	2.1	0.6	2.0	1.1	3.2	3.3	5.6	2.9	5.9	5.7	9.5	3.6	0.5	0.6	0.2	0.0	0.0	0.0	0.0	0.0
1997	2	4.9	5.0	3.9	4.7	8.3	5.0	1.9	0.4	0.4	0.2	0.0	0.6	0.7	0.1	0.0	0.0	0.4	0.2	0.0	0.0	0.0	0.0
	1	8.5	4.8	6.8	3.5	5.9	5.3	3.2	0.0	1.4	0.4	0.7	0.7	1.8	0.8	0.4	0.0	0.1	0.0	0.0	0.0	0.0	0.0
1999	2	0.0	0.1	0.3	0.7	0.0	2.3	5.4	12.8	10.1	5.7	6.7	2.3	1.3	0.1	0.6	0.3	0.3	0.1	0.0	0.0	0.0	0.0
	1	0.0	0.0	0.2	0.3	0.4	3.1	12.6	14.0	10.6	4.2	2.1	1.1	0.7	0.2	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2000	2	0.5	3.6	5.4	5.9	4.4	1.2	3.0	4.5	3.8	7.7	3.9	0.9	1.0	0.0	0.0	0.0	0.0	0.0	0.2	0.6	0.0	0.0
	1	1.5	3.7	6.3	9.3	3.9	2.0	1.0	6.5	3.0	6.6	2.3	0.0	2.0	0.5	0.4	0.0	0.0	0.0	0.4	0.0	0.0	0.0
2001	2	2.5	1.3	1.4	0.2	1.6	0.7	1.6	2.6	3.0	2.1	2.6	8.6	15.2	7.5	0.7	0.0	0.9	0.2	0.2	0.0	0.0	0.0
	1	1.9	0.9	0.8	0.8	1.6	2.2	4.2	2.8	1.5	1.2	7.5	10.7	5.3	0.2	0.0	0.9	0.2	0.0	0.0	0.0	0.0	0.0
2000	2	0.0	0.5	0.6	0.4	0.0	0.2	0.4	1.3	1.0	1.9	0.4	0.2	0.6	0.0	0.0	4.4	8.8	13.2	8.8	7.3	0.0	0.0
	1	0.0	0.0	0.0	0.2	0.2	0.0	0.4	0.8	1.1	0.6	0.4	0.0	0.4	7.3	26.3	5.9	2.9	1.5	1.5	0.0	0.0	0.0
2001	2	1.4	0.5	0.2	0.7	0.6	0.9	1.2	0.6	1.5	1.2	1.9	6.5	8.4	6.9	2.1	3.5	4.9	2.1	0.7	0.0	0.0	0.0
	1	2.8	1.0	0.3	0.3	0.3	2.0	2.1	0.4	1.3	3.1	3.4	6.5	9.9	6.3	9.6	6.8	0.7	0.0	0.1	0.0	0.0	0.0
2002	2	0.4	2.4	6.8	9.3	7.5	5.2	1.1	1.6	2.5	1.9	1.7	1.4	3.2	2.0	0.7	0.7	0.1	0.2	0.1	0.3	0.1	0.0
	1	0.3	2.1	6.1	8.2	6.3	6.3	2.1	2.0	2.5	2.0	1.4	1.5	2.9	2.0	0.9	1.0	0.4	0.2	0.0	0.0	0.0	0.0

Table 8. Fishery age compositions

Source	Year	Fish	Tows	adj #	sex	Age														
						1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
fishery	1977	437	44	200	3	0.0	0.0	0.2	1.2	2.5	5.1	5.5	6.7	6.7	9.9	4.6	7.6	4.1	3.9	2.3
fishery	1978	310	33	200	2	0.0	0.0	0.0	0.7	2.6	3.6	4.6	5.9	3.9	4.6	3.9	3.3	2.0	3.0	2.0
fishery					1	0.0	0.0	0.0	0.3	1.3	3.0	1.0	1.0	2.0	2.6	2.6	3.0	2.0	2.0	0.0
fishery	1980	221	27	200	3	0.0	0.0	0.0	0.0	1.4	5.1	8.3	7.8	10.1	5.1	4.1	5.5	3.7	4.6	3.2
fishery	1982	434	56	200	3	0.0	0.0	0.0	0.9	2.8	5.9	6.1	3.0	6.3	5.6	4.2	5.4	4.9	2.8	4.7
fishery	1987	1066	46	200	2	0.0	0.0	0.0	0.6	1.8	3.0	4.1	4.5	2.3	1.8	1.3	1.8	1.5	1.3	1.6
fishery					1	0.0	0.1	0.1	1.2	0.4	3.3	5.5	4.1	3.2	2.8	2.6	1.8	1.7	2.3	1.7
fishery	1988	375	30	200	2	0.0	0.0	0.3	1.1	1.3	4.5	2.9	5.9	5.1	4.0	1.9	1.3	1.1	1.1	0.8
fishery					1	0.0	0.0	0.3	1.6	0.8	3.5	2.7	6.4	3.7	1.6	2.7	1.9	2.1	2.4	1.6
fishery	1990	241	44	200	2	0.0	0.0	0.4	0.4	2.1	2.5	2.1	2.9	2.9	4.6	4.1	2.5	2.1	2.1	0.8
fishery					1	0.0	0.0	0.0	0.0	0.4	1.7	1.7	0.8	3.3	7.5	5.4	6.6	1.7	2.9	0.8
fishery	1993	233	29	200	2	0.0	0.0	0.0	0.0	0.0	0.9	0.9	3.9	1.3	2.6	3.0	2.1	0.9	1.3	2.1
fishery					1	0.0	0.0	0.0	0.0	0.0	0.4	3.0	0.4	1.3	0.9	2.1	3.4	3.4	2.6	2.6
fishery	1995	169	17	156	2	0.0	0.0	0.0	1.2	2.4	2.4	4.1	2.4	7.1	3.0	2.4	3.6	1.2	1.8	1.8
fishery					1	0.0	0.0	0.0	0.0	0.0	1.8	1.2	3.6	4.1	7.1	3.0	3.6	3.0	1.2	1.2
fishery	1996	244	44	200	2	0.0	0.0	1.2	0.8	0.4	2.0	2.0	3.7	6.1	3.7	2.5	0.8	0.0	1.2	1.6
fishery					1	0.0	0.0	0.0	0.4	2.0	2.9	4.1	5.3	4.1	7.4	2.0	3.7	0.4	3.3	2.0
fishery	1997	278	42	200	2	0.0	0.0	0.0	3.6	6.5	7.2	4.7	2.5	1.8	1.1	1.4	0.7	1.4	1.4	1.1
fishery					1	0.0	0.0	0.4	1.1	3.6	2.5	2.5	2.5	3.3	1.8	1.4	1.1	1.4	1.4	0.4
fishery	1999	171	4	76	2	0.0	0.0	0.0	0.0	2.9	8.2	8.2	7.6	6.4	3.5	1.2	1.2	2.3	0.0	1.8
fishery					1	0.0	0.0	0.0	0.0	0.6	4.7	3.5	3.5	2.9	2.3	0.6	1.8	1.2	0.6	1.2
fishery	2000	1041	44	200	2	0.0	0.0	0.7	6.0	10.8	5.5	4.3	2.7	1.9	1.3	1.8	1.2	1.2	1.2	0.6
fishery					1	0.0	0.1	1.2	5.4	8.6	6.8	4.1	3.0	1.8	1.3	1.2	1.3	1.2	1.3	1.2
fishery	2001	1561	59	200	2	0.0	0.1	0.7	8.1	16.1	10.3	3.2	1.6	0.9	1.0	1.0	0.4	0.6	0.9	0.5
fishery					1	0.0	0.0	0.8	8.1	16.0	8.1	3.0	1.5	0.9	0.6	1.1	0.8	0.9	0.8	0.4
fishery	2002	750	23	200	2	0.0	0.0	0.3	3.3	8.7	14.1	10.5	4.5	1.7	0.9	0.8	0.9	0.3	0.4	0.7
fishery					1	0.0	0.0	0.3	4.3	10.1	14.4	11.2	4.0	1.6	0.3	0.3	0.9	0.4	0.4	0.3

Table 8 (Cont.)

Source	Year	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40+
fishery	1977	2.8	0.9	2.1	2.3	1.4	1.6	1.2	1.4	0.0	2.5	1.8	1.8	0.7	0.9	0.5	0.7	1.2	0.7	0.9	1.2	0.9	1.2	1.6	0.9	8.5
fishery	1978	0.7	1.6	1.6	1.0	2.3	0.7	1.3	0.7	1.3	0.0	0.3	0.3	0.0	0.3	0.0	0.3	0.3	0.3	0.0	0.7	0.3	1.0	1.6	0.3	4.9
fishery		0.3	1.0	0.3	2.0	1.6	0.7	1.0	0.7	0.7	0.3	0.3	0.7	0.3	0.3	0.0	0.7	0.7	0.3	0.0	0.3	1.0	0.7	0.0	0.0	3.6
fishery	1980	0.9	1.8	2.8	1.8	1.4	3.2	3.2	2.3	0.5	0.9	0.9	1.8	0.5	0.9	1.8	0.5	0.5	0.9	0.9	0.9	1.4	1.4	0.0	0.5	9.2
fishery	1982	4.2	3.0	2.6	3.3	2.1	3.3	3.5	2.6	1.6	0.5	1.4	0.5	1.2	1.6	0.9	0.7	0.5	0.9	0.5	0.5	0.9	0.7	0.0	0.5	9.8
fishery	1987	1.6	2.0	1.6	0.8	0.7	0.8	0.8	0.8	0.8	0.3	0.7	0.6	0.6	0.4	0.4	0.1	0.4	0.2	0.3	0.4	0.5	0.4	0.2	0.4	4.1
fishery		2.0	1.9	1.9	1.8	1.2	0.6	0.8	0.5	0.7	0.6	1.4	0.5	0.3	0.8	0.3	0.5	0.2	0.0	1.0	0.7	0.7	0.2	0.9	0.5	4.3
fishery	1988	0.5	1.1	1.3	0.8	1.1	0.8	0.3	0.5	1.1	0.5	0.8	0.8	0.8	1.1	0.8	0.3	0.8	0.0	0.8	0.3	0.8	1.6	0.8	0.3	1.1
fishery		1.6	1.9	1.9	0.8	0.8	1.1	0.8	0.8	0.5	1.6	0.8	0.5	1.3	0.8	0.3	0.3	0.0	0.3	0.8	0.3	0.8	0.0	0.0	0.0	0.8
fishery	1990	0.8	0.0	2.1	1.2	1.2	1.2	1.2	0.8	0.4	0.8	0.8	0.8	0.4	0.0	0.0	0.0	0.4	0.0	0.8	0.0	0.4	0.0	0.0	0.0	5.0
fishery		2.5	2.5	1.7	1.2	0.0	2.1	1.2	0.4	0.4	0.0	0.0	0.0	0.8	0.4	0.4	0.8	0.0	0.0	0.0	0.0	0.0	0.0	0.4	0.0	4.1
fishery	1993	0.4	0.9	1.3	0.9	1.7	2.1	2.1	2.6	1.3	0.9	0.9	0.9	0.0	0.0	0.9	0.0	0.4	0.9	0.9	0.9	0.4	0.4	0.0	0.9	5.2
fishery		3.0	3.0	4.3	2.1	2.1	2.6	1.3	0.9	0.9	0.0	0.4	1.7	1.7	0.4	0.0	0.0	2.1	0.4	0.4	0.4	0.4	0.9	0.0	0.0	5.2
fishery	1995	1.2	3.6	1.8	2.4	2.4	1.2	0.0	0.0	1.8	0.6	0.6	0.6	0.0	0.0	0.0	0.0	0.0	0.0	1.2	0.0	0.0	1.2	0.0	1.2	4.1
fishery		1.2	2.4	0.0	0.0	1.2	1.2	0.0	0.0	0.6	0.6	0.6	3.0	0.0	0.0	0.6	0.0	0.0	0.6	0.0	0.0	0.6	0.0	0.0	0.0	1.2
fishery	1996	0.8	1.6	0.8	0.8	0.4	0.8	0.4	0.4	1.2	0.4	0.4	0.4	0.0	0.4	0.4	1.2	0.4	0.8	0.0	0.0	0.0	0.4	0.0	0.0	3.7
fishery		0.8	1.6	1.6	1.2	0.8	1.6	0.4	1.6	0.8	0.4	0.4	0.8	0.0	0.8	1.2	0.0	0.4	0.8	0.0	0.0	1.6	0.4	0.4	0.0	2.0
fishery	1997	0.7	2.5	1.1	1.1	1.1	0.7	0.7	0.4	0.0	1.8	0.7	1.4	0.7	0.0	0.4	0.7	0.4	1.1	0.0	0.0	0.0	0.0	0.0	0.0	8.3
fishery		0.4	2.2	1.1	0.0	0.0	0.7	1.8	1.8	0.7	2.5	0.0	1.4	0.4	1.1	0.7	0.0	0.0	0.0	1.1	0.0	0.0	0.0	0.7	0.0	2.2
fishery	1999	0.6	1.2	0.6	1.2	2.9	0.6	1.2	0.0	1.8	0.0	0.0	0.0	0.0	1.2	0.0	0.6	0.0	0.0	0.0	0.0	0.6	0.0	0.0	0.0	1.8
fishery		0.6	1.8	0.6	1.8	0.6	2.9	0.6	1.8	0.0	0.0	1.2	0.6	0.6	0.6	1.2	0.0	0.0	0.6	1.2	0.0	0.0	0.6	0.0	0.0	2.9
fishery	2000	1.1	0.5	1.2	1.0	0.7	1.0	0.8	0.9	0.6	0.3	0.2	0.1	0.3	0.0	0.4	0.0	0.2	0.1	0.1	0.2	0.0	0.3	0.2	0.2	1.6
fishery		1.1	0.3	1.0	1.0	0.9	0.7	0.7	0.5	0.5	0.5	0.0	0.3	0.5	0.5	0.2	0.0	0.1	0.2	0.3	0.0	0.1	0.1	0.2	0.1	1.2
fishery	2001	0.7	0.4	0.4	0.3	0.4	0.4	0.2	0.5	0.3	0.2	0.2	0.1	0.1	0.1	0.1	0.2	0.1	0.1	0.0	0.1	0.1	0.0	0.1	0.1	1.0
fishery		0.5	0.4	0.5	0.5	0.5	0.1	0.1	0.0	0.1	0.2	0.1	0.2	0.0	0.0	0.4	0.1	0.1	0.3	0.0	0.1	0.0	0.0	0.1	0.0	0.8
fishery	2002	0.3	0.0	0.1	0.1	0.0	0.4	0.1	0.3	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1
fishery		0.5	0.0	0.3	0.3	0.3	0.0	0.0	0.1	0.0	0.0	0.1	0.3	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0

Table 9. Survey age compositions.

Source	Year	Fish	Tows	adj #	sex	Age 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Triennial	1980	233	4	104	2	0.9	2.8	1.1	12.9	5.0	8.9	5.1	2.5	2.8	3.0	3.2	1.1	1.4	1.5	0.8
Triennial					1	0.6	5.6	0.0	6.0	2.2	7.2	8.0	6.9	4.3	2.6	1.1	0.0	0.5	0.0	0.0
Triennial	1983			0	2	0.0	0.0	8.8	8.2	1.0	4.2	0.8	0.5	0.0	0.2	0.0	0.7	0.0	0.5	0.4
Triennial					1	0.0	15.4	18.5	9.4	2.7	1.9	0.5	0.4	0.7	0.3	0.6	1.0	0.9	1.5	0.5
Triennial	1986	229	9	154	2	3.0	5.8	5.1	7.6	9.6	7.8	4.6	4.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Triennial					1	3.0	4.4	3.0	9.0	8.8	12.8	7.1	1.3	1.0	1.0	0.0	0.0	0.0	0.0	0.0
Triennial	1995			200	2	4.9	2.8	9.6	7.9	5.2	2.2	2.0	0.1	0.6	2.2	1.0	1.4	0.0	0.6	1.9
Triennial					1	5.4	4.3	9.9	6.1	4.3	3.6	1.1	1.0	0.4	1.4	2.1	1.9	1.3	1.2	0.8
Triennial	1998			200	2	0.0	4.1	4.7	18.6	8.7	4.1	3.3	2.2	0.4	0.4	0.1	0.5	0.1	0.1	0.0
Triennial					1	0.8	5.5	8.0	17.8	8.7	4.7	3.2	1.2	1.1	0.1	0.3	0.2	0.3	0.1	0.1
Triennial	2001	1031	101	200	2	6.2	26.0	2.4	3.0	7.7	7.6	2.7	0.6	0.1	0.2	0.0	0.0	0.0	0.0	0.0
Triennial					1	4.5	25.6	1.8	2.5	3.4	3.0	0.8	0.5	0.1	0.1	0.0	0.0	0.1	0.0	0.0
Slope	2000	114	19	111	2	0.3	0.7	9.1	11.7	12.3	4.5	3.1	3.6	1.6	0.8	0.8	0.0	0.0	0.0	0.0
Slope					1	0.1	1.3	13.9	8.4	17.5	5.1	2.6	0.2	0.5	0.6	0.0	0.0	0.9	0.0	0.0
Slope	2001	155	11	115	2	0.0	7.4	2.7	10.9	10.0	23.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Slope					1	0.0	3.9	3.4	11.9	8.5	15.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Slope-nw	2000	320	26	200	2	0.3	0.2	0.8	1.4	2.3	1.6	0.4	1.8	0.0	0.0	0.0	1.5	2.9	1.5	1.5
Slope-nw					1	0.8	0.2	0.2	0.6	1.8	1.2	0.2	1.5	0.0	0.0	0.0	1.5	2.9	4.4	5.8
Slope-nw	2001	358	44	200	2	0.1	14.7	2.2	4.1	7.3	5.1	1.1	0.3	0.2	0.9	0.7	3.0	0.6	0.0	0.7
Slope-nw					1	0.4	15.8	1.9	4.2	4.9	7.5	1.3	2.0	2.9	1.0	0.1	0.0	0.8	2.6	1.7
Slope-nw	2002	828	44	200	2	0.0	4.4	29.6	4.8	5.4	3.0	2.1	0.8	0.0	0.0	0.0	0.1	0.0	0.0	0.0
Slope-nw					1	0.0	3.7	27.4	4.4	6.9	2.9	1.6	0.1	0.0	0.0	0.0	0.0	0.1	0.0	0.1

Source	Year	sex	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40+
Triennial	1980	2	0.1	0.8	0.1	0.0	0.5	0.0	0.0	0.1	0.1	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0
Triennial		1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Triennial	1983	2	0.0	0.0	0.0	2.3	1.3	4.0	0.6	1.9	0.6	0.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.6	0.0	0.0	0.0	0.0	0.0	0.4
Triennial		1	0.3	0.7	1.0	1.8	0.4	0.6	0.0	0.2	0.8	0.1	0.2	0.2	0.0	0.1	0.0	0.2	0.2	0.0	0.0	0.0	0.0	0.1	0.0	0.4	0.5
Triennial	1986	2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.4
Triennial		1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.4
Triennial	1995	2	2.4	0.0	0.9	1.7	0.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.0
Triennial		1	1.3	0.8	0.5	0.4	0.3	0.1	0.2	0.3	0.0	0.0	0.1	0.2	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.0	0.0	0.0
Triennial	1998	2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0
Triennial		1	0.2	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Triennial	2001	2	0.0	0.0	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1
Triennial		1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Slope	2000	2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Slope		1	0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.0	0.0	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Slope	2001	2	0.0	0.0	0.0	0.0	0.0	0.5	0.0	0.0	0.5	0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Slope		1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2
Slope-nw	2000	2	2.9	1.5	2.9	2.9	0.0	2.9	1.5	2.9	2.9	2.9	1.5	0.0	0.0	0.0	1.5	0.0	0.0	0.0	0.0	0.0	0.0	1.5	1.5	0.0	4.4
Slope-nw		1	2.9	0.1	4.4	1.5	1.5	1.5	4.4	0.0	1.5	1.5	2.9	0.0	1.5	1.5	0.0	1.5	1.5	0.0	0.0	0.0	0.0	1.5	0.0	0.0	0.0
Slope-nw	2001	2	0.1	0.7	0.2	0.0	0.7	0.0	1.3	0.0	0.0	0.0	0.0	0.0	0.0	0.7	0.0	0.0	0.0	0.0	0.0	0.7	0.0	0.0	0.0	0.0	0.0
Slope-nw		1	0.6	0.6	0.0	0.0	1.6	0.0	0.0	0.8	1.0	0.0	0.0	0.0	0.0	0.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.6	0.0	0.0	1.3
Slope-nw	2002	2	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.1	0.0	0.0	0.0	0.0	0.5
Slope-nw		1	0.0	0.2	0.0	0.0	0.0	0.3	0.0	0.0	0.4	0.1	0.1	0.0	0.0	0.3	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1

Table 10. Life history characteristics at age based on equations in Rogers et al. (2000). Eggs/kg is eggs per kg mature females.

Both Sexes			Female					Male		
Age		M	Length		Weight	Maturity	Eggs/kg	Length		Weight
years	cv(%)		cm	cv (%)	kg	%	x100,000	cm	cv (%)	kg
1	24	0.05	11.7	10	0.0	0	0.2	10.7	8	0.0
2	24	0.05	16.2	10	0.1	0	0.2	15.7	8	0.1
3	23	0.05	20.1	9	0.2	0	0.3	19.9	8	0.1
4	23	0.05	23.4	9	0.2	0	0.5	23.2	8	0.2
5	23	0.05	26.1	9	0.3	0	0.6	25.9	8	0.3
6	22	0.05	28.5	9	0.4	2	0.8	28.1	8	0.4
7	22	0.05	30.5	9	0.5	7	0.9	29.8	8	0.5
8	21	0.05	32.2	9	0.6	19	1.1	31.3	8	0.6
9	21	0.05	33.7	9	0.7	38	1.2	32.4	8	0.7
10	21	0.05	34.9	9	0.8	57	1.3	33.4	7	0.7
11	20	0.05	35.9	9	0.9	73	1.4	34.1	7	0.8
12	20	0.05	36.8	9	1.0	82	1.5	34.7	7	0.8
13	20	0.05	37.6	9	1.0	88	1.6	35.2	7	0.8
14	19	0.05	38.2	9	1.1	92	1.7	35.6	7	0.9
15	19	0.05	38.7	9	1.1	94	1.8	36.0	7	0.9
16	19	0.05	39.2	9	1.2	96	1.8	36.2	7	0.9
17	18	0.05	39.6	9	1.2	97	1.9	36.5	7	0.9
18	18	0.05	39.9	8	1.2	97	1.9	36.6	7	0.9
19	18	0.05	40.2	8	1.3	98	2.0	36.8	6	1.0
20	17	0.05	40.4	8	1.3	98	2.0	36.9	6	1.0
21	17	0.05	40.6	8	1.3	98	2.0	37.0	6	1.0
22	17	0.05	40.8	8	1.3	98	2.1	37.0	6	1.0
23	16	0.05	41.0	8	1.3	99	2.1	37.1	6	1.0
24	16	0.05	41.1	8	1.3	99	2.1	37.2	6	1.0
25	16	0.05	41.2	8	1.3	99	2.1	37.2	6	1.0
26	15	0.05	41.3	8	1.4	99	2.1	37.2	6	1.0
27	15	0.05	41.4	8	1.4	99	2.1	37.2	6	1.0
28	15	0.05	41.4	8	1.4	99	2.1	37.3	5	1.0
29	14	0.05	41.5	8	1.4	99	2.1	37.3	5	1.0
30	14	0.05	41.5	8	1.4	99	2.2	37.3	5	1.0
31	14	0.05	41.6	8	1.4	99	2.2	37.3	5	1.0
32	13	0.05	41.6	8	1.4	99	2.2	37.3	5	1.0
33	13	0.05	41.6	8	1.4	99	2.2	37.3	5	1.0
34	13	0.05	41.6	7	1.4	99	2.2	37.3	5	1.0
35	12	0.05	41.7	7	1.4	99	2.2	37.3	5	1.0
36	12	0.05	41.7	7	1.4	99	2.2	37.3	5	1.0
37	12	0.05	41.7	7	1.4	99	2.2	37.3	4	1.0
38	11	0.05	41.7	7	1.4	99	2.2	37.3	4	1.0
39	11	0.05	41.7	7	1.4	99	2.2	37.4	4	1.0
40	11	0.05	41.7	7	1.4	99	2.2	37.4	4	1.0

Table 11. Effects of revising and updating data with Model 2 versus Model 3 as the basis. Model 2 was the last full assessment (Rogers et al. 2000). Model 3 was the 2001 update (Methot and Rogers 2001) which is the basis of current rebuilding analyses. Models 2 fit selectivities, survey catchabililites, and yearly recruitments, while Model 3 refit only recruitments. Models 6 and 7 are full, revised data updates of Model 2 and 3, respectively. Models 4 shows effect of fitting all parameters using Model 3 data, while Model 5 shows effects of revising data used in Model 4. See Table 1 for a fuller description of the models.

Model Number from Table 1		**3**	**7**	**2**	**4**	**5**	**6**
Ending Year of Model		**2001**	**2002**	**1999**	**2001**	**2001**	**2002**
Data sources available in		**update**	**full**	**full**	**update**	**update**	**full**
Data Type		**original**	**revised**	**original**	**original**	**revised**	**revised**
# Parameters not yearly recruits		1	1	21	21	21	21
Estimated yearly recruitments		37	38	36	38	38	39
Fixed yearly recruitments		2	2	1	1	1	1
Recruitments hitting lower bound		3	4	0	2	4	4
Catchabilities (q)							
Triennial survey		0.88	0.88	0.88	1.13	1.16	1
Slope survey		0.79	0.79	0.79	0.74	0.8	0.55
P.o.p. survey		1.16	1.16	1.16	1.27	1.16	1.28
Ending Year Biomass (mt)		6611	6435	10010	6509	5773	8374
Ending Year f			0.026	0.04	0.027	0.039	0.022
% spawn (unfished versus end year)		11%	10%	17%	10%	8%	11%
total log-likelihood		-1956	-2135	-1750	-1934	-1814	-2062
fishery	Age	-493	-415	-478	-492	-420	-421
fishery	Length	-606	-570	-551	-606	-529	-548
Triennial	index	-0.88	-2.4	1	2.2	1.5	2.1
Triennial	Age	-179	-180	-171	-173	-183	-183
Triennial	Length	-357	-536	-357	-358	-391	-504
slope	index	-3.6	-2	-0.08	-2.7	-3	-2.7
slope	Age	-29	-31	n/a	-29	-21	-27
slope	Length	-276	-383	-182	-264	-253	-363
Pop	Index	2.9	2.9	3	3	3	3
Pop	Length	-15	-18	-15	-15	-19	-19

Table 12. Model 6 estimated population numbers of females (times 100,000) . Dark shaded cells trace recruitments in 1964-1966 which were restricted by the lower bound. Light shaded cells at bottom show strong estimated year classes in very recent years. Cells in borders trace shelf survey high catchability ages forwards (1977 on) and backwards (2001 back).

Ages

Year	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
63	20	9	9	8	8	8	7	7	6	6	6	5	5	5	5	4	4	4	4	3	3	3	3	3	3	2	2	2	2	2	2	2	2	2	1	1	1	1	1	19
64	0	19	9	8	8	8	7	7	6	6	6	5	5	5	5	4	4	4	4	3	3	3	3	3	3	2	2	2	2	2	2	2	2	2	1	1	1	1	1	19
65	0	0	18	8	8	8	7	7	6	6	6	5	5	5	5	4	4	4	4	3	3	3	3	3	3	2	2	2	2	2	2	2	2	2	1	1	1	1	1	19
66	0	0	0	18	8	8	7	7	6	6	6	5	5	5	5	4	4	4	4	3	3	3	3	3	3	2	2	2	2	2	2	2	2	2	1	1	1	1	1	19
67	20	0	0	0	16	7	7	6	6	5	5	5	4	4	4	4	3	3	3	3	3	3	2	2	2	2	2	2	2	2	2	1	1	1	1	1	1	1	1	16
68	2	19	0	0	0	15	6	6	5	5	4	4	4	4	3	3	3	3	3	2	2	2	2	2	2	2	2	2	1	1	1	1	1	1	1	1	1	1	1	14
69	32	2	18	0	0	0	13	5	5	4	4	4	3	3	3	3	3	2	2	2	2	2	2	2	2	2	1	1	1	1	1	1	1	1	1	1	1	1	1	12
70	1	31	2	17	0	0	0	12	5	4	4	4	3	3	3	3	3	2	2	2	2	2	2	2	2	2	1	1	1	1	1	1	1	1	1	1	1	1	1	12
71	0	1	29	2	16	0	0	0	12	5	4	4	3	3	3	3	3	2	2	2	2	2	2	2	2	2	1	1	1	1	1	1	1	1	1	1	1	1	1	12
72	13	0	1	28	2	15	0	0	0	11	4	4	3	3	3	3	3	2	2	2	2	2	2	2	2	2	1	1	1	1	1	1	1	1	1	1	1	1	1	12
73	3	13	0	1	26	2	14	0	0	0	10	4	4	3	3	3	3	2	2	2	2	2	2	2	2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	12
74	20	3	12	0	1	24	2	13	0	0	0	9	4	3	3	3	2	2	2	2	2	2	2	2	2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	11
75	4	19	2	11	0	1	23	1	12	0	0	0	8	3	3	3	2	2	2	2	2	2	2	2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	11
76	4	4	18	2	11	0	1	21	1	11	0	0	0	8	3	3	2	2	2	2	2	2	2	2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	11
77	5	4	4	17	2	10	0	1	20	1	10	0	0	0	7	3	3	2	2	2	2	2	2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	10
78	6	4	4	4	16	2	10	0	1	18	1	10	0	0	0	7	3	2	2	2	2	2	2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	10
79	10	6	4	4	4	15	2	9	0	1	17	1	9	0	0	0	6	3	2	2	2	2	2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	10
80	18	10	6	4	4	3	14	2	8	0	1	16	1	8	0	0	0	6	2	2	2	2	2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	10
81	14	17	9	5	4	3	3	13	2	8	0	1	15	1	8	0	0	0	5	2	2	2	2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	10
82	9	14	16	9	5	3	3	3	12	2	7	0	1	13	1	7	0	0	0	5	2	2	2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	9
83	3	8	13	16	8	5	3	3	3	11	1	6	0	0	12	1	6	0	0	0	4	2	2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	9
84	2	3	8	12	15	8	4	3	3	2	10	1	6	0	0	11	1	6	0	0	0	4	2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	8
85	4	2	2	7	12	14	7	4	3	2	2	8	1	5	0	0	9	1	5	0	0	0	3	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	8
86	5	3	2	2	7	11	12	6	3	2	2	2	7	1	4	0	0	8	0	4	0	0	0	3	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0	7
87	9	4	3	2	2	6	10	11	5	3	2	2	1	6	1	4	0	0	7	0	3	0	0	0	2	1	1	1	1	1	1	1	1	1	0	0	0	0	0	6
88	6	9	4	3	2	2	5	8	9	4	2	1	1	1	5	1	3	0	0	5	0	3	0	0	0	2	1	1	1	1	1	0	0	0	0	0	0	0	0	5
89	6	6	9	4	3	2	2	5	7	7	3	2	1	1	1	4	1	2	0	0	4	0	2	0	0	0	2	1	1	0	0	0	0	0	0	0	0	0	0	5
90	2	6	6	8	4	3	2	1	4	6	6	3	2	1	1	1	3	0	2	0	0	4	0	2	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	4
91	2	2	6	5	8	3	2	1	1	3	4	5	2	1	1	1	1	3	0	2	0	0	3	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	3
92	6	2	2	5	5	7	3	2	1	1	3	4	4	2	1	1	1	1	2	0	1	0	0	2	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	3
93	6	5	2	1	5	5	6	3	2	1	1	2	3	3	2	1	1	0	0	2	0	1	0	0	2	0	1	0	0	0	1	0	0	0	0	0	0	0	0	3
94	3	5	5	2	1	5	4	5	2	1	1	1	2	2	3	1	1	0	0	0	1	0	1	0	0	2	0	1	0	0	0	1	0	0	0	0	0	0	0	2
95	23	3	5	5	2	1	4	3	4	2	1	1	1	1	2	2	1	1	0	0	0	1	0	1	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	2
96	10	22	3	5	4	2	1	3	3	4	1	1	1	0	1	2	2	1	0	0	0	0	1	0	1	0	0	1	0	1	0	0	0	0	0	0	0	0	0	2
97	2	9	21	2	5	4	2	1	3	2	3	1	1	0	0	1	1	1	1	0	0	0	0	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1
98	9	2	9	20	2	4	3	1	1	2	2	2	1	1	0	0	1	1	1	1	0	0	0	0	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1
99	3	9	2	8	18	2	3	3	1	1	2	2	2	1	0	0	0	1	1	1	0	0	0	0	0	1	0	0	0	0	1	0	0	0	0	0	0	0	0	1
100	34	3	8	2	8	17	2	3	2	1	1	2	1	2	1	0	0	0	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
101	35	33	3	8	2	7	15	2	3	2	1	0	1	1	1	1	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
102	6	33	31	2	8	2	7	14	2	3	2	1	0	1	1	1	1	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
103	-0	6	32	30	2	7	1	6	13	1	2	2	1	0	1	1	1	1	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1

Table 13. Retrospective comparison of parameters fit in the fully fitted Model 6. See Table 1 for a more complete description of the models. Fits limited by lower bounds are in bold. Fixed parameters are enclosed in boxes.

Model Number from Table 1		2	4	5	6
Ending Year of Model		1999	2001	2001	2002
Data sources available in		full	update	update	full
Data Type		original	original	revised	revised
Natural mortality		0.05	0.05	0.05	0.05
Fishery Selectivity					
	Transition	36	36	36	36
Ascending curve	minimum selectivity	0.001	0.001	0.001	0.001
	inflection	0.75	0.74	0.737	0.74
	slope	0.67	0.67	0.598	0.59
Descending Curve	infl	0.5	0.5	0.5	0.5
	slope	1	1	1	1
	final	1	1	1	1
Triennial Survey catchability		0.88	1.13	1.16	1.03
Triennial Selectivity					
	Transition	28	28	28	28
Ascending curve	minimum selectivity	0.01	0.01	0.01	0.01
	inflection	0.44	0.43	0.432	0.43
	slope	0.48	0.56	0.59	0.53
Descending Curve	infl	0.1	**0.1**	0.1	**0.1**
	slope	1.22	1.24	1.28	1.01
	final	0.12	0.12	0.12	0.13
Slope Survey catchability		0.79	0.74	0.8	0.55
Slope Selectivity	Transition	28	28	28	28
Ascending curve	minimum selectivity	0.001	0.001	0.001	0.001
	inflection	0.76	0.65	0.68	0.67
	slope	0.38	0.74	0.64	0.88
Descending Curve	infl	**0.1**	**0.1**	0.11	0.18
	slope	0.74	0.85	0.91	1.00
	final	0.05	0.06	0.06	0.08
P.o.p. Survey catchability		1.16	1.27	1.15	1.28
P.o.p. Selectivity	Transition	28	28	28	28
Ascending curve	minimum selectivity	0.001	0.001	0.001	0.001
	inflection	0.62	0.62	0.61	0.61
	slope	2.49	2.58	2.37	2.44
Descending Curve	infl	0.12	0.12	0.125	0.12
	slope	1.29	1.26	1.32	1.26
	final	0.05	0.05	0.05	0.05
cv age at age 40 (aging error)		0.24	0.24	0.24	0.24
cv age at age 2 (aging error)		0.11	0.11	0.11	0.11
Old discount factor		0.05	0.05	0.05	0.05
Percent mis-sexed		0	0	0	0.00
Female length at age one		10.66	10.66	10.66	10.66
Female Length at age 40		41.78	41.78	41.78	41.78
Female k		0.16	0.16	0.16	0.16
Female cv in length at age 1		0.10	0.10	0.10	0.10
Female cv in length at age 40		0.07	0.07	0.07	0.07
Male length at age one		11.65	11.65	11.65	11.65
Male Length at Age 40		37.36	37.36	37.36	37.36
Male k		0.21	0.21	0.21	0.21
Male cv in length at age 1		0.08	0.08	0.08	0.08
Male cv in length at age 40		0.04	0.04	0.04	0.04
Virgin recruitment multiplier		same as background			
Beverton-Holt Stock-Recruitment shape paramet		1.00	1.00	1.00	1.00
Background recruitment		0.20	0.19	0.20	0.20
Recruitment Standard Deviation		0.50	0.50	0.50	0.50
Recruitment trend		0.00	0.00	0.00	0.00
Recruitment Multiplier		1.00	1.00	1.00	1.00
recruitment years fixed		1999	2000-2001	2001	2002
fixed recruitment values (times 10,000)		0.1246	0.1171	0.1246	0.1246

Table 14. Model 6 results (first column) compared to results from sensitivity runs requested by the SSC review panel. One run assumed catch was double the landings in 2000-2002, which raised the assumed discard rate. The other run used 1996-2002 fishery lengths unweighted by state landings.

Change		**none**	**double landings**	**raw fishery lengths**
Years Affected		**none**	**2000-2002**	**1996-2002**
# Parameters not yearly recruits		21	21	21
Estimated yearly recruitments		39	39	39
Fixed yearly recruitments		1	1	1
Recruitments hitting lower bound		4	4	4
Catchabilities (q)				
Triennial survey		1	0.997	1.21
Slope survey		0.55	0.52	0.74
P.o.p. survey		1.28	1.27	1.36
Ending Year Biomass (mt)		8374	8717	5296
Ending Year F at midage		0.022	0.034	0.035
% spawn (unfished versus end year)		11%	12%	6.5%
total log-likelihood		-2062	-2063	-2066
fishery	Age	-421	-421	-422
fishery	Length	-548	-548	-549
Triennial	Index	2.1	2.1	1.07
Triennial	Age	-183	-183	-185
Triennial	Length	-504	-504	-509
slope	Index	-2.7	-2.9	-1
slope	Age	-27	-27	-26
slope	Length	-363	-364	-360
Pop	Index	3	3.2	3.1
Pop	Length	-19	-19	-19

Table 15 . Comparison of rebuilding analyses based on the 2001 update (Model 3) versus this update with only recruitments refit (Model 7) or all parameters refit (Model 6). In Model 6 and 7, 2003 catch is assumed equal to 2002 catch (129 mt). Effects of progressively including 1997-1999, 2000, and 2001 recruits in estimating virgin recruitment and resampling new recruitments are shown for Model 6. Last age composition year is also increased from 1999 to 2000 and finally 2001. For example, when "Year of last age composition" = 1999, then recruits after 1999 are estimated within the rebuilding analyses by resampling recruits during time periods specified under "Years resampled for future recruitments" (1983-1996 or 1983-1999).

Model Number from Table 1	**3**	**7**		**6**			
Year of OY	**2002**	**2004**		**2004**			
Year of last age composition	1998	1999	2000	1999	1999	2000	2001
Years for virgin recruitment average	63-96	63-96	63-00	63-96	63-99	63-00	63-01
Years resampled for future recruitments	83-96	83-96	83-00	83-96	83-99	83-00	83-01
Virgin Recruitment (numbers x 1000)	1577	1508	1523	1581	1530	1671	1808
Virgin Spawn	29044	27773	28049	29118	28178	30775	33208
Target (40%) spawn	11618	11109	11220	11647	11271	12310	13319
Current Spawn /Virgin	14%	10%	10%	12%	12%	11%	11%
Minimum rebuilding year	2014	2017	2014	2015	2014	2011	2011
Maximum allowed rebuilding year	2047	2050	2047	2048	2047	2044	2044
50% Probability of rebuilding by max. year							
F	0.03	0.03	0.04	0.03	0.03	0.05	0.06
OY(mt)	190	162	216	225	222	345	439
60 % Probability of rebuilding by max. year							
F	0.03	0.03	0.03	0.03	0.03	0.04	0.05
OY(mt)	181	151	203	209	205	321	417
70% Probability of rebuilding by max. year							
F	0.03	0.02	0.03	0.03	0.03	0.04	0.05
OY(mt)	168	139	188	193	192	299	391
80 % Probability of rebuilding by max. year							
F	0.03	0.02	0.03	0.03	0.03	0.04	0.05
OY(mt)	157	125	173	175	172	272	364

Table 16. Comparison of 10 year projections at the current management OY probability (P=0.7) for options presented in Table 15.

Model Number (Table 1)	**3**	**7**		**6**			
Year of last age composition	1998	1999	2000	1999	1999	2000	2001
Years for virgin recruitment average	63-96	63-96	63-00	63-96	63-99	63-00	63-01
Years resampled for future recruitments	83-96	83-96	83-00	83-96	83-99	83-00	83-01
year							
2004	198	139	188	193	192	299	391
2005	210	146	207	201	201	333	455
2006	220	153	225	209	208	362	519
2007	229	160	239	216	215	384	570
2008	237	166	250	223	222	399	604
2009	245	172	259	230	228	412	628
2010	252	178	269	236	234	422	652
2011	257	184	277	243	239	431	669
2012	263	190	284	249	245	440	676
2013	268	195	290	255	250	446	680
2014	273	201	294	261	254	451	679

Table 17. Comparison of Model 6 results (first column) to results from exploratory models changing natural mortality (M) or adding the NWFSC slope survey index (NWFSC). Exploratory models were those requiring change in either fixed parameters (M) or number of parameters (NWFSC).

Type of Change		none	M	NWFSC
Ending Year of Model		2002	2002	2002
Data sources available in		full	full	full
Data Type		revised	revised	revised
# Parameters not yearly recruits		21	21	27
Estimated yearly recruitments		39	39	39
Fixed yearly recruitments		1	1	1
Recruitments hitting lower bound		4	6	4
Catchabilities (q)				
Triennial survey		1	0.23	0.61
Slope survey		0.55	0.1	0.27
P.o.p. survey		1.28	0.37	0.88
NWFSC survey				0.13
Ending Year Biomass (mt)		8374	54966	26877
Ending Year f		0.022	0.004	0.006
% spawn (unfished versus end year)		11%	26%	40%
total log-likelihood		-2062	-2086	-2742
fishery	Age	-421	-456	-427
fishery	Length	-548	-549	-598
Triennial	Index	2.1	-4	-0.26
Triennial	Age	-183	-180	-182
Triennial	Length	-504	-486	-487
slope	Index	-2.7	-5.7	-4
slope	age	-27	-26.8	-34
slope	Length	-363	-362	-398
Pop	Index	3	3.1	3
Pop	Length	-19	-14	-18
nwfsc	Index			-1
nwfsc	age			-174
nwfsc	Length			-421

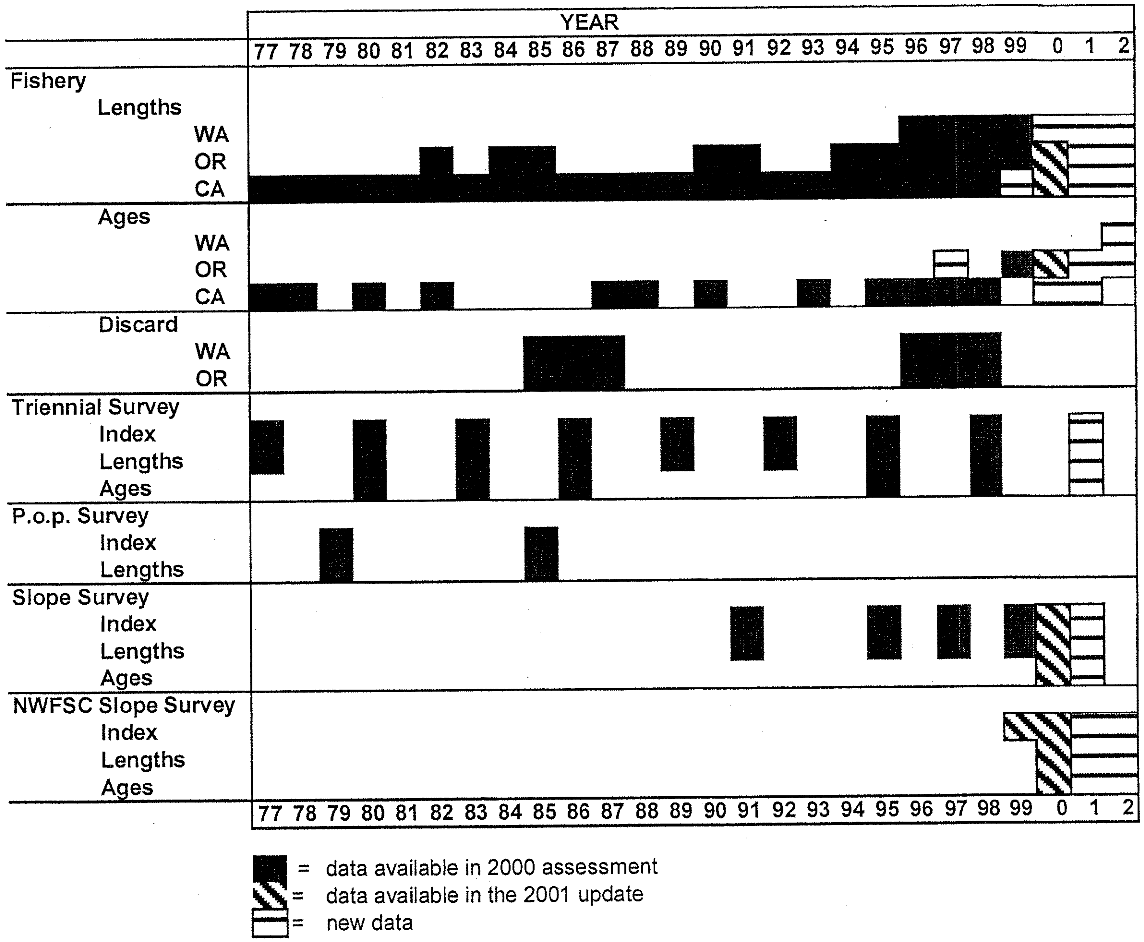
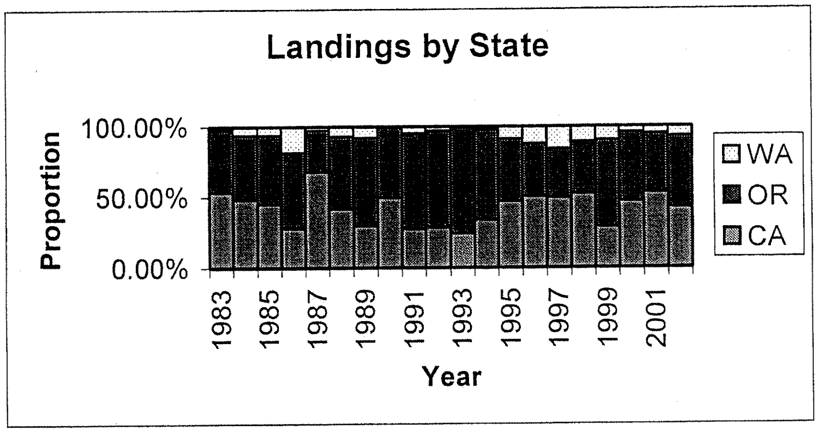


Figure 1. Comparison of data available for use in the last full assessment (Rogers et al. 2000), the 2001 update (Methot and Rogers 2001), and data new to this update. The NWFSC slope survey was not utilized in the 2001 update and only in an exploratory model in this update. Ages designated as "new data" were not utilized in the models.



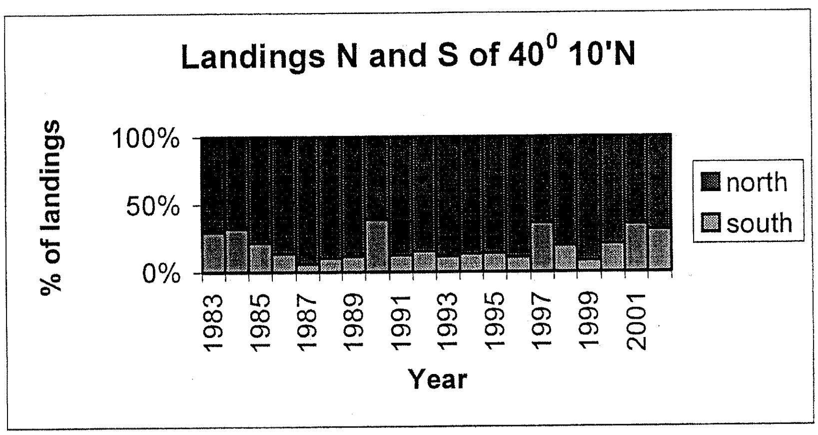


Figure 2. Comparison of darkblotched rockfish landings by state (above) and by ports north and south of 40^0 10' N Latitude (below).

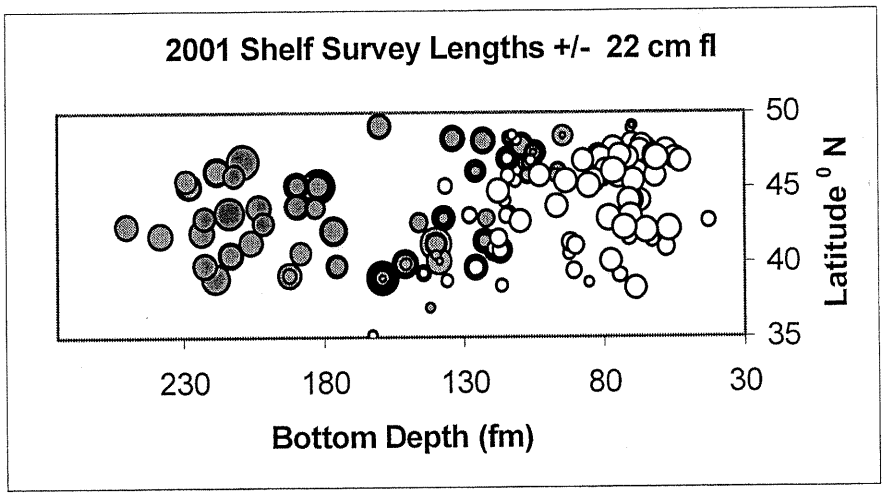


Figure 3 . Comparison of size distribution based on bottom depth and latitude in the 2001 AFSC shelf survey. Each bubble represents a measured fish. Location of bubble is based on the latitude and depth of the catch of the measured fish. Size of the bubble relates to the difference between the length of the fish and 22 cm fl. Shaded bubbles are positive differences (> 22 cm fl), unshaded are negative differences (< 22 cm fl).

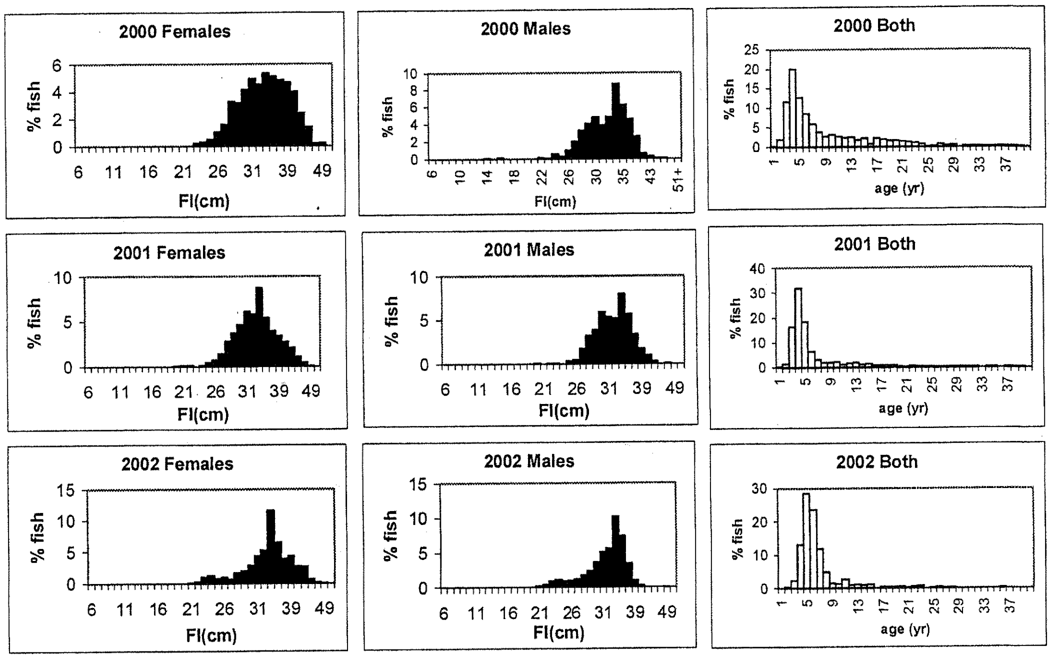


Figure 4. Length and age compositions for latest fishery data. Lengths after 32 cm are in 2-cm bins. Aging for 2001 and 2002 and Oregon in 2000 was done in 2002. Ages for all three years were not used in update models.

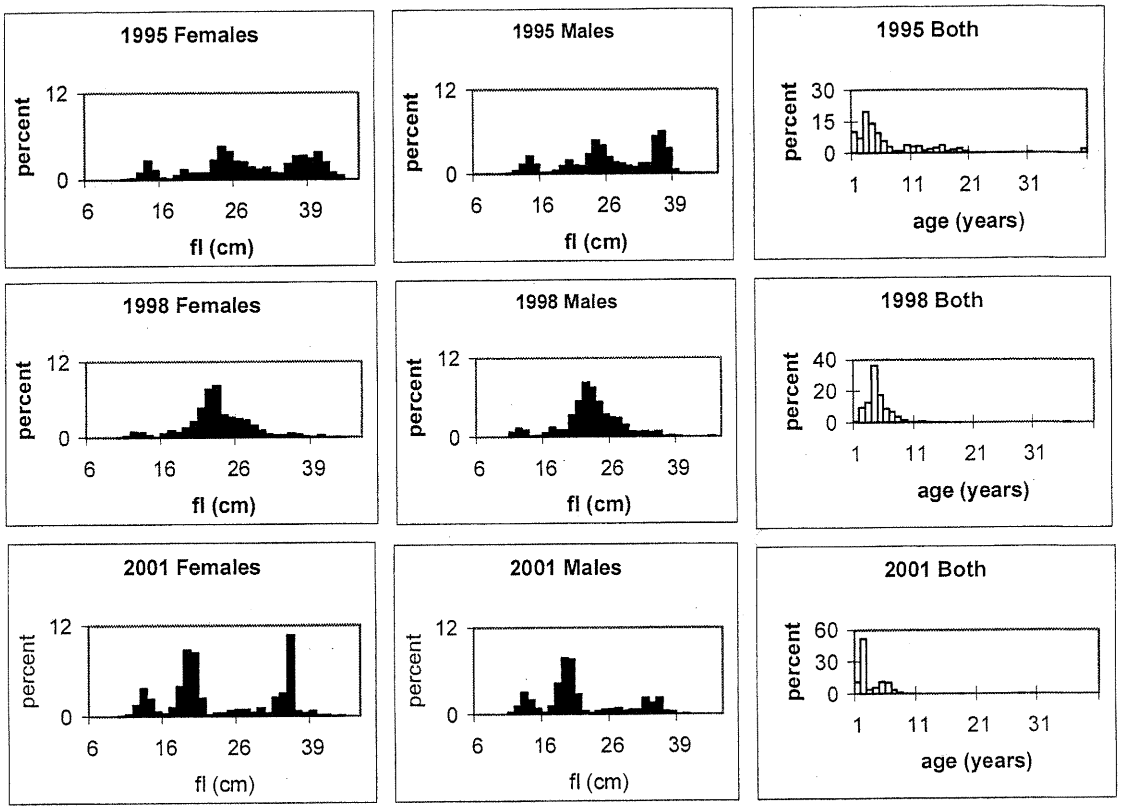


Figure 5. Comparison of recent AFSC shelf survey length and age compositions. Lengths after 32 cm are in 2-cm bins. Aging for 2001 was done in 2002 and not used in update models.

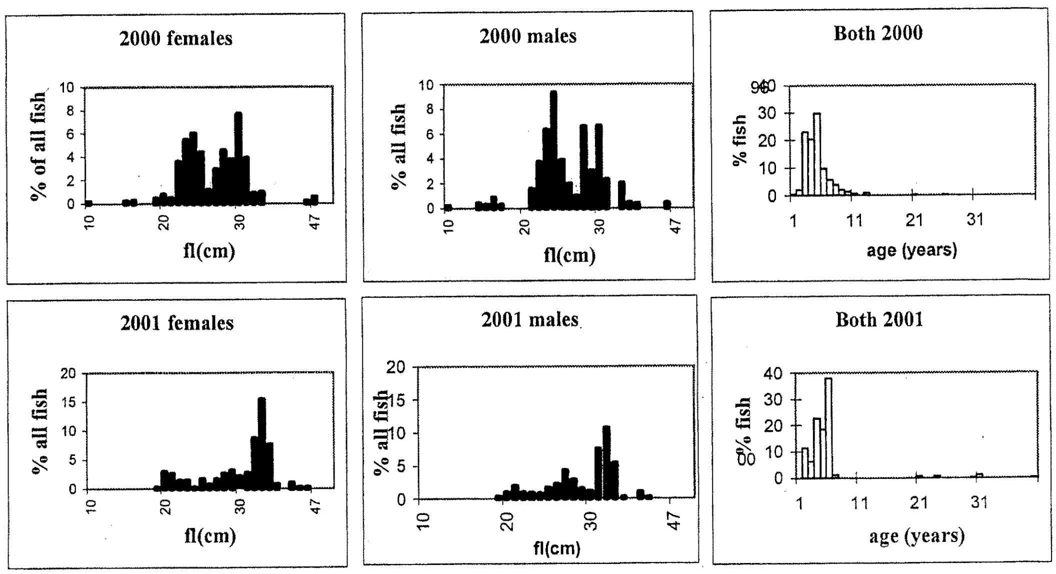


Figure 6. Comparison of recent AFSC slope survey length and age compositions. Lengths after 32 cm are in 2-cm bins. Aging for 2001 was done in 2002 and not used in update models.

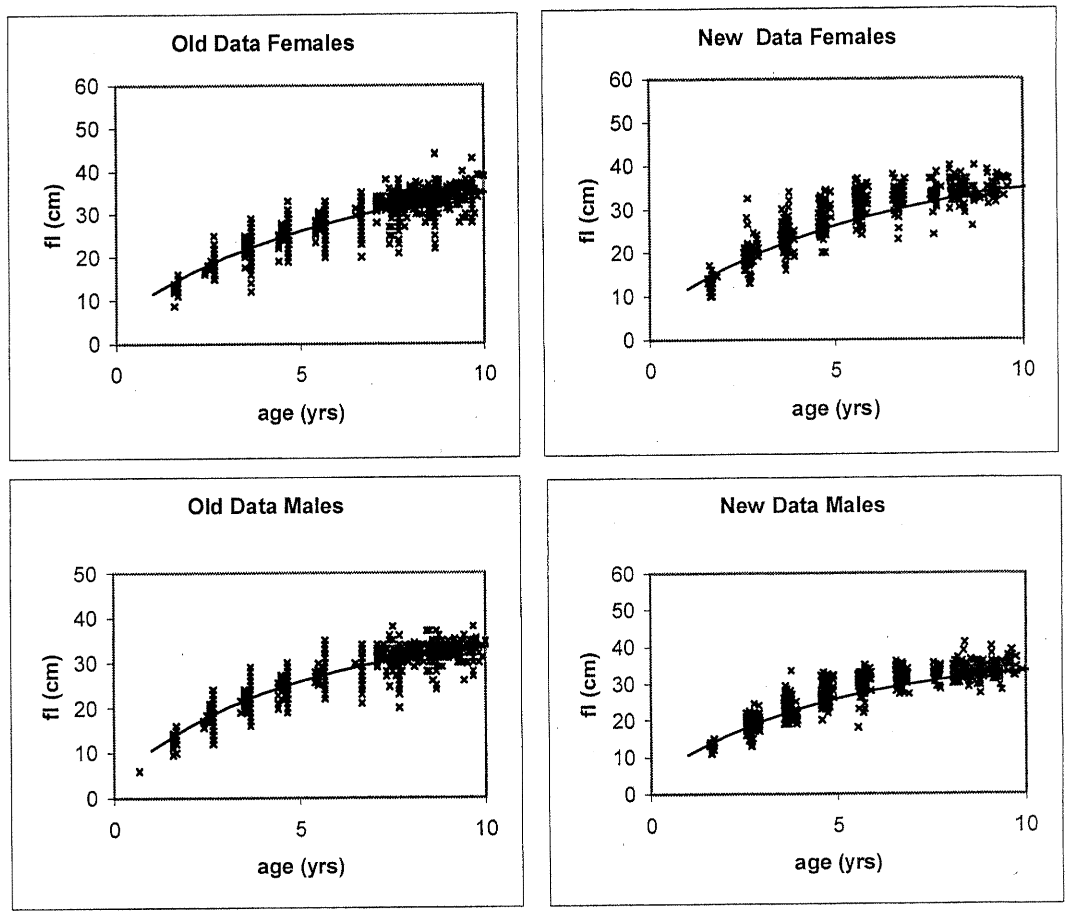


Figure 7. Comparison of the age-length relationship for fish aged previously (old data) versus fish aged in 2002 (new data). Solid line is von Bertanlaffy growth curve based on previous ages.

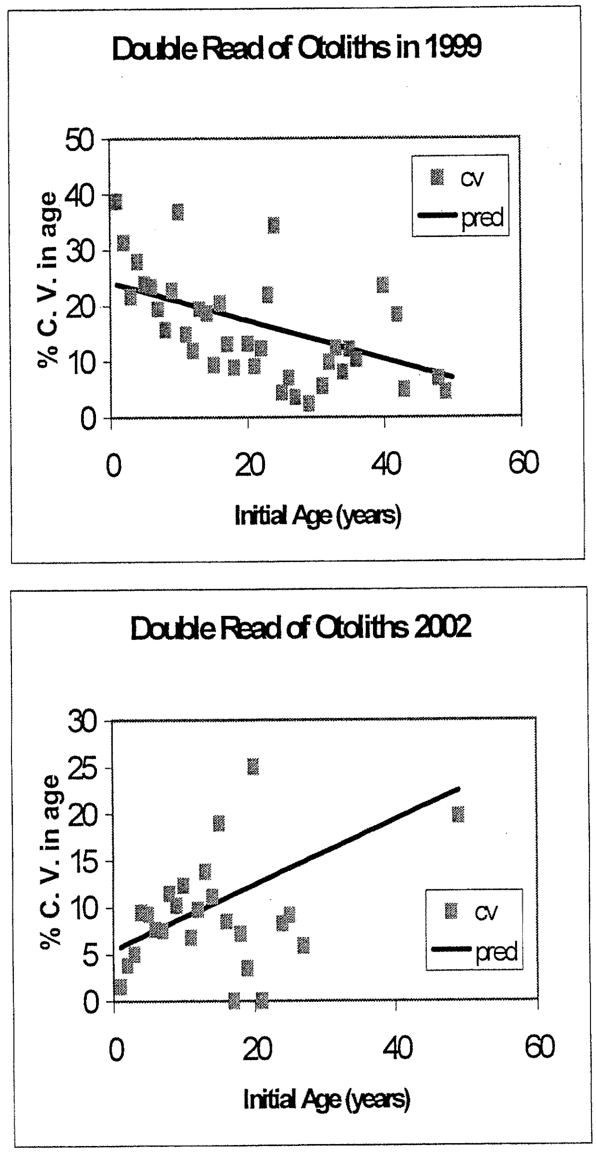


Figure 8. Comparison of darkblotched rockfish survey length compositions for 2000-2002. Northern boundary for all surveys is the U.S.- Canadian border, southern boundary is 34^0 30' N for the AFSC surveys and 35^0 N for the NWFSC survey. Depth ranges are 100-700 fm for slope surveys and 30-275 fm for shelf survey. Heavy solid line is the AFSC slope survey, thin solid line is NWFSC slope survey, and dotted heavy line is the AFSC shelf survey.

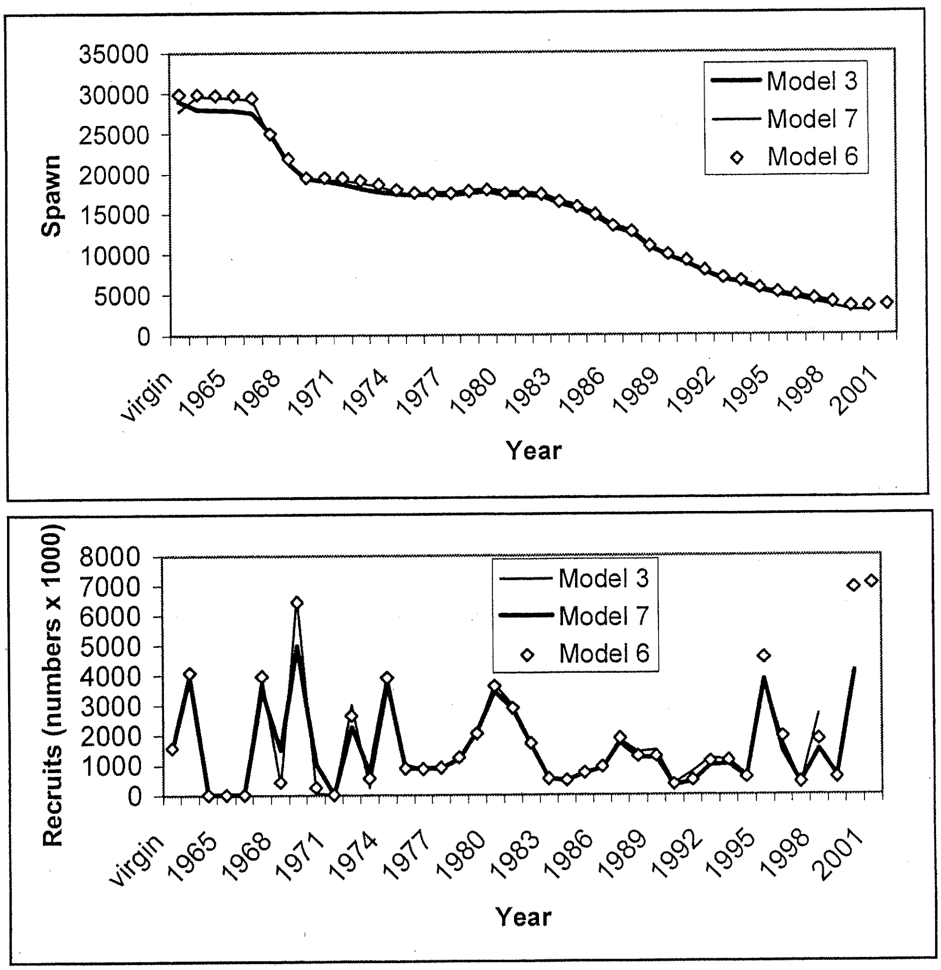


Figure 9. Comparison of Model 3 (2001 update) inputs into the rebuilding analyses versus those from Model 7 (refit only recruitments) and Model 6 (refit all parameters).

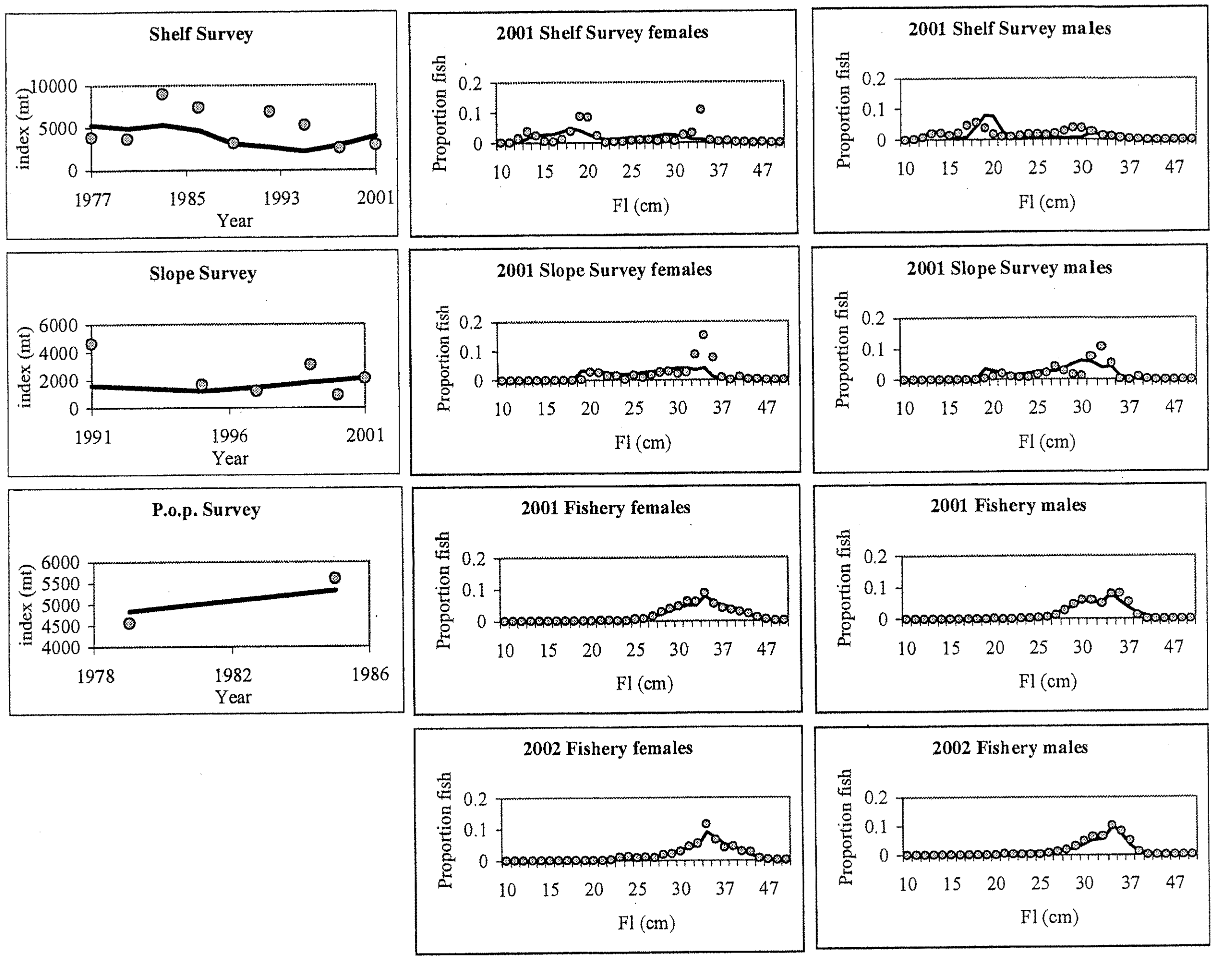


Figure 10. Fit of Model 6 estimates to survey indices and recent length compositions in the surveys and fishery. Lines connect model estimates, circles are data points.

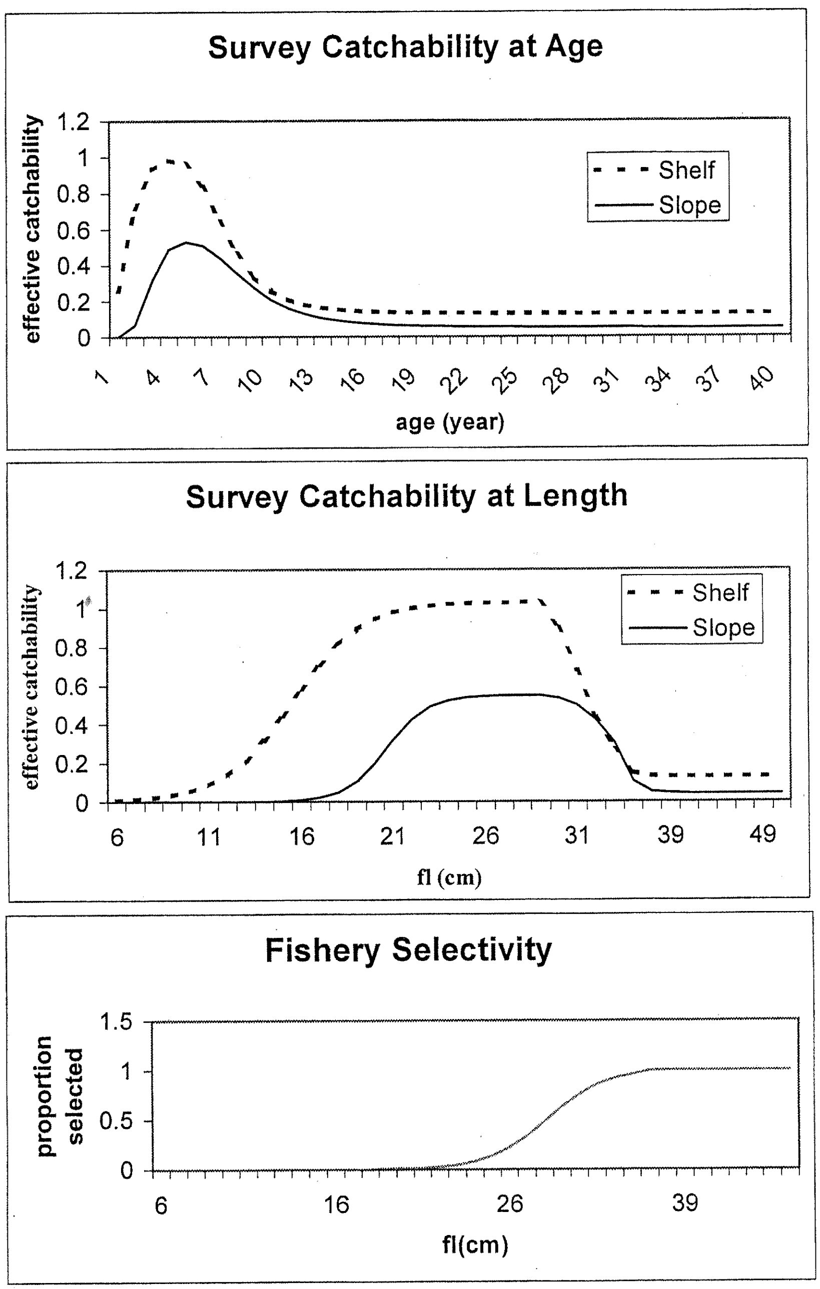


Figure 11. Model 6 estimated catchability at age (catchability at full selectivity times proportion selected) for females in the shelf and slope survey.

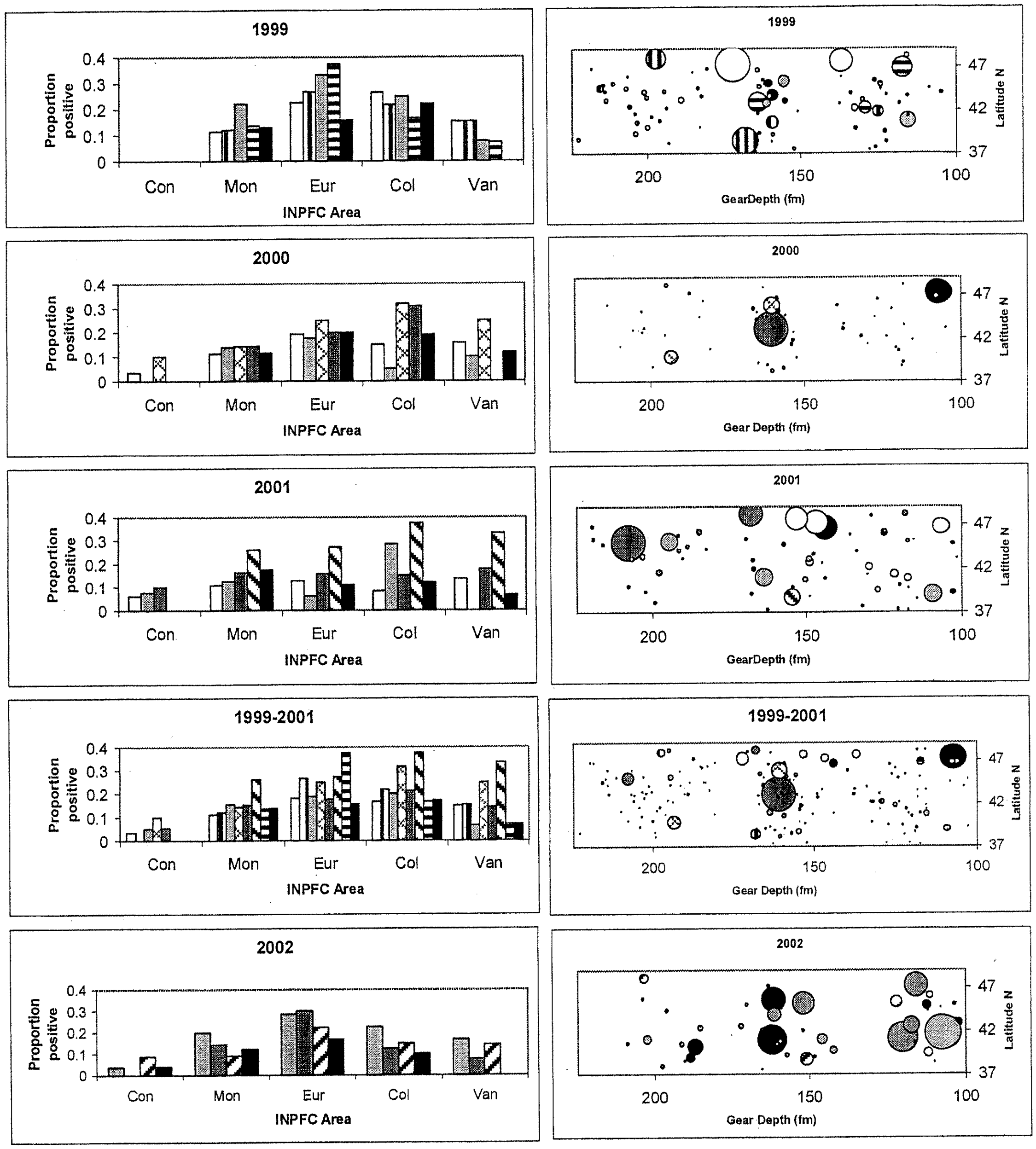


Figure 14 . Comparison of the AFSC and NWFSC darkblotched catches by boat. Empty bars and circles = AFSC Miller Freeman, other shades and patterns refer to specific boats participating in the NWFSC survey. In plots on the right, the location of the bubble indicates depth and latitude of the tow and size of bubble directly relates to maximum catch weight.

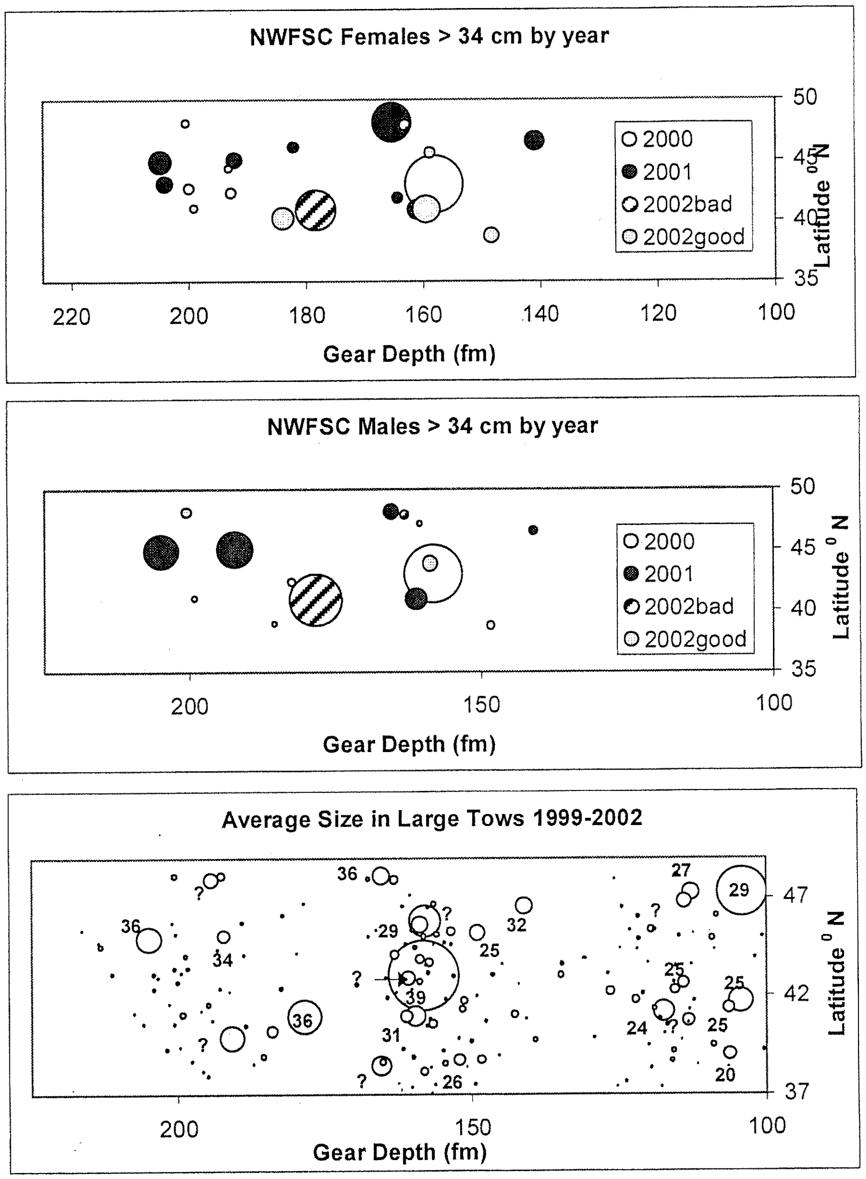


Figure 15 . Plots indicating location of larger darkblotched rockfish. In top two plots, position of bubble indicates tow location, while size of bubble directly relates to the percentage of fish greater than 34 cm for that year (percentages sum to 100 for each year). For 2002, bad versus good indicates use of tow in biomass index (bad = not used). In bottom plot, all tows are plotted by location and size of bubble is directly related to darkblotched catch weight. Larger catches are labeled with average fl (cm). Question marks mean the catch was not sampled for lengths.

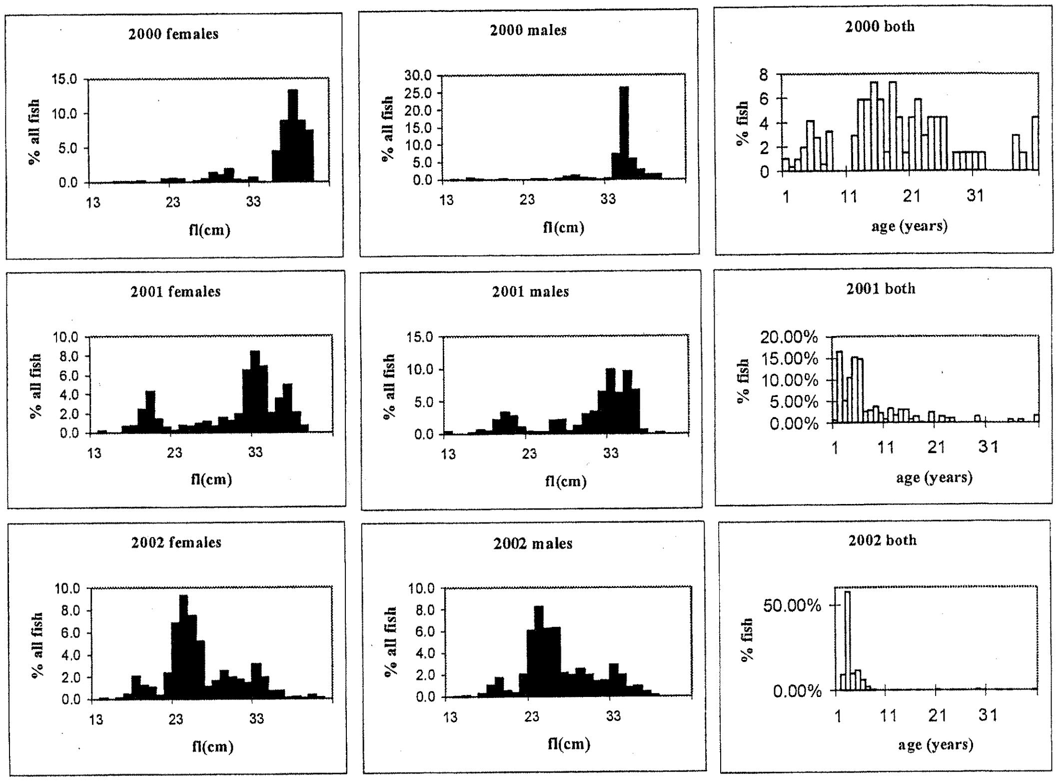


Figure 16. Comparison of recent NWFSC slope survey length and age compositions. Lengths after 32 cm are in 2-cm bins. Aging for 2001 and 2002 was done in 2002 and not used in the exploratory model.

GROUNDFISH ADVISORY SUBPANEL STATEMENT ON
PRELIMINARY RANGE OF HARVEST LEVELS FOR 2004

The Groundfish Advisory Subpanel (GAP) reviewed the proposed harvest levels recommended by the Groundfish Management Team (GMT) and the Scientific and Statistical Committee (SSC) and provides the following comments.

Except as noted below, the GAP recommends the medium optimum yield (OY) levels identified in Exhibit B.4, Attachment 1 be the preferred alternatives for 2004 harvest levels, within the ranges identified in that Exhibit. The medium OY of 4,320 mt for **yellowtail** is also recommended.

In regard to sablefish, the GAP reminds the Council the influences of environmental factors are well-documented in other fisheries such as salmon and sardines. Further, the author of the sablefish assessment has presented considerable work on environmental impacts on sablefish reproduction. It is, therefore, appropriate to use the medium OY level for sablefish that is derived from the assessment.

We have attached a table showing our recommended OY ranges and preferred options for those species where no values were shown in Exhibit B.4, Attachment 1. The preferred options of the majority of the GAP are underlined and **bold.** The preferred options of a minority of the GAP are in *italics*.

SPECIES	LOW OY	LOW/MID OY	MEDIUM OY	HIGH OY
Pacific Ocean Perch	*318*		444	**<u>555</u>**[1/]
Widow	*30*		284[1/]	**<u>501[1/]</u>**
Canary	*31*		**<u>45</u>**[1/]	46
Bocaccio	*199*	295[1/]	**<u>377[1/]</u>**	710[1/]
Darkblotched	*172*		272	**<u>417[1/]</u>**
Black (OR/CA)	729		***<u>775</u>***[1/]	861

PFMC
06/17/03

1/ Preferred based on P_{MAX} of 60%.
2/ Based on model 8, P_{MAX} of 60%.
3/ Preferred based on P_{MAX} of 60%, from Model 9.
4/ Preferred based on continuation of 61% / 39% split from 2003; other values for canary are based on 50% / 50% split.
5/ P_{MAX} of 60%, from STAR model B2.
6/ Preferred based on P_{MAX} of 60% from STAT model C.
7/ P_{MAX} of 60%, from STAR model B1.
8/ Preferred based on P_{MAX} of 60%, with recruits re-sampled through 2001.
9/ Preferred based on medium OY value.

SCIENTIFIC AND STATISTICAL COMMITTEE REPORT ON PRELIMINARY RANGE OF HARVEST LEVELS FOR 2004

The Scientific and Statistical Committee (SSC) reviewed all the materials associated with agenda item B.3 and notes that new results are available for: Pacific ocean perch, widow rockfish, bocaccio, black rockfish, cowcod, yellowtail rockfish, and darkblotched rockfish. Moreover, although the 2004 acceptable biological catches (ABCs) and optimum yields (OYs) of sablefish, shortspine thornyhead, canary rockfish, yelloweye rockfish, and lingcod have also been updated in Table 2.1-1 (see Exhibit B.4, Attachment 1, June 2003), the SSC considers those changes to be routine, because they are based on assessments and rebuilding analyses that have been previously reviewed.

For the seven stocks with new information available, the SSC recommends the Council consider the following ranges for harvest levels in 2004. For the overfished stocks other than cowcod, a range of alternatives is presented that represents the probability of rebuilding the stock by T_{MAX} (i.e., P = 0.6, 0.7, or 0.8), which the SSC views as a policy decision. Where alternative model formulations were developed by the assessment authors and/or the Stock Assessment Review (STAR) Panels, the SSC has narrowed the range to include those models listed here (see SSC statement on agenda item B.3 -- Stock Assessments and Rebuilding Analyses for 2004 Groundfish Management).

Pacific Ocean Perch (POP) (Exhibit B.3, Attachment 2, June 2003; page 7, Table 3):

Model	P =0.5	P = 0.6	P = 0.7	P = 0.8	comment
Model C	664 mt	555 mt	444 mt	318 mt	full posterior, project with recuits

Widow Rockfish (Exhibit B.3, Attachment 5, June 2003; page 7, Table 4b):

Model	P =0.5	P = 0.6	P = 0.7	P = 0.8	comment
Model 7	248 mt	181 mt	111 mt	30 mt	rec. overide, R/S, power = 2
Model 8	354 mt	284 mt	212 mt	123 mt	rec. overide, R/S, power = 3 (base)
Model 9	582 mt	501 mt	419 mt	323 mt	rec. overide, R/S, power = 4

Bocaccio (Exhibit B.3, Attachment 8, June 2003; page 5, Tables 1 & 2):

Model	P =.05	P = 0.6	P = 0.7	P = 0.8	comment
STARb2	333 mt	295 mt	250 mt	199 mt	remove sport CPUE
STATc	439 mt	376 mt	306 mt	236 mt	blended model
STARb1	784 mt	710 mt	625 mt	525 mt	remove triennial survey

Black Rockfish (Exhibit B.3, Attachment 10, June 2003; page 31, Table 14):

Model	2004 OY
Low Catch	729 mt
STAR Base	775 mt
High Catch	861 mt

Cowcod (Exhibit B.3, Attachment 12, June 2003):

The cowcod rebuilding review did not involve any modeling *per se*, but reviewed landings statistics in recent years and recalculated trend indices. Consequently, the ABC and OY for the southern and northern areas are simply carried forward from 2003.

Yellowtail Rockfish (Exhibit B.3, Attachment 14, June 2003; page 53, Table 26):

Model	2004 OY

Base	4,320 mt	model updated from prior assessment (see Tagart *et al*. 2000)

Darkblotched Rockfish (Exhibit B.3, Supplemental Attachments 15 & 16 Combined, June 2003; page 32, Table 15):

Model	P -.05	P = 0.6	P = 0.7	P = 0.8	comment
6-1999	222 mt	205 mt	192 mt	172 mt	resample 1983-1999
6-2000	345 mt	321 mt	299 mt	272 mt	resample 1983-2000 (STAR base)
6-2001	439 mt	417 mt	391 mt	364 mt	resample 1983-2001

PFMC
06/17/03

Revised preliminary GMT-recommended alternatives for acceptable biological catches (ABCs) and total catch optimum yields (OYs) (mt) for 2004. (Overfished stocks in CAPS). - 6/17/03 - 9:15 a.m.

Stock	2003 ABCs/OYs		2004 ABCs and OY Alternatives				
	ABC	OY	ABC	Low OY	Med OY	High OY	Comments
LINGCOD	841	651	*		735		Pmax=60%
Pacific Cod	3,200	3,200	3,200		3,200		
PACIFIC WHITING (Coastwide)	188,000	148,200	*	Deferred until Mar 04			
Sablefish							
North of Conception	8,209	6,500	*	4,670	7,556	8,365	F60-dd; F45-dd; F45-rs
Conception INPFC area	441	294	*	238	326	351	
PACIFIC OCEAN PERCH	689	377	862	318	444	555	C-post 80%; 70%; 60%
Shortbelly Rockfish	13,900	13,900	13,900		13,900		
WIDOW ROCKFISH	3,871	832	~3,460	181	284	501	Models 7-9; no SR; 60%
CANARY ROCKFISH (50/50) a/	256	44	*	31	42	46	80%; 60%; 50%
Chilipepper Rockfish	2,700	2,000	2,700		2,000		
BOCACCIO	198	≤20	*	199	306	710	b1-80%; c-70%; b2-60%
Splitnose Rockfish	615	461	615		461		
Yellowtail Rockfish	3,146	3,146	4,320		4,320		F50 w/pref model
Shortspine Thornyhead	1,004	955	1,030		983		
Longspine Thornyhead	2,461	2,461	2,461		2,461		
S. of Pt. Conception	390	195	390		195		
COWCOD (S. Concep)	5	2.4	5		2.4		
N. Concep & Monterey	19	2.4	19		2.4		
DARKBLOTCHED	205	172	*	172	272	364	80% w/99; 00; 01
YELLOWEYE	52	22	*		24		2004 Proj 70%
Nearshore Species							
Black WA	1,115	835	540		540		88% N ABC N of Falcon
Black OR-CA b/			775	729	775	861	Total CA & OR ABC
Cabezon WA c/			*				
Cabezon OR c/			*				
Cabezon CA c/			*				
Minor Rockfish North	4,795	3,115	4,795		3,115		
Remaining Rockfish North	2,727	2,081	1,612		1,216		Rem assess/un- black
Bocaccio	318	239	318		239		
Chilipepper - Eureka	32	32	32		32		
Redstripe	576	432	576		432		
Sharpchin	307	230	307		230		
Silvergrey	38	29	38		29		
Splitnose	242	182	242		182		
Yellowmouth	99	74	99		74		
Other Rockfish North	2,068	1,034	2,068		1,034		
Minor Rockfish South	3,506	2,015	3,506		2,015		
Remaining Rockfish South	854	689	854		689		
Bank	350	263	350		263		
Blackgill	343	306	343		306		
Sharpchin	45	34	45		34		
Yellowtail	116	87	116		87		
Other Rockfish South	2,652	1,326	2,558		1,279		
Dover Sole	8,510	7,440	8,510		7,440		
English Sole	3,100	3,100	3,100		3,100		
Petrale Sole	2,762	2,762	2,762		2,762		
Arrowtooth Flounder	5,800	5,800	5,800		5,800		
Other Flatfish	7,700	7,700	7,700		7,700		
Other Fish	14,700	14,700	<14,700		<14,700		

a/ Updated the alternative OYs from the last rebuilding analysis. The high OY value ranged last year was at a P_{MAX} of 50%. All other stocks with new rebuilding analyses have high OYs based on a P_{MAX} of 60%. The canary stock was not assessed in 2003.

b/ The OR/CA harvest guideline options are: 1) 488 mt in OR and 287 mt in CA based on a 63:37 catch ratio in OR and CA from 1990-2002 catch history; 2) 450 mt in OR and 325 mt in CA based on a 1.4 OR:CA catch ratio from 1985-2002; and 3) 434 mt in OR and 341 mt in CA based on a nearshore area calculation (0-50 fm) from San Fran. N to the CA/OR border and the OR nearshore area.

c/ Cabezon will be assessed in the summer of 2003. The stock assessment review (STAR) will occur the third week of Sept. Nearshore management measures will be ranged to encompass a full range of cabezon assessment outcomes.

* NOTE: These ABC values will be provided immediately following the June Council meeting.

STATEMENT OF THE GROUNDFISH MANAGEMENT TEAM ON INSEASON ADJUSTMENTS

This page to Ms. Michelle Robinson

Updated Bycatch Scorecard

Estimated mortality (mt) of overfished West Coast groundfish species by fishery in 2003.

Fishery	Bocaccio 1/	Canary	Cowcod	Darkblotched	Lingcod 7/	POP	Whiting	Widow	Yelloweye
Limited Entry Groundfish									
Trawl- Non-whiting *2/*	9.2	8.1		88.0	77.0	65.5	1,800	1.4	0.6
Trawl- at-sea whiting 2a/		4.1		5.0	0.3	9.0	95,300	182.0	0.0
Trawl- shoreside whiting		0.5		1.5	0.2	0.2	50,900	30.0	
Fixed Gear	0.1	0.5	0.1		20.0				1.0
Recreational Groundfish									
WA		1.5			35.0				3.5
OR		9.3			105.0			4.0	3.7
CA (N)		0.5			195.0			1.0	0.1
CA (S)	5.0	2.7			20.0			0.0	0.4
Tribal									
Midwater Trawl		1.1		0.0	0.0	0.0	0	45.0	0.0
Bottom Trawl				0.0	4.5	0.0			
Troll		0.5		0.0	0.9	0.0			0.1
Fixed gear		0.7		0.0	5.5	0.0		0.0	3.0
Open Access									
Groundfish directed	0.2	0.3	0.0		50.0				0.5
CA Halibut	0.5	0.1	0.1	0.0	0.0	0.0	0	0.0	0.1
CA Gillnet *3/*	0.5								
CA Sheepshead *3/*									
CPS- wetfish *3/*	0.5								
CPS- squid *4/ 5/*									
Dungeness crab *3/*				0.0					
HMS *3/*		0.0	0.0	0.0					
Pacific Halibut *3/*	0.0	0.0		0.0	UR	0.0	0	0.0	0.5
Pink shrimp	0.1	0.5		0.0	0.5	0.0	1	0.1	0.1
Ridgeback prawn	0.1	0.0	0.0	0.0	0.0	0.0	0	0.0	0.0
Salmon troll	0.2	1.6			0.3			0.0	0.2
Sea Cucumber	0.0	0.0	0.0	0.0	0.0	0.0	0	0.0	0.0
Spot Prawn (trawl)									
Spot Prawn (trap)									
Research: Based on two most recent NMFS trawl shelf and slope surveys with expanded estimates for south of Pt. Conception									
	2.0	1.0		1.6	3.0	3.0	200	1.5	0.8
EFPs: *6/*									
CA: NS FF trawl	0.5	0.5	0.2						0.5
OR: selective FF trawl		**4.0**		3.1	13.0			1.0	1.2
WA: AT trawl		**3.0**		3.0	2.0	10.0		3.0	0.4
WA: dogfish LL		0.0		0.0	0.0	0.0	0	0.0	0.0
WA: pollock		0.0		0.0	0.0	0.0	0	0.0	0.0
EFP Subtotal		**7.5**							
TOTAL	18.9	40.5	0.4	102.2	532.2	87.7	148,200	269.0	16.7
2003 OY	< 20	44.0	2.4	172.0	651.0	377.0	148,200	832.0	22.0

Shaded cells represent either NA- Not applicable; TR- Trace amount (<0.01 mt); UR- Not reported in available data sources.
1/ South of 40°10' N. lat.
2/ Using observer data, all landings are results of modeling GMT Option 1
2a/ Calculated using five-year average (1998-2002); includes tribal at-sea whiting
3/ Mortality estimates are not hard numbers, based on their GMT's best professional judgement.
4/ Bycatch amounts by species unavailable, but bocaccio occurred in 0.1% of all port samples and other rockfish in another 0.1% of all port
5/ Expected landed catch only. Discard/total mortality estimates not available.
6/ The Council capped the 2003 canary rockfish set-aside for all the EFPs in combination at 6.5 mt to derive an expected total catch of 44 mt of canary rockfish in 2003.
7/ Lingcod total reflects total catch, not mortality

These two pages presented by Jim Hastie and Rod Moore.

GMT RECOMMENDATIONS FOR INSEASON ADJUSTMENTS

Management Options - North of 40°10'

Trawl

1. Restore fishing area from 50 to 75 fms in:
   a. Period 4 (canary = 10.9 mt)
   b. Periods 5 and 6 (canary = 10.2 mt)
   c. Periods 4 and 6 (canary = 11.2 mt)

Note: Periods 4 and 5 are not considered a viable option as it would result in 12.7 mt of canary

2. Change trip limits to:

Large footrope	Small footrope
Sablefish - 8,000-10,000 lbs/2 mo. (from 10K)	Sablefish - (no change)
Dover - 34,000 lbs/2 mo (from 31K)	Dover - (no change)
LS - 10,000-13,000 lbs 2/mo (from 14K)	LS - 5000 lbs/2 mo.
SS - 2300-2500 lbs/2 mo (from 2800)	SS - 1000 lbs/2 mo.

Note: Given the current uncertainty regarding discard rate revisions in September, the GMT believes that the lower end of the ranges would provide greater security that DTS target opportunities could continue throughout the remainder of the year. If no increases in discard assumptions arise, the upper end of the range should be sufficient to allow the fishery to continue through the end of the year. However, the GMT reminds the Council that the failure to make precautionary adjustments in June of 2001 led to closure of the DTS fishery during the final three months of that year.

LE & OA Gear (non-trawl)

1. Nearshore Rockfish - Increase trip limit for minor nearshore rockfish from 3,000 lbs/2 mo. to 4,000 lbs/2 mo. of which no more than 1200 lbs can be species other than black or blue rockfish (was 900 lbs) inside 27 fms

Note: This action is designed to allow the California fishery north of 40°10' to fully take its nearshore targets, and may require Oregon to take independent action at a later date to constrain its fishery to the existing target for black rockfish.

Management Options - South of 40°10'

Trawl

1. Change trip limits to:

	Period 4	Periods 5 & 6 (same as large footrope in north)
Sablefish	12,000 lbs/2 mo.	8,000-10,000 lbs/2 mo.
Dover	37,000 lbs/2 mo. (from 35K)	34,000 lbs/2 mo.
LS	16,000 lbs/2 mo.	10,000-13,000 lbs/2 mo.
SS	2900 lbs/2 mo. (from 3100)	2300-2500 lbs/2 mo.

Note: DTS trip limits are higher south of 40°10' in period 4 as part of the April arrangement for closing the fishery inside 200 fm during that period to protect bocaccio. Southern limits are the same as in the north during periods 5 and 6.

Management Options - South of 40°10' (cont.)

Fixed Gear

Current trip limits (LE & OA):

	Shallow NS	Deeper NS
Period 3	400 lbs/2 mo.	200 lbs/2 mo.
Period 4	500 lbs/2 mo.	400 lbs/2 mo.
Period 5	400 lbs/2 mo.	200 lbs/2 mo.
Period 6	200 lbs/2 mo.	200 lbs/2 mo.

1. Shallow Changes
   a. Period 4 = 400 lbs/2 mo.; Period 5 = 300 lbs/2 mo.
   b. Period 4 = 400 lbs/2 mo.; Period 5 = 200 lbs/2 mo.
   c. Periods 4 & 5 = 300 lbs/2 mo.
2. Deeper Changes - Period 4 = 500 lbs/2 mo.; Period 5 = 300 lbs/2 mo.

Management Options - South of 40°10' and North of 34°27'

Exempted Trawl
Make correction to closed area (RCA) for exempted trawl to 60-200 fms (from 200 fms to shore) for remainder of the year. Note: This area was inadvertently closed to match the directed trawl regulations.

Management Options - South of 34°27'

Exempted Trawl
Make correction to closed area (RCA) for exempted trawl to 100-200 fms (from 200 fms to shore) for remainder of the year. Note: This area was inadvertently closed to match the directed trawl regulations.

Note: Actions in April to close these trawl fisheries inside 200 fms during period 4 were based on evaluation of the new bycatch data for the directed groundfish fishery only. No adjustments were made in the expected bycatch of the California halibut fishery, and hence that fishery should not have been closed.

2003 landings data supporting June inseason recommendations

	QSM thru 5/24	Annual target	Pct. attainment	Trip limits Period 1	Trip limits Period 2	Trip limits Period 3
Trawl						
Longspine	654	2,029	32%			
Shortspine	329	755	44%			
Sablefish	671	2,364	28%			
Dover sole	2,694	7,006	38%			
LE + OA Nearshore: North of 40o10'	50	186	27%			
LE + OA Nearshore: South of 40o10'						
Shallow NS	6	38	16%	200 lb / 2 mo	Closed	400 lb / 2 mo
Deep NS	5	48	10%	200 lb / 2 mo	Closed	200 lb / 2 mo
CA Scorpionfish	0	21	0%	Closed		800 lb / 2 mo

ENFORCEMENT CONSULTANTS REPORT ON STATUS OF GROUNDFISH FISHERIES AND INITIAL POLICY CONSIDERATION OF INSEASON ADJUSTMENTS

The Enforcement Consultants (EC) has continuing concerns regarding the pattern of constantly shifting depth lines in the groundfish fishery. This strategy has created an extremely complex regulation pattern, which challenges the ability of the industry to understand what is expected of them. This also applies to the enforcement assets responsible for enforcing the regulations in a fair and equitable manner.

By example: If management option "c" for trawl north 40E10" N latitude is adopted, there will be thirteen lines composed of thousands of way points (trawl, fixed gear, and B Platoon) at play during the second half of this year. The modeling component used to justify this management proposal requires precision and accuracy on the part of the industry and enforcement programs. The EC is concerned that the achievement of these management objectives are being jeopardized by the complexities being incorporated into depth-based management in this first year of implementation. Adding to our concern is the fact we will be attempting to bring the vessel monitoring system on line during this time of extreme complexity.

When depth-based management was first proposed, the EC cautioned the Council that enforcement would be challenging. Simplicity is paramount to making enforcement of this management regime work. The first question a prosecutor and judge will ask is, "Is it reasonable to conclude that the defendant understood the regulation?" The first element of the defense argument will be that indeed, the defendant did not.

PFMC
06/17/03

GROUNDFISH ADVISORY SUBPANEL STATEMENT ON STATUS OF GROUNDFISH FISHERIES AND INITIAL POLICY CONSIDERATION OF INSEASON ADJUSTMENTS

The Groundfish Advisory Subpanel (GAP) held lengthy discussions on a variety of issues involving inseason adjustments. The GAP met with the Groundfish Management Team (GMT) to review management changes, and received a presentation from the California Department of Fish and Game on possible options for groundfish management south of Cape Mendocino, based on a new optimum yield (OY) value for bocaccio. GAP deliberations took place over the course of two days and involved all GAP members and members of the public, many of whom represented sport and commercial fisheries. A description of the GAP proposals for inseason adjustments is attached; these adjustments are based on recommendations provided by the GMT and the State of California. However, the GAP will comment first on the California proposals.

California recommended requesting an emergency rule that would change the OY for bocaccio for 2003 to 100 mt. If the emergency rule were issued, it would be followed by a number of management changes affecting the sport and commercial fisheries south of Cape Mendocino. These changes would vary in their impacts on bocaccio and canary rockfish. The GAP and members of the public debated the pros and cons of making an OY change inseason. A vote was then taken on the issue of requesting an emergency rule to change the OY. By a majority of 13 to 3, the GAP recommended *against* requesting an emergency rule.

The GAP then discussed an inseason adjustment involving extending the shallow boundary of the Rockfish Conservation Area to 30 fathoms in the area south of the California Conception management line (north 34°27' N latitude), while keeping in place any existing seasons, bag limits, and retention rules for sport and nontrawl commercial fisheries. The GAP unanimously approved making this change. The GAP believes, based on information presented during the discussion, that this change will have no impact on bocaccio or canary rockfish.

GAP Proposals for In-Season Adjustments - to begin July 1, 2003 unless otherwise noted

North of 40°10'

Limited entry trawl

1. Move shallow RCA boundary to 75 fathoms for periods 4 and 6

2. Large footrope limits adjusted to:
   Longspine - 13,000 lbs / 2 mos
   Shortspine - 2,500 lbs / 2 mos

3. Small footrope limits adjusted to:
   Longspine - 5,000 lbs / 2 mos
   Shortspine - 1,000 lbs / 2 mos

Limited entry and open access fixed gear

Increase trip limit for minor nearshore rockfish to 4,000 lbs / 2 mos, of which no more than 1,200 lbs may be species other than blue or black rockfish inside 27 fathoms

South of 40°10'

Limited entry trawl

1. For period 4, adjust trip limits to:
   Sablefish - 12,000 lbs / 2 mos
   Dover sole - 37,000 lbs / 2 mos
   Longspine - 16,000 lbs / 2 mos
   Shortspine - 2,900 lbs / 2 mos

2. For periods 5 and 6, adjust trip limits to:
   Sablefish - 10,000 lbs / 2 mos
   Dover sole - 34,000 lbs / 2 mos
   Longspine - 13,000 lbs / 2 mos
   Shortspine - 2,500 lbs / 2 mos

Limited entry and open access fixed gear

1. For shallow nearshore: period 4 - 400 lbs / 2 mos; period 5 - 300 lbs / 2 mos
2. For deeper nearshore: period 4 - 500 lbs / 2mos; period 5 - 300 lbs / 2 mos

Coastwide, North of 36°

For limited entry and open access daily trip limit sablefish, increase the limit to 300 lbs / day or 1 landing of 950 lbs / week, with a cumulative limit of 3,800 lbs / 2 mos

Between 40°10' and 34°27'

For exempted trawl, correct the closed area to between 60 fathoms and 200 fathoms

South of 34°27'

For exempted trawl, correct the closed area to between 100 fathoms and 200 fathoms

Allow fishing to a depth of 30 fathoms; all existing seasons, bag limits, and retention rules to remain in effect

PFMC
06/17/03

Rick Shepherd
F/V Sunset
200 Bertsch Ave
Crescent City,
95531

(707) 464-7638
daskiya@aol.com

April 29, 2003

Re: In-season trawl management

Dear Mr. Burner;

I am a trawler based out of Crescent City, CA. I mainly fish the waters between Cape Blanco, Oregon to Eureka CA. I am very concerned and confused with the decision by the PFMC regarding the in-season restrictions beginning May 1, 2003. I have spent the last two years developing a market for what we call beach fish which includes mainly Sand Dabs, Petrale, English, Sand and Flounder Sole.

I have thirty years fishing experience and have never seen the ocean so rich in all types of sea life. The conditions of our ocean have come full circle in replenishing the fish-crab-shrimp and baitfish. I believe due to a more North Westerly flow and not a southerly influence is replenishing the sea life. I believe this is a resource that should be harvested. I realize the problem with harvesting these fish is there interaction with Canary Rock. I do not catch canary Rock inside of 50 fathoms. I cannot speak for Oregon and Washington, or even areas South of Eureka; but in the area I fish I have never caught Canary Rock inside of 50 fathoms.

My concern is with a small footrope I can harvest 20,000 lbs of beach fish, which may sustain the markets until we are able to harvest more, but not enough to operate a fishing vessel on. Also, with a small footrope I am able to harvest 3,000 lbs of Sable and 12,500 lbs of Dover Sole. This I will not do because of the fact I will be discarding Channel Rock because if you fish outside of 200 fathoms you will catch Channel Rock. The only option that I can see is to fish a large footrope, which 99% of the fleet will choose to do and the market for Beach Fish will go away. And that market will take years to get back and will not be there if or when you ever let us catch the Beach Fish. This leads me to the next concern of the large footrope; every trawler will be harvesting their Dover between 200 and 300 fathoms. In this area that is a strip less than a mile wide. During the summer months the Dover live between 100-200 fathoms. Fishing more tows to catch the Dover because of the normal location of the fish and the increased pressure in a small area will create high Black Cod discards that will be mainly caught in deeper waters while fishing Channel Rock.

I will lose my markets and be forced to fish in an area that will be over fished and unsafe for my boat over a fish I do not catch. I believe this in-season management plan will devastate the trawl industry.

Markets will be lost and large numbers of boats will be forced to fish in a small area which compromises the safety of the smaller vessels.

Sincerely,

Rick Shepherd

Subject: Re: West Coast Groundfish???????????????
From: Bill Robinson <Bill.Robinson@noaa.gov>
Date: Wed, 28 May 2003 09:41:44 -0700
To: Lee Ann Hightower <hightowers@cablespeed.com>
CC: Jim Seger <Jim.Seger@noaa.gov>, Mike Burner <Mike.Burner@noaa.gov>, Ed Waters <Edward.Waters@noaa.gov>, John DeVore <John.DeVore@noaa.gov>, Jennifer Gilden <Jennifer.Gilden@noaa.gov>, pfmc.comments@noaa.gov, Rod Moore <seafood@attglobal.net>, hradtke@oregonvos.net

Dear Mr. Hightower,

Your frustration is shared by many if the number of phone calls we at NMFS, Northwest Region have been receiving is any measure. The amount of time it has taken to prepare the inseason regulatory changes recommended by the Council is solely the result of obtaining and checking for accuracy the coordinates for both the 200 and 50 fathom lines, and by the unavoidable review and approval of the regulatory changes by our Headquarters Office in Silver Springs, Maryland. I am happy to report that the new regulations will be taken to the Office of the Federal Register in Washington D.C. this afternoon. We have asked that they be filed immediately and that they be effective upon filing. As soon as we hear that the regulations are filed we will do our best to send out public notices. The first thing we will do is post them on our website (www.nwr.noaa.gov), so please check it frequently today and tomorrow. I very much hope that everyone who is able only to fish the shallower waters can be back fishing again no later than tomorrow. I apologize for the amount of time it has taken. We are trying our best to be responsive to the needs of those engaged in the fishery. Best wishes.

Bill Robinson

Lee Ann Hightower wrote:

> Mr. Chairman and members of the Council, We need to know what is happening with the current closure for the west coast groundfish. We are getting killed out here! When you first talked about closing the fishery down to redraw the coordiantes for the 200fa and the 50fa line, you said a two week closure... at the most three weeks. Well, we are all on week four now... we still have not heard one word from the Council on how things are progressing. And knowing that the process for the Council to get things into the Federal Register are long and arduous... it's not looking good for an opening anytime soon. Do we all need to declare bankruptcy right now?? The appearance of discrimination against those of us that use small footropes nearshore is looking more and more as a fact. Some of us are not capable of fishing with big gear that can operate outside of 200fa... we can not even hold that much wire on our boats without being in danger of capsizing... nor do we have the horse power it takes to pull that much gear through the water... you need to take that into consideration. As I write this, the large vessels continue to tow away... still making a living... they haven't missed a day of fishing. We (small boats) have been shut down for almost a month now... during the inseason time I might add. Many of us will soon be in jeapardy of loosing assets, like our homes or boats. We have already lost so much with the Cable Crossing, the Vessel Traffic Lane Change, and other inseason adjustments that we have no reserves left to fall back on. While I hate to think of discrimation to be an actual plausible cause... the Councils actions or <u>lack of action</u> speaks much louder than any words ever could... and thus speaks for itself. The Council needs to take action on this issue immediately. It is not that hard to draw up the coordiantes for the 200fa and the 50fa lines. Ask the fishermen themselves... they know right where they are and could have had the lines drawn out during one coffee break. Which makes all this look

more like politics that is keeping us shut down instead of real fish issues. The Council's action or lack there of, have real human impact. You are literally killing us off out here. While I am writing this I would like to include a couple of questions. How was it decided upon to use the 50fa line? Is it possible to use the 75fa line? The distance between 50fa and the 3 mile line is almost non-existant. We will hardly have any area that will be available for us to fish in... meanwhile the large vessels get to move in 50fa closer into the RCA... while we are moved out an additional 25fa away from the RCA. That does not appear to be **equal** opportunity... it reeks of politics. The difference between 75fa and 50fa is huge for the small boats... it will impact us much harder the large boats will be impacted. They can simply move to the deeper waters... we do not have that option. PLEASE come up with some different restrictions for us that will still allow us to survive. We do not want to catch fish into extinction... we want a viable **sustainable** fishery that we can continue our livelihood into the future... many of us have been fishing our small family boats for generations. But sadly, many of us do not encourage our children to partake of our tradition of being a fisherman... competition and politics have put an end to that dream. This is not information for the comment period (already past) for the Council's next meeting... we simply need to know what is going on asap. PLEASE... email me back asap and let me know what is going on with this closure and when we will be able to fish again... so that **we** may have the same opportunity as the large vessels. Sincerely,Mrs. Lee Ann HightowerF/V Sea OtterNeah Bay, WA360-385-7299 Home360-301-2824 Boat

Exhibit B.5.d
Supplemental Public Comment 2
June 2003

Kenyon Hensel
871 Elk Valley rd
Crescent City CA
95531
707-465-6857

RECEIVED
JUN - 9 2003
PFMC

Re: Northern area near shore management year 2003 mid season adjustments.

I must protest as strongly as possible the current management trends for the near shore waters north of the 40/10 line. Both California and Oregon are currently managing the near shore waters using an OY based on a single previous years catch instead of the required catch history, or biological stock assessments.

This year's OY is based on the year 2000 catch where the near shore commercial fishermen where constrained by the lowest bi-monthly limits ever imposed. These limits, though raised at each PFMC meeting though out that year, constrained catch to 186mts out of a 225mt OY.

I have been told this OY is not large enough to allow the seasonal up ward catch adjustments the fishermen need to take advantage of the good weather and strong market of the summer months. This has created a situation that threatens long established markets and infrastructure up and down the coast.

I was also told last fall, that because of the way that this years OY was derived, it would be soft number subject to mid season adjustments. That is the reason I did not protest more strongly at the time**. I am asking that the council to fallow through on that second promise and consider these scenarios for mid season adjustments.**

One: Simply allow the upward adjustment of the year 2000 to this summer's catch. The increases may or may not create an over fishing of the OY. In the year 2000 we had an increase to 6000lbs per two months by the July fishing period. The fishery was then reduced to 2000 per month in October for a landed catch of 186mts. The number being used for this years OY.

Two: Relieve the northern area of the precautionary measures, applied to the black rockfish portion of this year's OY. These measures are no longer necessary in light of the latest Black Rock fish assessment. By allowing the commercial fishery to fish this year's OY without cutting it in half first, we could double catch rates at this meeting.

Three: Allow upward adjustments in catch rates for the different sub management areas at the June meeting. The council's intent should be that that the commercial catch be all of, or even a portion over, the 186mt northern area OY. In consideration of the increases indicated by this year's stock assessment and the fact that this years OY is not derived from biological information, over fishing would not be the out come in any of these scenarios.

We badly need to have an increase in the black and blue rockfish component of our catch allowances. With out the seasonal increases in these fish, some of the last near shore markets will be lost along with the infrastructure that supports them. Many fishermen, especially those who fish out side of the areas that can supply the live market, cannot make enough money to support their fishing efforts. This hardship is completely unnecessary in light of the recent stock assessment for Black Rock fish. I can see no reason for the council to arbitrarily harm the near shore commercial fishery to this degree. Not rising this year's mid season catch levels will cause grater damage to this fishery then any previous council action.

Kenyon Hensel

UNITED ANGLERS
of Southern California

5948 Warner Avenue
Huntington Beach, CA 92649
714 840-0227 TEL
714 840-3146 FAX

RECEIVED
JUN 10 2003
PFMC

June 9, 2003

Dr. Don McIsaac, Executive Director
Pacific Fishery Management Council
7700 NE Ambassador Place
Portland, OR 97220

RE: **Comments for the Pacific Coast Groundfish 2003 In-season Adjustments and Management Measures for 2004**

Dear Dr. McIsaac:

United Anglers of Southern California is the state's largest association of recreational anglers. We represent some 50,000 affiliated sportfishermen throughout California dedicated to ensuring quality fishing today and tomorrow.

It is our belief that much of the cause of this failure to adequately manage the groundfish fisheries is a result of lack of attention to the issue of bycatch and habitat protection. Over the past 20 years management has focused on measures to redirect effort from certain rockfish by imposing trip limits and monthly landing limits on commercial fishing activities that impact rockfish. This approach however has not had a great effect on the effort being exerted in the prime habitat zones for these species. Groundfish trawls and open access trawls have continued to trawl the same areas with the primary difference only being the target specie. Trip limits and monthly landing limits are an invitation to high grading and increases in bycatch and possibly even longer drags over sensitive habitat. Additionally, the PFMC in managing groundfish hasn't yet begun collecting essential fishery information on exempted trawls.

The management regime for 2003 virtually ended groundfishing by recreational anglers. It has recently come to light that recently obtained data has painted a better picture for the bocaccio stocks. Since this data improvement does not appear to imply a recovery of bocaccio but instead appears to indicate that the rates of stock declines were not as steep as originally estimated the council should continue to move in a precautionary manner. We certainly do not want to return to the management regime of 2003.

In recognition of the improved data UASC believes that immediate action should be taken to ease restrictions. However, we request that such relief not extend to an easing of restrictions within the core habitat of bocaccio between 50 and 200 fathoms for the remainder of 2003 and for 2004.

Sincerely,

Tom R.

Tom Raftican
President, United Anglers of Southern California

Cc: Robert C. Hight, Director, California Department of Fish and Game
Michael Flores, President, California Fish and Game Commission

Oregon Report Regarding Observer Implementation Status For Inseason Action

The Council and its Advisory Bodies need to determine the framework for using observer data in-season. For example, observer data, including fish ticket and log book data analysis should be completed within six months of the in-season period under consideration for management change.

Therefore, this recommendation is that Council action in-season based on observer data should meet criteria for minimum data analysis and timeframes for that analysis. In particular the GMT should work with NMFS Observer Program staff to better understand the time constraints of providing these data. NMFS should be encouraged to establish sufficient staff resources to remove time constraints that block access to appropriate in-season data. The GMT and Observer Program staff should develop a clear timeline for when observer data using fish tickets and logbook data will be available. In addition the GMT should work with the state agencies and the PacFIN Data Committee to assist with logbook processing. By the September Council meeting, advisory bodies should make recommendations on these minimum criteria to the Council for review and approval in September 2003. Absent establishing criteria, in-season action should not be driven by incomplete observer data analysis.

GROUNDFISH MANAGEMENT TEAM REPORT ON STANDARDS AND CRITERIA FOR APPROVING EXEMPTED FISHING PERMITS

Following the April Council meeting, the Groundfish Management Team (GMT) developed a proposed process and timeline for Exempted Fishing Permit (EFP) application review and consideration by the Council that consists of an annual process beginning in April (Exhibit B.6.b, GMT Report 2) to coincide with the Council's multi-year management process. The approach would include setting aside a portion of the optimum yields (OYs) for rebuilding species of concern as part of setting the acceptable biological catches and OYs in June; in the absence of EFP applications that meet the standards and criteria sufficient to take the portion of the OYs that have been set aside, there would be a release of those set asides back to the scheduled groundfish fisheries.

The GMT also revised its proposed Council Operating Procedure that describes the standards and criteria for approving exempted fishing permits (Exhibit B.6.b, GMT Report 3) to reflect this proposed process. These proposed standards and criteria are consistent with the Magnuson-Stevens Fishery Conservation and Management Act, the Council's West Coast Groundfish fishery management plan, and draft National Marine Fisheries Service standards and protocols.

The GMT recommends the Council approve the revised Council Operating Procedure for the standards and criteria for approving EFPs, as well as the proposed process and timeline.

PFMC
06/02/03

PROPOSED COUNCIL PROCESS FOR CONSIDERATION OF EXEMPTED FISHING PERMITS FOR MULTI-YEAR MANAGEMENT

Year 1 (2003)

November

- Preliminary ABCs/OYs for Years 3 and 4 (2005 & 2006)

Year 2 (2004)

April

- Preliminary EFP Concepts for Year 3 (2005)
- Preliminary EFP OY "set asides" for Years 3 and 4 (2005 and 2006)
- Preliminary Management Measures for Years 3 and 4 (2005 and 2006)

June

- Draft EFP Applications for Year 3 (2005)
- EFP Application review by GMT, GAP and SSC
    - Proposals from individuals or non-government agencies must be presented to GMT in writing at least 2 weeks prior to June Council mtg; proposals from federal or state agencies may be presented at the June Council mtg
- Council consider approving for public review
- Adopt final EFP OY "set asides" for Years 3 and 4 (2005 and 2006)
- Final Management Measures for Years 3 and 4 (2005 and 2006)

November

- Final EFP Applications for Year 3 (2005)
    - Applications received after the Nov Council mtg for the following calendar year will not be considered
- EFP Application review (if revised) by GMT, GAP and SSC
- Council consider recommending approval to NMFS

Year 3 (2005)

April

- Release of EFP "set asides" for Year 3 (2005)
- Process and Schedule same as above for Year 4 (2006)

Year 4 (2006)

April

- Release of EFP "set asides" for Year 4 (2006)
- Preliminary Report on EFP from Year 3 (2005) to GMT for consideration
- Process and Schedule same as above for Years 5 and 6 (2007 and 2008)

September

- Final Report on EFP from Year 3 (2005) to GMT, SSC, and Council

REVISED PROPOSED COUNCIL OPERATING PROCEDURE: PROTOCOL FOR COUNCIL CONSIDERATION OF EXEMPTED FISHING PERMITS FOR PACIFIC COAST GROUNDFISH FISHERIES

DEFINITION

An exempted fishing permit (EFP) is a federal permit, issued by the National Marine Fisheries Service, which authorizes a vessel to engage in an activity that is otherwise prohibited by the Magnuson-Stevens Fishery Conservation and Management Act (Magnuson-Stevens Act) or other fishery regulations for the purpose of collecting limited experimental data. EFPs can be issued to federal or state agencies, marine fish commissions, or other entities, including individuals. An EFP applicant need not be the owner or operator of the vessel(s) for the EFP is requested *[NMFS Report, April 2002]*.

PURPOSE

The specific objectives of a proposed exempted fishery may vary. The Pacific Fishery Management Council's fishery management plan (FMP) for West Coast groundfish stocks provides for EFPs to promote increased utilization of underutilized species, realize the expansion potential of the domestic groundfish fishery, and increase the harvest efficiency of the fishery consistent with the Magnuson-Stevens Act and the management goals of the FMP *[PFMC West Coast Groundfish FMP, August 1990]*. However, EFPs are commonly used to explore ways to reduce effort on depressed stocks, encourage innovation and efficiency in the fisheries, provide access to constrained stocks while directly measuring the bycatch associated with those fishing strategies, and to evaluate current and proposed management measures *[GMT report, October 2002]*.

PROTOCOL

Submission

The Pacific Fishery Management Council and its advisory bodies (Groundfish Management Team [GMT] and Scientific and Statistical Committee [SSC]) should review EFP proposals prior to issuance; the GMT and SSC may provide comment on methodology and relevance to management data needs and make recommendations to the Council accordingly. The Groundfish Advisory Subpanel and the public may also comment on EFP proposals *[NMFS Report, April 2002]*. Completed applications for EFPs from individuals or non-government agencies for Council consideration must be received by the Council for review, at least two weeks prior to the **June** Council meeting. Applications for EFPs from federal or state agencies must meet the briefing book deadline for the **June** Council meeting.

Proposal Contents

EFP proposals must contain sufficient information for the Council to determine:

- There is adequate justification for an exemption to the regulations;
- The potential impacts of the exempted activity have been adequately identified; and
- The exempted activity would be expected to provide information useful to management and use of groundfish fishery resources. *[GMT report, October 2002]*

Therefore, applicants must submit a completed application in writing that includes, but is not limited to, the following information:

- Date of application.
- Applicant's names, mailing addresses, and telephone numbers.
- A statement of the purpose and goals of the experiment for which an EFP is needed, including a general description of the arrangements for the disposition of all species harvested under the EFP.

- Valid justification explaining why issuance of an EFP is warranted.

- A statement of whether the proposed experimental fishing has broader significance than the applicant's individual goals.
- Number of vessels covered under the EFP.
- A description of the species (target and incidental) to be harvested under the EFP and the amount(s) of such harvest necessary to conduct the experiment; this description should include harvest estimates of overfished species.
- A description of a mechanism, such as at-sea fishery monitoring, to ensure that the harvest limits for targeted and incidental species are not exceeded and are accurately accounted for.
- A description of the proposed data collection and analysis methodology.
- For each vessel covered by the EFP, the approximate time(s) and place(s) fishing will take place, and the type, size, and amount of gear to be used.
- The signature of the applicant *[PFMC West Coast Groundfish FMP, August 1990]*.

NOTE: The GMT, SSC, and/or Council may request additional information necessary for their consideration.

Review and Approval

The GMT and SSC will review EFP proposals in September and make recommendations to the Council for action; the Council will consider those proposals for preliminary action. Final action on EFPs will occur at the November Council meeting. Only those EFP applications that were considered in September may be considered in November; EFP applications received after the September Council meeting for the following calendar year will not be considered.

EFP proposals must contain a mechanism, such as at-sea fishery monitoring, to ensure the harvest limits for targeted and incidental species are not exceeded and are accurately accounted for. Also, EFP proposals must include a description of the proposed data collection and analysis methodology used to measure whether the EFP objectives will be met.

The Council will give priority consideration to those EFP applications that:
- Emphasize resource conservation and management with a focus on bycatch reduction
- Encourage full retention of fishery mortalities
- Involve data collection on fisheries stocks and/or habitat
- Encourage innovative gear modifications and/or development *[GMT report, October 2002]*

In its review, the GMT review will consider the following questions:
- Is the application complete?
- Is the EFP proposal consistent with the goals and objectives of the West Coast Groundfish FMP?
- Does the EFP account for fishery mortalities, by species?
- Are the harvest estimates of overfished species within the amounts set aside for EFP activities?
- Does the EFP meet one or more of the Council's priorities listed above?
- Is the EFP proposal compatible with the federal observer program effort?
- What infrastructure is in place to monitor, process data, and administer the EFP?
- How will achievement of the EFP objectives be measured?
- What is the funding source for at-sea monitoring?
- Has there been coordination with appropriate state and federal enforcement, management and science staff?

SSC Review:
- All EFP applications should first be evaluated by the GMT for consistency with the goals and objectives of the groundfish FMP and the Council's strategic plan for groundfish.
- When a proposal is submitted to the GMT that includes a significant scientific component that would benefit from SSC review, the GMT can refer the application to the SSC's groundfish subcommittee for comment.
- In such instances, the groundfish subcommittee will evaluate the scientific merits of the application and will specifically evaluate the application's (a) problem statement; (b) data collection methodology; (c) proposed analytical and statistical treatment of the data; and (d) the generality of the inferences that

could be drawn from the study. *[SSC report, April 2003]*

Other considerations:

- EFP candidates or participants may be denied future EFP permits under the following circumstances:

  If the applicant/participant (fisher/processor) has violated past EFP provisions; or has been convicted of a crime related to commercial fishing regulations punishable by a maximum penalty range exceeding $1,000 within the last three years; or within the last three years assessed a civil penalty related to violations of commercial fishing regulations in an amount greater than $5,000; or, has been convicted of any violation involving the falsification of fish receiving tickets including, but not limited to, mis-reporting or under-reporting of groundfish. Documented fish receiving tickets indicating mis-reporting or under-reporting of groundfish will not qualify for consideration when fish reporting documents are used as part of the qualifying criteria for EFPs. *[EC Report, April 2003]*

Report Contents

The EFP applicant must present a preliminary report on the results of the EFP and the data collected (including catch data) to the GMT at the **April** Council meeting of the following year. A final written report on the results of the EFP and the data collected must be presented to the GMT, SSC, and the Council at the September Council meeting. This final report should include a summary of the work completed, an analysis of the data collected, and conclusions and/or recommendations. Timely presentation of results is required to determine whether future EFPs will be recommended.

PFMC
06/02/03

Exhibit B.6.b
Supplemental GAP Report
June 2003

GROUNDFISH ADVISORY SUBPANEL STATEMENT ON STANDARDS AND CRITERIA FOR APPROVING EXEMPTED FISHING PERMITS

The Groundfish Advisory Subpanel (GAP) reviewed the proposed timetable and changes in Council operating procedures developed by the Groundfish Management Team (GMT) and provided in Exhibit B.6.b GMT Reports 1 through 3.

While the GAP generally agrees with the GMT recommendations, it suggests one modification to the timetable. As proposed, unused "set asides" are scheduled for release in April of each year. However, because the Council has adopted a system of using two, one-year optimum yields (OYs) within the two-year management process, it is unlikely we will know in April whether an exempted fishing permit (EFP) "set aside" will be fully used, especially for new EFPs and those that involve a summer-only fishery. The GAP recommends additional check points be established that will allow unused "set asides" to be released in time for any inseason adjustments that could occur for the remainder of the year.

An alternative could involve a roll-over of unused OY and EFP "set asides" to the second year of the two-year cycle, thus bringing us closer to true two-year management and allowing greater stability in the fisheries.

The GAP also suggests there is a policy issue implicit in the EFP process which must be considered by the Councils: at low OY levels, does the use of fish for EFPs "trump" the use of fish for directed fisheries and/or incidental catch in directed fisheries? The Council will need to keep this issue in mind each and every time it approves an EFP and develop some standards on how to weigh the costs and benefits of using scarce fish for EFPs versus directed fisheries.

PFMC
06/17/03

WASHINGTON DEPARTMENT OF FISH AND WILDLIFE
PRELIMINARY EXEMPTED FISHING PERMIT PROPOSALS FOR 2004

The Washington Department of Fish and Wildlife is considering applying for exempted fishing permits (EFPs) for the following fisheries for 2004:

Arrowtooth Flounder Trawl EFP With Specific Gear Requirements

In 2003, we are conducting an Arrowtooth Trawl EFP and are requiring participants to modify their gear for purposes of excluding overfished rockfish, while retaining targeted flatfish species. Following the EFP this year, we will work with the participants to define the various modifications that were used and evaluate which methods were most successful at excluding rockfish.

In 2004, we would require that EFP participants adhere to the gear standards and configurations developed by the group while targeting arrowtooth flounder in the rockfish conservation area (RCA).

Spiny Dogfish Longline EFP With Area Restrictions

In 2003, we had one participant in our Dogfish Longline EFP. Based on our preliminary review of the EFP catch data, we believe that he was able to successfully target dogfish while avoiding canary and yelloweye rockfish in certain areas.

In 2004, we would define those areas with coordinates and require that EFP participant restrict their harvest to those areas.

The implementation of these EFP proposals would be consistent with the Council standards and protocols. We would require 100% observer coverage, retention of all rockfish, and bycatch caps. Our proposed bycatch caps for 2004 would be the same as in 2003, with the exception of yelloweye rockfish in the Dogfish Longline EFP would be reduced from 2.0 mt to 1.0 mt. The following is a list of the proposed bycatch caps (mt) for these EFPs:

	Canary	Yeye	Darkbl	Widow	POP	Lingcod
Arrowtooth EFP	3.0	0.5	3.0	3.0	18.0	NA
Dogfish EFP	0.5	1.0	0.4	0.4	0.4	2.0

WDFW plans to meet with industry representatives regarding these preliminary EFP proposals. We will have more concrete proposals at the September Council meeting.

GMT RECOMMENDATIONS FOR INSEASON ADJUSTMENTS

Management Options - North of 40°10'

Trawl

1. Restore fishing area from 50 to 75 fms in:
   a. Period 4 (canary = 11.0 mt)

2. Change trip limits in Periods 4,5, & 6 to:

Large footrope	Small footrope
Sablefish - 9,000 lbs/2 mo. (from 10K)	Sablefish - (no change)
Dover - 34,000 lbs/2 mo (from 31K)	Dover - (no change)
Longspine - 11,500 lbs 2/mo (from 14K)	Longspine - 5,000 lbs/2 mo.
Shortspine - 2,400 lbs/2 mo (from 2,800)	Shortspine - 1,000 lbs/2 mo.

LE & OA Gear (non-trawl)

1. Nearshore Rockfish - Increase trip limit for minor nearshore rockfish from 3,000 lbs/2 mo. to 4,000 lbs/2 mo. of which no more than 1,200 lbs can be species other than black or blue rockfish (was 900 lbs) inside 27 fms between 40°10' and 46°10'.

Management Options - South of 40°10'

Trawl

1. Change trip limits to:

   Periods 4, 5 & 6 (same as large footrope in north)
   Sablefish - 9,000 lbs/2 mo.
   Dover - 34,000 lbs/2 mo
   Longspine - 11,500 lbs 2/mo
   Shortspine - 2,400 lbs/2 mo

Fixed Gear

1. Shallow Nearshore Rockfish changes
   a. Period 4 = 400 lbs/2 mo.; Period 5 = 300 lbs/2 mo.

2. Deep Nearshore Rockfish changes
   a. Period 4 = 500 lbs/2 mo.; Period 5 = 300 lbs/2 mo.

Groundfish Trawl and Exempted Trawl RCA boundaries

South of 40°10' and North of 34°27'
Move shoreward boundaries of the exempted trawl RCA and the groundfish trawl RCA to 60-200 fms (from 200 fms to shore) for remainder of the year.

South of 34°27'
Move shoreward boundaries of the exempted trawl RCA and the groundfish trawl RCA to 100-200 fms (from 200 fms to shore) for remainder of the year.

2003 landings data and projections supporting June inseason recommendations

Trawl projections

	Without Southern open inside 60 fm in Period 4 *		With Southern open inside 60 fm in Period 4	
	Canary	Bocaccio	Canary	Bocaccio
Move Northern inshore line to 75 fm				
Period 4 only	10.95	9.0	11.0	9.8
Periods 4 & 6	11.3	9.0	~~11.35~~	9.8
Available amount, given OR rec change	**11.3**	**10.3**	**11.3**	**10.3**

* The numbers increased slightly from Tuesday afternoon because the small footrope Dover limit had been errantly modeled as 10,000 lb per 2 months instead of the 12,500 lb per 2 months scheduled for periods 4-6.

Trawl landings

	QSM thru 5/24	Annual target	Pct. attainment
Longspine	654	2,029	32%
Shortspine	329	755	44%
Sablefish	671	2,364	28%
Dover sole	2,694	7,006	38%

Fixed-gear DTL sablefish fishery

Progress through May ~35%-40%

Expected through June ~45%-50%

Given the same limits throughout the year, July-December would be expected to contribute about half of the annual total

	QSM thru 5/24	Annual target	Pct. attainment
LE + OA Nearshore: North of 40o10'	50	186	27%
LE + OA Nearshore: South of 40o10'			
Shallow NS	6	38	16%
Deep NS	5	48	10%
CA Scorpionfish	0	21	0%

Table 3 (North). Trip Limits and Gear Requirements[1/] for Limited Entry Trawl Gear North of 40°10' N. Latitude[2/]

Other Limits and Requirements Apply -- Read Sections IV. A. and B. NMFS Actions before using this table

		JAN-FEB	MAR-APR	MAY-JUN	JUL-AUG	SEP-OCT	NOV-DEC
	Rockfish Conservation Area[10/] **(RCA):** North of 40°10' N. lat.	100 fm - 250 fm (line modified to incorporate petrale sole fishing grounds)	100 fm - 250 fm	50 fm - 200 fm	75 fm - 200 fm	50 fm - 200 fm	50 fm - 200 fm (line modified to incorporate petrale sole fishing grounds)
	Small footrope or midwater trawl gear is required shoreward of the RCA; all trawl gear (large footrope, midwater trawl, and small footrope gear) is permitted seaward of the RCA.						
	A vessel may have more than one type of limited entry bottom trawl gear on board, but the most restrictive trip limit associated with the gear on board applies for that trip and will count toward the cumulative trip limit for that gear. A vessel may not have limited entry bottom trawl gear on board if that vessel also has trawl gear on board that is permitted for use within a RCA, including limited entry midwater trawl gear, regardless of whether the vessel is intending to fish within a RCA on that fishing trip. **See IV.A.(14)(iv) for details.**						
1	**Minor slope rockfish**[3/]	1,800 lb/ 2 months					
2	**Pacific ocean perch**	3,000 lb/ 2 months					
3	**DTS complex**						
4	Sablefish	6,000 lb/ 2 months		9,000 lb/ 2 months providing that only large footrope or midwater trawl gear is used to land any groundfish species during the entire limit period. If small footrope gear is used at any time in any area (North or South, shoreward or seaward of RCA) during the entire limit period, then 3,000 lb/2 months.			
5	Longspine thornyhead	8,000 lb/ 2 months	9,000 lb/ 2 months	11,500 lb/ 2 months providing that only large footrope or midwater trawl gear is used to land any groundfish species during the entire limit period. If small footrope gear is used at any time in any area (North or South, shoreward or seaward of RCA) during the entire limit period, then the longspine thornyhead limit is 5000 lb/2 months.			
6	Shortspine thornyhead	2,300 lb/ 2 months	2,400 lb/ 2 months	2,400 lb/ 2 months providing that only large footrope or midwater trawl gear is used to land any groundfish species during the entire limit period. If small footrope gear is used at any time in any area (North or South, shoreward or seaward of RCA) during the entire limit period, then the shortspine thornyheads limit is 1,000 lb/2 months.			
7	Dover sole	26,000 lb/ 2 months		34,000 lb/ 2 months providing that only large footrope or midwater trawl gear is used to land any groundfish species during the entire limit period. If small footrope gear is used at any time in any area (North or South, shoreward or seaward of RCA) during the entire limit period, then the limits is 12,500 lb/2 months.			
8	**Flatfish**						
9	All other flatfish[4/]	100,000 lb/ 2 months	All other flatfish plus petrale & rex sole: 100,000 lb/ 2 months, no more than 30,000 lb/ 2 months of which may be petrale sole providing that only large footrope or midwater trawl gear is used to land any groundfish species during the entire limit period. If small footrope gear is used at any time in any area (North or South, inshore or offshore of RCA) during the entire limit period, then 20,000 lb/ 2 months, no more than 10,000 lb/ 2 months of which may be petrale sole.				100,000 lb/ 2 months
10	Petrale sole	Not limited					Not limited
11	Rex sole	Included in all other flatfish					
12	Arrowtooth flounder	30,000 lb/ trip	200,000 lb/ 2 months providing that only large footrope or midwater trawl gear is used to land any groundfish species during the entire limit period. If small footrope gear is used at any time in any area (North or South, inshore or offshore of RCA) during the entire limit period, then 5,000 lb/2 mo.				
13	**Whiting**[5/]	20,000 lb/ trip		Primary Season (only mid-water trawl permitted in the RCA)		10,000 lb/ trip	
14	**Other Fish**[9/]	Not limited					
15	**Use of small footrope bottom trawl**[7/] **or mid-water trawl is required for landing all of the following species:**						
16	**Minor shelf rockfish and widow rockfish**[3/]	300 lb/ month		1,000 lb/ month, no more than 200 lb/ month of which may be yelloweye rockfish			300 lb/ month
17	**Widow rockfish**						
18	mid-water trawl - permitted within the RCA	CLOSED[6/]		During primary whiting season, in trips of at least 10,000 lb of whiting: combined widow and yellowtail limit of 500 lb/ trip, cumulative widow limit of 1,500 lb/ month		CLOSED[6/]	12,000 lb/ 2 months
19	**Canary rockfish**	100 lb/ month		300 lb/ month		100 lb/ month	
20	**Yellowtail**						
21	mid-water trawl - permitted within the RCA	CLOSED[6/]		During primary whiting season, in trips of at least 10,000 lb of whiting: combined widow and yellowtail limit of 500 lb/ trip, cumulative yellowtail limit of 2,000 lb/ month			18,000 lb/ 2 months
22	small footrope trawl[7/]	In landings without flatfish, 1,000 lb/ month. As flatfish bycatch, per trip limit is the sum of 33% (by weight) of all flatfish except arrowtooth flounder, plus 10% (by weight) of arrowtooth flounder. Total yellowtail landings not to exceed 10,000 lb/ 2 months, no more than 1,000 lb of which may be landed without flatfish.					
23	**Minor nearshore rockfish**	300 lb/ month					
24	**Lingcod**[8/]	800 lb/ 2 months		1,000 lb/ 2 months		800 lb/ 2 months	

1/ Gear requirements and prohibitions are explained above. See IV. A.(14).

2/ "North" means 40°10' N. lat. to the U.S.-Canada border. 40°10' N. lat. is about 20 nm south of Cape Mendocino, CA.

3/ Bocaccio and chilipepper are included in the trip limits for minor shelf rockfish and splitnose rockfish is included in the trip limits for minor slope rockfish.

4/ "Other" flatfish means all flatfish at 50 CFR 660.302 except those in this Table 3 with species specific management measures, including trip limits.

5/ The whiting "per trip" limit in the Eureka area shoreward of 100 fm is 10,000 lb/ trip throughout the year. Outside Eureka area, the 20,000 lb/ trip limit applies. See IV. B.(3).

6/ Closed means that it is prohibited to take and retain, possess, or land the designated species in the time or area indicated. See IV. A.(7).

7/ Small footrope trawl means a bottom trawl net with a footrope no larger than 8 inches (20 cm) in diameter.

8/ The minimum size limit for lingcod is 24 inches (61 cm) total length.

9/ Other fish are defined at 50 CFR 660.302, as those groundfish species or species groups for which there is no trip limit, size limit, quota, or harvest guideline.

10/ The "Rockfish Conservation Area" is a gear and/or sector specific closed area generally described by depth contours but specifically defined by lat/long coordinates set out at IV. A.(19)(e), that may vary seasonally.

To convert pounds to kilograms, divide by 2.20462, the number of pounds in one kilogram.

Table 3 (South). Trip Limits and Gear Requirements[1/] for Limited Entry Trawl Gear South of 40°10' N. Latitude[2/]

Other Limits and Requirements Apply -- Read Sections IV. A. and B. NMFS Actions before using this table

	JAN-FEB	MAR-APR	MAY-JUN	JUL-AUG	SEP-OCT	NOV-DEC
Rockfish Conservation Area[10/] (RCA):						
40°10' - 38° N. lat.	50 fm - 250 fm (line modified to incorporate petrale sole fishing grounds)	60 fm - 250 fm	60 fm - 200 fm	60 fm - 200 fm	60 fm - 200 fm	60 fm - 200 fm (line modified to incorporate petrale sole fishing grounds)
38° - 34°27' N. lat.	50 fm - 150 fm	60 fm - 150 fm	60 fm - 200 fm	60 fm - 200 fm	60 fm - 200 fm	60 fm - 200 fm (line modified to incorporate petrale sole fishing grounds)
South of 34°27' N. lat.	100 fm - 150 fm along the mainland coast; shoreline - 150 fm around islands		100 fm - 200 fm along the mainland coast; shoreline - 200 fm around islands	60 fm - 200 fm	100 fm - 200 fm along the mainland coast; shoreline - 200 fm around islands	100 fm - 200 fm along the mainland coast; shoreline - 200 fm around islands (line modified to incorporate petrale sole fishing grounds)

Small footrope or midwater trawl gear is required shoreward of the RCA; all trawl gear (large footrope, midwater trawl, and small footrope gear) is permitted seaward of the RCA.

A vessel may have more than one type of limited entry bottom trawl gear on board, but the most restrictive trip limit associated with the gear on board applies for that trip and will count toward the cumulative trip limit for that gear. A vessel may not have limited entry bottom trawl gear on board if that vessel also has trawl gear on board that is permitted for use within a RCA, including limited entry midwater trawl gear, regardless of whether the vessel is intending to fish within a RCA on that fishing trip. **See IV.A.(14)(iv) for details.**

		JAN-FEB	MAR-APR	MAY-JUN	JUL-AUG	SEP-OCT	NOV-DEC
1	**Minor slope rockfish[3/]**						
2	40°10' - 38° N. lat.	1,800 lb/ 2 months					
3	South of 38° N. lat.	30,000 lb/ 2 months					
4	**Splitnose**						
5	40°10' - 38° N. lat.	1,800 lb/ 2 months					
6	South of 38° N. lat.	30,000 lb/ 2 months					
7	**DTS complex**						
8	Sablefish	6,000 lb/ 2 months		10,000 lb/ 2 months	9,000 lb/ 2 months		
9	Longspine thornyhead	8,000 lb /2 months	9,000 lb/ 2 months	14,000 lb/ 2 months	11,500 lb/ 2 months		
10	Shortspine thornyhead	2,300 lb/ 2 months	2,400 lb/ 2 months	2,800 lb/ 2 months	2,400 lb/ 2 months		
11	Dover sole	26,000 lb/ 2 months		31,000 lb/ 2 months	34,000 lb/ 2 months		
12	**Flatfish**						
13	All other flatfish[4/]	70,000 lb/ 2 months	All other flatfish plus petrale & rex sole: 70,000 lb/ 2 months, no more than 20,000 lb/ 2 months of which may be petrale sole				70,000 lb/ 2 months
14	Petrale sole	No limit					No limit
15	Rex sole	Included in all other flatfish					
16	Arrowtooth flounder	No limit	1,000 lb/ 2 months				No limit
17	**Whiting[5/]**	20,000 lb/ trip		Primary Season (only mid-water trawl permitted within the RCA)		10,000 lb/ trip	
18	**Other Fish[9/]**	Not limited					
19	**Use of small footrope bottom trawl[7/] or mid-water trawl is required for landing all of the following species:**						
20	**Minor shelf rockfish, widow, and chilipepper rockfish[3/]**	300 lb/ month					
21	**Widow rockfish**						
22	mid-water trawl - permitted within the RCA	CLOSED[6/]					12, 000 lb/ 2 months
23	**Canary rockfish**	100 lb/ month		300 lb/ month		100 lb/ month	
24	**Bocaccio**	CLOSED[6/]					
25	**Cowcod**	CLOSED[6/]					
26	**Minor nearshore rockfish**	300 lb/ month					
27	**Lingcod[8/]**	800 lb/ 2 months		1,000 lb/ 2 months		800 lb/ 2 months	

1/ Gear requirements and prohibitions are explained above. See IV. A.(14).

2/ "South" means 40°10' N. lat. to the U.S.-Mexico border. 40°10' N. lat. is about 20 nm south of Cape Mendocino, CA.

3/ Yellowtail is included in the trip limits for minor shelf rockfish and POP is included in the trip limits for minor slope rockfish.

4/ "Other" flatfish means all flatfish at 50 CFR 660.302 except those in this Table 3 with species specific management measures, including trip limits.

5/ The whiting "per trip" limit in the Eureka area shoreward of 100 fm is 10,000 lb/ trip throughout the year. Outside Eureka area, the 20,000 lb/ trip limit applies. See IV. B.(3).

6/ Closed means that it is prohibited to take and retain, possess, or land the designated species in the time or area indicated. See IV. A.(7).

7/ Small footrope trawl means a bottom trawl net with a footrope no larger than 8 inches (20 cm) in diameter.

8/ The minimum size limit for lingcod is 24 inches (61 cm) total length.

9/ Other fish are defined at 50 CFR 660.302, as those groundfish species or species groups for which there is no trip limit, size limit, quota, or harvest guideline.

10/ The "Rockfish Conservation Area" is a gear and/or sector specific closed area generally described by depth contours but specifically defined by lat./long. coordinates set out at IV. A.(19)(e), that may vary seasonally.

To convert pounds to kilograms, divide by 2.20462, the number of pounds in one kilogram.

Table 4 (North). Trip Limits for Limited Entry Fixed Gear North of 40°10' N. Latitude[1/]

Other Limits and Requirements Apply -- Read Sections IV. A. and B. NMFS Actions before using this table

	JAN-FEB	MAR-APR	MAY-JUN	JUL-AUG	SEP-OCT	NOV-DEC
Rockfish Conservation Area[8/] (RCA):						
North of 46°16' N. lat.	shoreline - 100 fm					
46°16' N. lat. - 40°10' N. lat.	27 fm - 100 fm					
1 **Minor slope rockfish[4/]**	1,800 lb/ 2 months	No more than 25% of the weight of sablefish landed/ trip				1,800 lb/ 2 months
2 **Pacific ocean perch**	1,800 lb/ 2 months					
3 **Sablefish**	300 lb/ day, or 1 landing per week of up to 800 lb, not to exceed 3,200 lb/ 2 months					
4 **Longspine thornyhead**	9,000 lb/ 2 months					
5 **Shortspine thornyhead**	2,000 lb/ 2 months					
6 **Dover sole**	5,000 lb/ month					
7 **Arrowtooth flounder**						
8 **Petrale sole**						
9 **Rex sole**						
10 **All other flatfish[2/]**						
11 **Whiting[3/]**	10,000 lb/ trip					
12 **Minor shelf rockfish, widow, and yellowtail rockfish[4/]**	200 lb/ month					
13 **Canary rockfish**	CLOSED[5/]					
14 **Yelloweye rockfish**	CLOSED[5/]					
15 **Cowcod**	CLOSED[5/]					
16 **Minor nearshore rockfish**	4,000 lb/ 2 months, no more than 1,200 lb of which may be species other than black or blue rockfish[6/]					
17 **Lingcod[7/]**	CLOSED[5/]		400 lb/ month			CLOSED[5/]
18 **Other fish[9/]**	Not limited					

1/ "North" means 40°10' N. lat. to the U.S.-Canada border. 40°10' N. lat. is about 20 nm south of Cape Mendocino, CA.

2/ "Other flatfish" means all flatfish at 50 CFR 660.302 except those in this Table 4 with species specific management measures, including trip limits.

3/ TThe whiting "per trip" limit in the Eureka area shoreward of 100 fm is 10,000 lb/ trip throughout the year. Outside Eureka area, the 20,000 lb/ trip limit applies. See IV. B.(3).

4/ Bocaccio and chilipepper are included in the trip limits for minor shelf rockfish and splitnose rockfish is included in the trip limits for minor slope rockfish.

5/ Closed means that it is prohibited to take and retain, possess, or land the designated species in the time or area indicated. See IV. A.(7).

6/ For black rockfish north of Cape Alava (48°09'30" N. lat.), and between Destruction Island (47°40'00" N. lat.) and Leadbetter Point (46°38'10" N. lat.), there is an additional limit of 100 lb or 30 percent by weight of all fish on board, whichever is greater, per vessel, per fishing trip.

7/ The minimum size limit for lingcod is 24 inches (61 cm) total length.

8/ The "Rockfish Conservation Area" is a gear and/or sector specific closed area generally described by depth contours but specifically defined by lat./long. coordinates set out at IV. A.(19)(e), that may vary seasonally.

9/ Other fish are defined at 50 CFR 660.302, as those groundfish species or species groups for which there is no trip limit, size limit, quota, or harvest guideline.

To convert pounds to kilograms, divide by 2.20462, the number of pounds in one kilogram.

Table 4 (South). Trip Limits for Limited Entry Fixed Gear South of 40°10' N. Latitude[1/]

Other Limits and Requirements Apply -- Read Sections IV. A. and B. NMFS Actions before using this table

		JAN-FEB	MAR-APR	MAY-JUN	JUL-AUG	SEP-OCT	NOV-DEC
	Rockfish Conservation Area[7/] (RCA): South of 40°10' N. lat.	20 fm - 150 fm			20 fm - 150 fm (See footnote 9 for description of Pt. Fermin/Newport South Jetty open area)	20 fm - 150 fm	
1	**Minor slope rockfish[4/]**						
2	40°10' - 38° N. lat.	1,800 lb/ 2 months	No more than 25% of weight of sablefish landed/ trip				1,800 lb/ 2 months
3	South of 38° N. lat.	30,000 lb/ 2 months					
4	**Splitnose**						
5	40°10' - 38° N. lat.	1,800 lb/ 2 months					
6	South of 38° N. lat.	20,000 lb/ 2 months					
7	**Sablefish**						
8	40°10' - 36° N. lat.	300 lb/ day, or 1 landing per week of up to 800 lb, not to exceed 3,200 lb/ 2 months					
9	South of 36° N. lat.	350 lb/ day, or 1 landing per week of up to 1,050 lb					
10	**Longspine thornyhead**	9,000 lb/ 2 months					
11	**Shortspine thornyhead**	2,000 lb/ 2 months					
12	**Dover sole**	5,000 lb/ month When fishing for Pacific sanddabs, vessels using hook-and-line gear with no more than 12 hooks per line, using hooks no larger than "Number 2" hooks, which measure 11 mm (0.44 inches) point to shank, and up to 1 lb (0.45 kg) of weight per line are not subject to the RCAs.					
13	**Arrowtooth flounder**						
14	**Petrale sole**						
15	**Rex sole**						
16	**All other flatfish[2/]**						
17	**Whiting[3/]**	10,000 lb/ trip					
18	**Minor shelf rockfish, widow, and yellowtail rockfish[4/]**	100 lb/ 2 month	CLOSED[5/]	200 lb/ 2 months	250 lb/ 2 months	200 lb/ 2 months	100 lb/ 2 months
19	**Canary rockfish**	CLOSED[5/]					
20	**Yelloweye rockfish**	CLOSED[5/]					
21	**Cowcod**	CLOSED[5/]					
22	**Bocaccio**	CLOSED[5/]					
23	**Minor nearshore rockfish**						
24	Shallow nearshore	200 lb/ 2 months	CLOSED[5/]	400 lb/ 2 months	400 lb/ 2 months	300 lb/ 2 months	200 lb/ 2 months
25	Deep nearshore	200 lb/ 2 months		200 lb/ 2 months	500 lb/ 2 months	300 lb/ 2 months	200 lb/ 2 months
26	California scorpionfish	CLOSED[5/]		800 lb/ 2 months		CLOSED[5/]	
27	**Lingcod[6/]**	CLOSED[5/]		400 lb/ month, when nearshore open			CLOSED[5/]
28	**Other fish[8/]**	Not limited					

1/ "South" means 40°10' N. lat. to the U.S.-Mexico border. 40°10' N. lat. is about 20 nm south of Cape Mendocino, CA.

2/ "Other flatfish" means all flatfish at 50 CFR 660.302 except those in this Table 4 with species specific management measures, including trip limits.

3/ The whiting "per trip" limit in the Eureka area shoreward of 100 fm is 10,000 lb/ trip throughout the year. Outside Eureka area, the 20,000 lb/ trip limit applies. See IV. B.(3).

4/ Chilipepper rockfish is included in the trip limits for minor shelf rockfish and POP is included in the trip limits for minor slope rockfish.

5/ Closed means that it is prohibited to take and retain, possess, or land the designated species in the time or area indicated. See IV. A.(7).

6/ The minimum size limit for lingcod is 24 inches (61 cm) total length.

7/ The "Rockfish Conservation Area" is a gear and/or sector specific closed area generally described by depth contours but specifically defined by lat/long coordinates set out at IV. A.(19)(e) that may vary seasonally.

8/ Other fish are defined at 50 CFR 660.302, as those groundfish species or species groups for which there is no trip limit, size limit, quota, or harvest guideline.

9/ During July-August, between a line drawn due south from Point Fermin (33° 42' 30" N. lat.; 118° 17' 30" W. long.) and a line drawn due west from the Newport South Jetty (33° 35' 37" N .lat.; 117° 52' 50" W. long.,) vessels fishing for all federal groundfish species, except all rockfish and lingcod, with hook&line and/or trap (or pot) gear may operate from shore to a boundary line approximating 50 fm.

To convert pounds to kilograms, divide by 2.20462, the number of pounds in one kilogram.

Table 5 (South). 2003 Trip Limits for Open Access Gears South of 40°10' N. Latitude[1/]

Other Limits and Requirements Apply -- Read Sections IV. A. and C. NMFS Actions before using this table

		JAN-FEB	MAR-APR	MAY-JUN	JUL-AUG	SEP-OCT	NOV-DEC
	Rockfish Conservation Area[7/] (RCA): South of 40°10' N. lat.	20 fm - 150 fm			20 fm - 150 fm (See footnote 8 for description of Pt. Fermin/Newport South Jetty open area)	20 fm - 150 fm	
1	**Minor slope rockfish[2/]**						
2	40°10' - 38° N. lat.	Per trip, no more than 25% of weight of the sablefish landed					
3	South of 38° N. lat.	10,000 lb/ 2 months					
4	**Splitnose**	200 lb/ month					
5	**Sablefish**						
6	40°10' - 36° N. lat.	300 lb/ day, or 1 landing per week of up to 800 lb, not to exceed 3,200 lb/ 2 months					
7	South of 36° N. lat.	350 lb/ day, or 1 landing per week of up to 1,050 lb					
8	**Thornyheads**						
9	40°10' - 34°27' N. lat.	CLOSED[5/]					
10	South of 34°27' N. lat.	50 lb/ day, no more than 2,000 lb/ 2 months					
11	**Dover sole**	3,000 lb/month, no more than 300 lb of which may be species other than Pacific sanddabs. When fishing for Pacific sanddabs, vessels using hook-and-line gear with no more than 12 hooks per line, using hooks no larger than "Number 2" hooks, which measure 11 mm (0.44 inches) point to shank, and up to 1 lb of weight per line are not subject to the RCAs.					
12	**Arrowtooth flounder**						
13	**Petrale sole**						
14	**Rex sole**						
15	**All other flatfish[3/]**						
16	**Whiting**	300 lb/ month					
17	**Minor shelf rockfish, widow and chilipepper rockfish[2/]**	100 lb/ 2 month	CLOSED[5/]	200 lb/ 2 months	250 lb/ 2 months	200 lb/ 2 months	100 lb/ 2 months
18	**Canary rockfish**	CLOSED[5/]					
19	**Yelloweye rockfish**	CLOSED[5/]					
20	**Cowcod**	CLOSED[5/]					
21	**Bocaccio**	CLOSED[5/]					
22	**Minor nearshore rockfish**						
23	Shallow nearshore	200 lb/ 2 months	CLOSED[5/]	400 lb/ 2 months	400 lb/ 2 months	300 lb/ 2 months	200 lb/ 2 months
24	Deep nearshore	200 lb/ 2 months		200 lb/ 2 months	500 lb/ 2 months	300 lb/ 2 months	200 lb/ 2 months
25	California scorpionfish	CLOSED[5/]		800 lb/ 2 months		CLOSED[5/]	
26	**Lingcod[4/]**	CLOSED[5/]		300 lb/ month, when nearshore open			CLOSED[5/]
27	**Other Fish[6/]**	Not limited					
28	**PINK SHRIMP EXEMPTED TRAWL GEAR** *(not subject to RCAs)*						
29	South	**Effective April 1 - October 31, 2003:** Groundfish 500 lb/day, multiplied by the number of days of the trip, not to exceed 1,500 lb/trip. The following sublimits also apply and are counted toward the overall 500 lb/day and 1,500 lb/trip groundfish limits: lingcod 300 lb/ month (minimum 24 inch size limit); sablefish 2,000 lb/ month; canary, thornyheads and yelloweye rockfish are PROHIBITED. All other groundfish species taken are managed under the overall 500 lb/day and 1,500 lb/trip groundfish limits. Landings of these species count toward the per day and per trip groundfish limits and do not have species-specific limits. The amount of groundfish landed may not exceed the amount of pink shrimp landed.					
30	**PRAWN AND, SOUTH OF 38°57'30" N. LAT., CALIFORNIA HALIBUT AND SEA CUCUMBER EXEMPTED TRAWL**						
31	**EXEMPTED TRAWL Rockfish Conservation Area[8/] (RCA):**						
32	40°10' - 38° N. lat.	50 fm - 250 fm	60 fm - 250 fm	60 fm - 200 fm			
33	38° - 34°27' N. lat.	50 fm - 150 fm	60 fm - 150 fm	60 fm - 200 fm			
34	South of 34°27' N. lat.	100 fm - 150 fm along the mainland coast; shoreline - 150 fm around islands		100 fm - 200 fm along the mainland coast; shoreline - 200 fm around islands			
35		Groundfish 300 lb/trip. Trip limits in this table also apply and are counted toward the 300 lb groundfish per trip limit. The amount of groundfish landed may not exceed the amount of the target species landed, except that the amount of spiny dogfish landed may exceed the amount of target species landed. Spiny dogfish are limited by the 300 lb/trip overall groundfish limit. The daily trip limits for sablefish coastwide and thornyheads south of Pt. Conception and the overall groundfish "per trip" limit may not be multiplied by the number of days of the trip. Vessels participating in the California halibut fishery south of 38°57'30" N. lat. are allowed to (1) land up to 100 lb/day of groundfish without the ratio requirement, provided that at least one California halibut is landed and (2) land up to 3,000 lb/month of flatfish, no more than 300 lb of which may be species other than Pacific sanddabs, sand sole, starry flounder, rock sole, curlfin sole, or California scorpionfish (California scorpionfish is also subject to the trip limits and closures in line 25).					

1/ "South" means 40°10' N. lat. to the U.S.-Mexico border. 40°10' N. lat. is about 20 nm south of Cape Mendocino, CA.

2/ Yellowtail rockfish is included in the trip limits for minor shelf rockfish and POP is included in the trip limits for minor slope rockfish.

3/ "Other flatfish" means all flatfish at 50 CFR 660.302 except those in this Table 5 with species specific management measures, including trip limits.

4/ The size limit for lingcod is 24 inches (61 cm) total length.

5/ Closed means that it is prohibited to take and retain, possess, or land the designated species in the time or area indicated. See IV. A.(7).

6/ Other fish are defined at 50 CFR 660.302, as those groundfish species or species groups for which there is no trip limit, size limit, quota, or harvest guideline.

7/ The "Rockfish Conservation Area" is a gear and/or sector specific closed area generally described by depth contours, but specifically defined by lat./long. coordinates set out at IV. A.(19)(e), that may vary seasonally.

8/ During July-August, between a line drawn due south from Point Fermin (33° 42' 30" N. lat.; 118° 17' 30" W. long.) and a line drawn due west from the Newport South Jetty (33° 35' 37" N .lat.; 117° 52' 50" W. long.,) vessels fishing for all federal groundfish species, except all rockfish and lingcod, with hook&line and/or trap (or pot) gear may operate from shore to a boundary line approximating 50 fm.

To convert pounds to kilograms, divide by 2.20462, the number of pounds in one kilogram.

able 5 (North). 2003 Trip Limits for Open Access Gears North of 40°10' N. Latitude[1/]

Other Limits and Requirements Apply -- Read Sections IV. A. and C. NMFS Actions before using this table

	JAN-FEB	MAR-APR	MAY-JUN	JUL-AUG	SEP-OCT	NOV-DEC
ockfish Conservation Area[8/] (RCA):						
North of 46°16' N. lat.	0 fm - 100 fm					
46°16' N. lat. - 40°10' N. lat.	27 fm - 100 fm					
1 **Minor slope rockfish[2/]**	Per trip, no more than 25% of weight of the sablefish landed					
2 **Pacific ocean perch**	100 lb/ month					
3 **Sablefish**	300 lb/ day, or 1 landing per week of up to 800 lb, not to exceed 3,200 lb/ 2 months					
4 **Thornyheads**	CLOSED[5/]					
5 **Dover sole**	3,000 lb/month, no more than 300 lb of which may be species other than Pacific sanddabs.					
6 **Arrowtooth flounder**						
7 **Petrale sole**						
8 **Rex sole**						
9 **All other flatfish[3/]**						
10 **Whiting**	300 lb/ month					
11 **Minor shelf rockfish, widow and yellowtail rockfish[2/]**	200 lb/ month					
12 **Canary rockfish**	CLOSED[5/]					
13 **Yelloweye rockfish**	CLOSED[5/]					
14 **Cowcod**	CLOSED[5/]					
15 **Minor nearshore rockfish**	4,000 lb/ 2 months, no more than 1,200 lb of which may be species other than black or blue rockfish[4/]					
16 **Lingcod[6/]**	CLOSED[5/]		300 lb/ month			CLOSED[5/]
17 **Other Fish[7/]**	Not limited					
18 **PINK SHRIMP EXEMPTED TRAWL** *(not subject to RCAs)*						
19 North	**Effective April 1 - October 31, 2003:** groundfish 500 lb/day, multiplied by the number of days of the trip, not to exceed 1,500 lb/trip. The following sublimits also apply and are counted toward the overall 500 lb/day and 1,500 lb/trip groundfish limits: lingcod 300 lb/month (minimum 24 inch size limit); sablefish 2,000 lb/month; canary, thornyheads and yelloweye rockfish are PROHIBITED. All other groundfish species taken are managed under the overall 500 lb/day and 1,500 lb/trip groundfish limits. Landings of these species count toward the per day and per trip groundfish limits and do not have species-specific limits. The amount of groundfish landed may not exceed the amount of pink shrimp landed.					
20 **PRAWN EXEMPTED TRAWL** *(not subject to RCAs)*						
21 North	Groundfish 300 lb/trip. Limits and closures in this table also apply and are counted toward the 300 lb groundfish per trip limit. The amount of groundfish landed may not exceed the amount of the target species landed, except that the amount of spiny dogfish landed may exceed the amount of target species landed. Spiny dogfish are limited by the 300 lb/trip overall groundfish limit. The daily trip limits for sablefish coastwide and the overall groundfish "per trip" limit may not be multiplied by the number of days of the trip.					
22 **SALMON TROLL**						
23 North	Salmon trollers may retain and land up to 1lb of yellowtail rockfish for every 2 lbs of salmon landed, with a cumulative limit of 200 lb/month, both within and outside of the RCA. This limit is within the 200 lb per month combined limit for minor shelf rockfish, widow rockfish and yellowtail rockfish, and not in addition to that limit. All groundfish species are subject to the open access limits, seasons and RCA restrictions listed in the table above.					

1/ "North" means 40°10' N. lat. to the U.S.-Canada border. 40°10' N. lat. is about 20 nm south of Cape Mendocino, CA.

2/ Bocaccio and chilipepper rockfishes are included in the trip limits for minor shelf rockfish and splitnose rockfish is included in the trip limits for minor slope rockfish.

3/ "Other flatfish" means all flatfish at 50 CFR 660.302 except those in this Table 5 with species specific management measures, including trip limits.

4/ For black rockfish north of Cape Alava (48°09'30" N. lat.), and between Destruction Island (47°40' N. lat.) and Leadbetter Point (46°38'10" N. lat.), there is an additional limit of 100 lbs or 30 percent by weight of all fish on board, whichever is greater, per vessel, per fishing trip.

5/ Closed means that it is prohibited to take and retain, possess, or land the designated species in the time or area indicated. See IV. A.(7).

6/ The size limit for lingcod is 24 inches (61 cm) total length.

7/ Other fish are defined at 50 CFR 660.302, as those groundfish species or species groups for which there is no trip limit, size limit, quota, or harvest guideline.

8/ The "Rockfish Conservation Area" is a gear and/or sector specific closed area generally described by depth contours, but specifically defined by lat./long. coordinates set out at IV. A.(19)(e), that may vary seasonally.

To convert pounds to kilograms, divide by 2.20462, the number of pounds in one kilogram.

GROUNDFISH MANAGEMENT TEAM REPORT ON FINAL ACTION ON GROUNDFISH INSEASON MANAGEMENT

The Groundfish Management Team (GMT) reviewed the assumptions, methods, and results of the California Department of Fish and Game analysis for shifting the depth line for recreational and fixed gear from 20 fm to 30 fm for two areas south of 36° N latitude. Overall, the GMT believes the methodology used for the analysis yields reasonable estimates of total mortality for canary and bocaccio rockfish. Given changes in current and anticipated effort, the lack of historical catch per unit of effort (CPUE) estimates from the data analyzed is of concern, and further evaluation of CPUE is appropriate for the necessary National Environmental Policy Act (NEPA) analysis.

Consideration of an associated sport bag sub-limit of one bocaccio, and increase in the commercial shelf trip limits must include analysis of how this would impact targeting of these species. In particular, an increase in the shelf trip limit may lead to increased targeting of shelf rockfish leading to a higher take of bocaccio and canary than currently analyzed. Current California efforts to restrict individual permits to one nearshore rockfish trip limit would not also limit an individual’s ability to take multiple shelf rockfish trip limits. The GMT is hesitant to endorse an increase in shelf trip limits as part of as part of the final action.

PFMC
06/19/03

STATEMENT OF THE GROUNDFISH MANAGEMENT TEAM ON INSEASON ADJUSTMENTS

Updated Bycatch Scorecard Based on Council Inseason Action (6/19/03)

Estimated mortality (mt) of overfished West Coast groundfish species by fishery in 2003.

Fishery	Bocaccio *1/*	Canary	Cowcod	Dkbl	Lingcod 7/	POP	Whiting	Widow	Yelloweye
Limited Entry Groundfish									
Trawl- Non-whiting *2/*	9.8	11.0		88.0	77.0	65.5	1,800	1.4	0.6
Trawl- at-sea whiting 2a/		4.1		5.0	0.3	9.0	95,300	182.0	0.0
Trawl- shoreside whiting		0.5		1.5	0.2	0.2	50,900	30.0	
Fixed Gear	1.05	0.66	0.1		20.0				1.0
Recreational Groundfish									
WA		1.5			35.0				3.5
OR		9.6			105.0			4.0	3.7
CA (N)		0.5			195.0			1.0	0.1
CA (S)	6.27	2.77			20.0			0.0	0.4
Tribal									
Midwater Trawl		1.1		0.0	0.0	0.0	0	45.0	0.0
Bottom Trawl				0.0	4.5	0.0			
Troll		0.5		0.0	0.9	0.0			0.1
Fixed gear		0.7		0.0	5.5	0.0		0.0	3.0
Open Access									
Groundfish directed	0.2	0.3	0.0		50.0				0.5
CA Halibut	0.5	0.1	0.1	0.0	0.0	0.0	0	0.0	0.1
CA Gillnet *3/*	0.5								
CA Sheepshead *3/*									
CPS- wetfish *3/*	0.5								
CPS- squid *4/ 5/*									
Dungeness crab *3/*				0.0					
HMS *3/*		0.0	0.0	0.0					
Pacific Halibut *3/*	0.0	0.0		0.0	UR	0.0	0	0.0	0.5
Pink shrimp	0.1	0.5		0.0	0.5	0.0	1	0.1	0.1
Ridgeback prawn	0.1	0.0	0.0	0.0	0.0	0.0	0	0.0	0.0
Salmon troll	0.2	1.6			0.3			0.0	0.2
Sea Cucumber	0.0	0.0	0.0	0.0	0.0	0.0	0	0.0	0.0
Spot Prawn (trawl)									
Spot Prawn (trap)									
Research: Based on 2 most recent NMFS trawl shelf and slope surveys, the IPHC halibut survey, and LOAs with expanded estimates for south of Pt. Conception.									
	2.0	1.0		1.6	3.0	3.0	200	1.5	0.8
EFPs: *6/*									
CA: NS FF trawl	0.5	0.5	0.2		20.0				0.5
OR: selective FF trawl		4.0		3.1	13.0			1.0	1.2
WA: AT trawl		3.0		3.0	2.0	10.0		3.0	0.4
WA: dogfish LL		0.0		0.0	0.0	0.0	0	0.0	0.0
WA: pollock		0.0		0.0	0.0	0.0	0	0.0	0.0
EFP Subtotal		7.5		6.1	35.0	10.0	0.0	4.0	2.1
TOTAL	21.72	43.93	0.4	102.2	552.2	87.7	148,200	269.0	16.7
2003 OY	< 20	44.0	2.4	172.0	651.0	377.0	148,200	832.0	22.0

Shaded cells represent either NA- Not applicable; TR- Trace amount (<0.01 mt); UR- Not reported in available data sources.
1/ South of 40°10' N. lat.
2/ Using observer data, all landings are results of modeling GMT Option 1
2a/ Calculated using five-year average (1998-2002); includes tribal at-sea whiting
3/ Mortality estimates are not hard numbers, based on their GMT's best professional judgement.
4/ Bycatch amounts by species unavailable, but bocaccio occurred in 0.1% of all port samples and other rockfish in another 0.1% of all port samples (and squid fisheries usually land their whole catch). In 2001, out of 84,000 mt total landings 1 mt was groundfish. This suggests that total bocaccio was caught in trace amounts.
5/ Expected landed catch only. Discard/total mortality estimates not available.
6/ The Council capped the 2003 canary rockfish set-aside for all the EFPs in combination at 7.5 mt to derive an expected total catch of 44 mt of canary rockfish in 2003.
7/ Lingcod total reflects total catch, not mortality

STATEMENT OF THE GROUNDFISH MANAGEMENT TEAM ON INSEASON ADJUSTMENTS

Summary of Impacts for Bocaccio and Canary Rockfish
Resulting from Council Inseason Action (6/19/03)

Bocaccio		
Move shallow line for trawl to 60 fms south of 40o10' in Period 4		0.8
Move shallow line for recreational to 30 fms south of 34o27' (Sep-Dec)*		1.27
Move shallow line for commercial FG & OA to 30 fms south of 34o27' (Sep-Dec)*		0.95
	Subtotal	3.02
	Previous Balance	18.7
	Total	**21.72**

Canary		
Move shallow line for trawl to 75 fms north of 40o10' in Period 4		2.85
Move shallow line for trawl to 60 fms south of 40o10' in Period 4		0.05
Move shallow line for recreational to 30 fms south of 34o27' (Sep-Dec)		0.07
Move shallow line for commercial FG & OA to 30 fms south of 34o27' (Sep-Dec)		0.16
	Subtotal	3.13
	Previous Balance	40.8
	Total	**43.93**

* NOTE: The GMT reviewed the methodology for the analysis that produced these results and believes these results to be reasonable. CDFG staff expressed that these should be considered maximum values as there have been many regulatory changes to the CA recreational and commercial fixed gear and open access fisheries since the base periods that were used (1993-99 for recreational and 1995-99 for commercial). These changes include additional closed areas to protect rockfish (e.g., Cowcod Conservation Area); reduction in rockfish bag limit from 15 to 10; number of hooks allowed reduced from 5 (or higher) to 2; and significantly reduced commercial fishing opportunity for shelf rockfish species.

Final Action on Groundfish Inseason Adjustment

The tribal Dungeness crab fishery occurs from about 12 fm out to 50 fm. These are areas of high crab density in the tribes' U&As. Therefore, the tribes have serious concerns about the Dungeness crab bycatch created by the recent management measures which push the trawl fleet inside 50 fm, particularly in the tribal U&As. The tribes feel there is a need for more information on the impacts of the trawl fishery on Dungeness crab, during molting, as it could potentially have serious implications for the crab fishery in the future. These management measures seem like an ill-advised tradeoff considering the economic value of Dungeness crab to the northwest Washington coast. The tribes would like the Council to explore restricting the fishery to outside of 50 fm, especially in the area between Point Chehalis and Sandpoint/Norwegian Memorial until the impacts can be further analyzed and accounted for. The tribes will continue dialogue with WDFW about this issue.

GROUNDFISH ADVISORY SUBPANEL STATEMENT ON IMPLEMENTATION OF A VESSEL MONITORING SYSTEM

The Groundfish Advisory Subpanel (GAP) reviewed the proposed rule which would implement a Vessel Monitoring System (VMS) for the Pacific groundfish fishery. Along with the comments on the proposed rule, the GAP requests the Council develop a timetable for expanding the VMS system beyond limited entry vessels. A timetable would enable other user groups such as commercial passenger fishing vessels and open access vessels to begin planning how a VMS system can best be adapted for their fisheries.

The GAP developed the following comments to the proposed rule and requests they be submitted to NMFS along with any other comments prepared by the Council or Council advisory bodies. The comments are not listed in any order of priority, but rather reflect issues that were discussed by the GAP and which the GAP believes need to be reflected in a final VMS rule.

1. Transferability - The proposed rule makes no provision for the transfer of VMS units from one owner to another or one boat to another. We suggest a simple notification system whereby a unit owner can inform NMFS that he or she no longer owns or controls the unit. The same notification system would be used in the event of a catastrophic vessel loss where a unit cannot be recovered.

2. Implementation date - As proposed, the final rule would go into effect after a regulatory “cooling off” period, currently estimated to be in October or November 2003. However, NMFS and the Council are also implementing a Congressionally-mandated capacity reduction program involving the same vessels that will be required to carry a VMS unit. We recommend that implementation of the VMS requirement be delayed until after the capacity reduction program is completed. In this way, a vessel owner will not have to buy a VMS unit one month and then scrap it the next.

3. Rescission language - As written, the VMS program is perpetual, even though the need for the VMS program may disappear if future groundfish management systems rescind the existing closed areas. We recommend that a specific termination clause be included in the final rule which ends the requirement for carrying a VMS unit at such time as the Council deems it no longer necessary.

4. Installation requirements - The proposed rule requires that a VMS unit be installed according to procedures established by NMFS. Discussion with NMFS Office of Law Enforcement personnel indicates these procedures will include installation by a NMFS-certified installer. We believe the installation requirements should be limited to installation pursuant to manufacturer instructions. Certified installers are often not available in smaller ports, and this requirement can be both time-consuming and costly. We note that the Environmental Assessment/Regulatory Impact Review (EA/RIR) prepared for the proposed rule grossly underestimates installation costs, which can include compensation for travel time for an installer to visit a remote port.

5. Backup units - The proposed rule does not include provision for a vessel owner to purchase a backup unit which can be used in the event the regular unit goes out of service during an expanded fishing trip. We recommend the final rule contain a provision for bringing a backup unit on-line during the course of a fishing trip through use of a simple declaration. This would prevent trips from being interrupted and would ensure continuous enforcement capability.

6. Breakdown contingencies - The proposed is unclear on action to be taken in the event of a VMS unit failure during the course of a fishing trip. We recommend the rule specify that in the event a unit breaks down during the course of a fishing trip, the vessel will be allowed to finish the trip as long as the vessel operator notifies NMFS of the malfunction.

7. Timeline for expansion - We have requested the Council to develop a provisional timeline covering the expansion of VMS requirements to other segments of the fishery. At such time as a timeline is approved, the rule should be amended to reflect those future requirements, thereby giving potentially

affected parties an opportunity to begin planning.

8. Shut-down provision for nongroundfish fishing - The proposed rule would establish a declaration system for those vessels that are legally fishing within the Rockfish Conservation area. We recommend that a vessel which has made a valid declaration and is legally permitted to fish in the Rockfish Conservation Area be allowed to shut down their VMS unit while fishing under the declaration.

9. Requirements for when a unit must be operating - Numerous comments have been made during the development of the proposed rule regarding the requirement that the unit be continuously operating, even when a vessel is in port or has been hauled out on land. Specific examples were provided of vessels in the Pacific groundfish fishery that are trailered to and from launching sites; are hauled out of the water at the end of day trips and stored on land; or fish or stay within internal waters for extended periods, but move frequently enough to prevent the "sleep mode" from activating. We explored several options for dealing with these unique situations, including exempting specific fisheries or developing general criteria under which a vessel could qualify for an exemption. Our final recommendation, which we believe to be the most fair and cost effective, is that the requirement to have an operating VMS unit only apply when a vessel is outside of the Boundary Line. This is analogous to fishing vessel safety requirements which differentiate between vessels operating inside and outside of the Boundary Line.

10. Cost/benefit statements - The proposed rule as published in the *Federal Register* contains several deficiencies where it addresses costs and benefits of the rule. For example, the discussion under "VMS" (68 FedReg No. 99, page 27975) states that the cost of a VMS unit "ranges from approximately $2,000 to $6,000." This cost does not reflect installation expenses. However, the discussion under "Classification" (68 FedReg No. 99, page 27976) estimates the costs of "purchasing and *installing* (emphasis added) the unit would be between $800 and $3,800 per individual vessel." Aside from the underestimation of installation costs (see comment above on installation), it is impossible for the cost of purchase and installation to be less than the cost of purchase alone.

    Further, the same paragraph goes on to state that "Revenues from expanded fishing were estimated to increase $26,000 per year for limited entry trawl vessels and $14,000 per year for limited entry longline and pot vessels." The revenue estimates were derived from the estimated revenue increase that results from the use of depth-based management, not from a requirement to have a VMS unit. Although the Council's preferred option is to have a VMS in order to more efficiently enforce depth-based management, the requirement to have a VMS does not in itself generate any additional revenue for a vessel, as depth-based management can be (and is being) enforced without the use of VMS. The rule analysis needs to be changed to reflect the fact that there is no revenue gain to vessels resulting from a requirement to carry a VMS unit. Every vessel required to carry a VMS unit will face an economic loss of varying degrees. The existing cost/benefit analysis is completely erroneous.

11. Payment of cost - The Council preferred action on VMS included an assumption that NMFS would pay the cost of purchasing and possibly installing and operating VMS units. Public support for VMS was based on the same assumption, as noted in testimony and advisory body reports to the Council. The proposed rule stipulates that all costs for purchasing, installing, and operating a VMS unit will be borne by the vessel owner. Given the erroneous cost/benefit analysis performed as noted above and the assumptions made when the VMS program was approved, we recommend the final rule not go into effect until NMFS provides a means of purchasing VMS units for vessels required to have them.

PFMC
06/18/03

Exhibit B.10.c
Supplemental GAP Report
June 2003

GROUNDFISH ADVISORY SUBPANEL STATEMENT ON GROUNDFISH STOCK ASSESSMENT REVIEW PROCESS FOR 2005 THROUGH 2006

The Groundfish Advisory Subpanel (GAP) discussed the stock assessment review (STAR) process for the next management biennium and the timetable for doing new or updated assessments on particular species of concern.

In reviewing the Terms of Reference (TOR) provided in Exhibit B.10, Attachment 1, the GAP notes the STAR Goals and Objectives include the need to "Satisfy the Magnuson-Stevens Sustainable Fisheries Act and other legal requirements." Aside from pointing out this is an incorrect legal reference (it should read "Magnuson-Stevens Fishery Conservation and Management Act"), the GAP believes the Terms of Reference insufficiently address the requirements of Section 304(e)(7) of that Act regarding a two-year review of management measures affecting rebuilding species. Aside from the general lack of reference to how this legally-required review is to be accomplished, the GAP is highly concerned that no effort will be made to review the status of canary rockfish, which is due for a two-year update in 2004. Even without the legal requirement, the GAP strongly believes canary qualifies for an assessment review on the basis of principles 2.a and 2.b of the Stock Assessment Priorities listed on page 5 of the TOR.

The GAP believes there is sufficient new data - both anecdotal and from new studies using submersibles - to indicate substantial changes in the canary population. Since the Council sponsors the STAR process, as noted on page 3 of the TOR, the GAP recommends the Council schedule at least an update assessment - if not a full assessment - for canary rockfish early in 2004.

The GAP also notes there is no reference to the Pacific whiting assessment scheduled for the winter of 2004. In regard to this assessment and subsequent management decisions, the GAP recommends that at least a subcommittee of the GAP, consisting of trawl, at-sea, and a processor representative, be convened at the March 2004 Council meeting to provide advice on the 2004 whiting management measures.

PFMC
06/17/03

Exhibit B.10.c
Supplemental SSC Report
June 2003

SCIENTIFIC AND STATISTICAL COMMITTEE REPORT ON
GROUNDFISH STOCK ASSESSMENT REVIEW PROCESS FOR 2005 THROUGH 2006

Dr. Elizabeth Clarke (National Marine Fisheries Service) presented an overview of issues related to the stock assessment review process for 2005 and 2006. After discussion of the key issues, it was agreed that:

1. Dr. Clarke will prepare a draft list of stocks to be assessed in the next stock assessment cycle prior to the September 2003 Scientific and Statistical Committee (SSC) meeting. For each stock, candidate assessment authors will be identified, and a determination will be made whether a full assessment or expedited assessment is appropriate.
2. The SSC will update its "Terms of Reference for Groundfish Rebuilding Analysis" to include all output needed by the Groundfish Management Team (GMT) as well as to reflect variables of interest from the rebuilding analysis software.
3. The SSC will continue to review rebuilding analyses. In a normal three-Council-meeting process, these reviews should be completed earlier than that experienced in this year's two-meeting process.
4. The Northwest Fisheries Science Center (NWFSC) will prepare an outline for an electronic assessment archive, including elements for all input data, output data, intermediate results, diagnostics, and full document in PDF format.
5. The SSC will schedule a methods workshop in 2004 and other "off" years (with logistical support from NWFSC) to address methodology issues common to multiple stock assessments, e.g. methods to derive indices of abundance from recreational catch-effort data; spatially explicit models for stock assessment; dealing with conflicting indices of abundance; etc.
6. The SSC will provide modifications to the stock assessment review (STAR) Terms of Reference needed to incorporate all of the points outlined in the following sections of this statement.

GENERAL SSC COMMENTS ON THE STAR PROCESS

SSC members participated in all of the Council's STAR Panels this year. Namely, the traditional STAR Panels for Pacific ocean perch (POP) and widow rockfish (STAR 1) and for bocaccio and black rockfish (STAR 2); and the new expedited review process for cowcod, darkblotched, and yellowtail rockfish (STAR-lite). Based on this experience, as well as feedback from other reviewers and Stock Assessment Team (STAT) members, the SSC compiled two lists of comments and recommendations for the STAR process in future years – one list for the traditional STAR process, and a separate list for the newly created STAR-lite process.

Traditional STAR Process

Although the Council's STAR process has been in place for more than five years, it has been an evolving process with year-to-year modifications based on the experience and "lessons learned" from earlier years. While the process is generally working well and has reached a mature level, continued fine tuning will be necessary to meet the challenge of providing thorough review of increasingly complex stock assessments.

Recent stock assessment research has focused on more fully incorporating uncertainty into management-related model outputs. This is important work that has been encouraged by the SSC. The resulting methodology (e.g., as used in the POP assessment) is considerably more complex than methods generally used presently. The large number of parameters estimated coupled with a variety of priors, penalty functions, and constraints tax the ability of reviewers to fully understand the nuances of model behavior using only the traditional tables and figures provided in stock assessment documents. Further, the use of numerically intensive Monte Carlo Markov Chain (MCMC) analysis for estimation of posterior distributions (used for quantifying uncertainty and central tendency) further exacerbates the problem. While the SSC encourages this type of "cutting edge" modelling, there is concomitant responsibility for assessment authors to provide a broader suite of intermediate results and model diagnostics in addition to those provided when less complex models are used for assessment. Because the volume of these data can be quite large, providing them in electronic form is more practical than via traditional hard copy, e.g., creating a data CD to accompany and to be referenced from the assessment document. Appendix A of

the POP STAR Panel Report provides a partial list of intermediate results and diagnostics that should be provided. Assessment authors with experience using these more complex models are encouraged to augment this list.
The lack of consistency among stock assessments – reviewed by different STAR Panels – is becoming an issue. Several examples are:

1. Discards estimates based on the new observer program data were used in the bocaccio assessment, but not for any of the other assessments conducted this year.

2. The NWFSC trawl survey has been used in the assessments for POP, sablefish, thornyheads, and Dover sole, but not for other species assessed recently.

3. Catchability for logbook and whiting bycatch indices of abundance has been assumed constant over time in most assessments; but in the yellowtail assessment, catchability was allowed to vary annually.

4. Selectivity is handled in a myriad of ways in the various stock assessments, e.g., constant over time, estimated as annual vectors, varying annually with random walk, etc.

While some variation is to be expected, standardization guidelines are needed to prevent further drift from consistent application of data and concepts.

For the Council to optimize the benefits derived from the appreciable resources dedicated to the STAR process, it is critically important for assessment authors to carefully review STAR Panel reports associated with previous assessments. The recommendations from these STAR reports should be foremost in planning for new stock assessments.

The process of selecting the reviewers who will sit on a STAR Panel should strive to balance the tension between providing institutional memory regarding the species being assessed and providing new views and insights. The former is generally accomplished by selecting reviewers from within the Council family, while the latter is handled via outside reviewers, such as those provided by the Center for Independent Experts (CIE). With the increased complexity of groundfish assessments (discussed above), another important consideration to ensure each panel has one or more members well versed in the use of these "cutting edge" models. The STAR Panel member selection process would benefit from SSC review of the composition of each panel before the (bi)annual assessment cycle begins.

Reports of the CIE reviewers regarding the pros and cons of the STAR process should be provided, at least to the SSC. These outside views of our process are critical in the Council's annual review of its STAR process.

STAR-lite Process

The STAR-lite process differs from the traditional STAR process in two fundamentals ways, (1) the review is much abbreviated, providing less than one day per stock (compared to 2.5 days per stock in the traditional process); and (2) the review is conducted by the SSC Groundfish Subcommittee rather than by an *ad-hoc* panel composed of Council-family scientists and at least one "outside reviewer." The recent STAR-lite (May 2003) worked well generally, but several steps will be needed to ensure that future STAR-lite processes are equally successful. Namely,

1. As a rule of thumb, the meeting length should be one day per stock.
2. Face-to-face meetings – not conference calls – are required to communicate stock assessment results and panel feedback within the abbreviated time period.
3. Local area network (LAN) support – including file sharing and printer access – is critical for the expedited process.
4. Documents that are distributed electronically should be in PDF format to maintain consistent pagination. Additionally, page numbers should appear on each page.

These items should be added to the Terms of Reference for the STAR-lite process. Items 3 and 4, above, should also be added to the Terms of Reference for the full STAR process.

Probably due to the newness of the STAR-lite process, STAT members are sometimes puzzled about aspects of the previous stock assessment that can be modified while staying within the guidelines of an "updated assessment." For example, should the catch time series be updated to reflect only newly available years since the last assessment or alternatively, should the entire catch time series be updated to reflect all database revisions since the last assessment? The SSC strongly prefers the latter, and in general, the principle that updated assessments should use best available data from all sources. Additionally, all model parameters should be re-estimated in the update. However, other issues (e.g., modifying objective function weights within the same stock assessment model) fall more into a gray area. The SSC recommends that this type of change should not be routine, but should be allowable in some cases, if strong justification is provided by the STAT.

Considerable effort is required by STAT members to prepare and document the assessment updates reviewed by a STAR-lite panel. In addition, the cumulative time and effort of the reviewers (SSC Groundfish Subcommittee plus GMT and GAP representatives) is substantial. In some cases – such as this year's yellowtail assessment – a large proportion of the resources that would be required to conduct a full assessment was dedicated to carrying out and reviewing the assessment update. Further, assessment updates typically will have a shorter "shelf life" than full assessments. Consequently in such cases, it may be more efficient to allow STAT members in consultation with the SSC to move these assessment updates to the full assessment status.

Finally, while the STAR-lite process worked well this year, it should be fully recognized that many issues which would have been explored in a full assessment were not possible to explore within the STAR-lite. These issues were tabled for the next full assessment.

PFMC
06/19/03

Exhibit B.11.b
Supplemental NMFS Report
June 2003

Draft Decisionmaking Framework for Pacific Coast Groundfish Essential Fish Habitat Environmental Impact Statement (modified from the draft presented at the April, 2002 Council meeting)

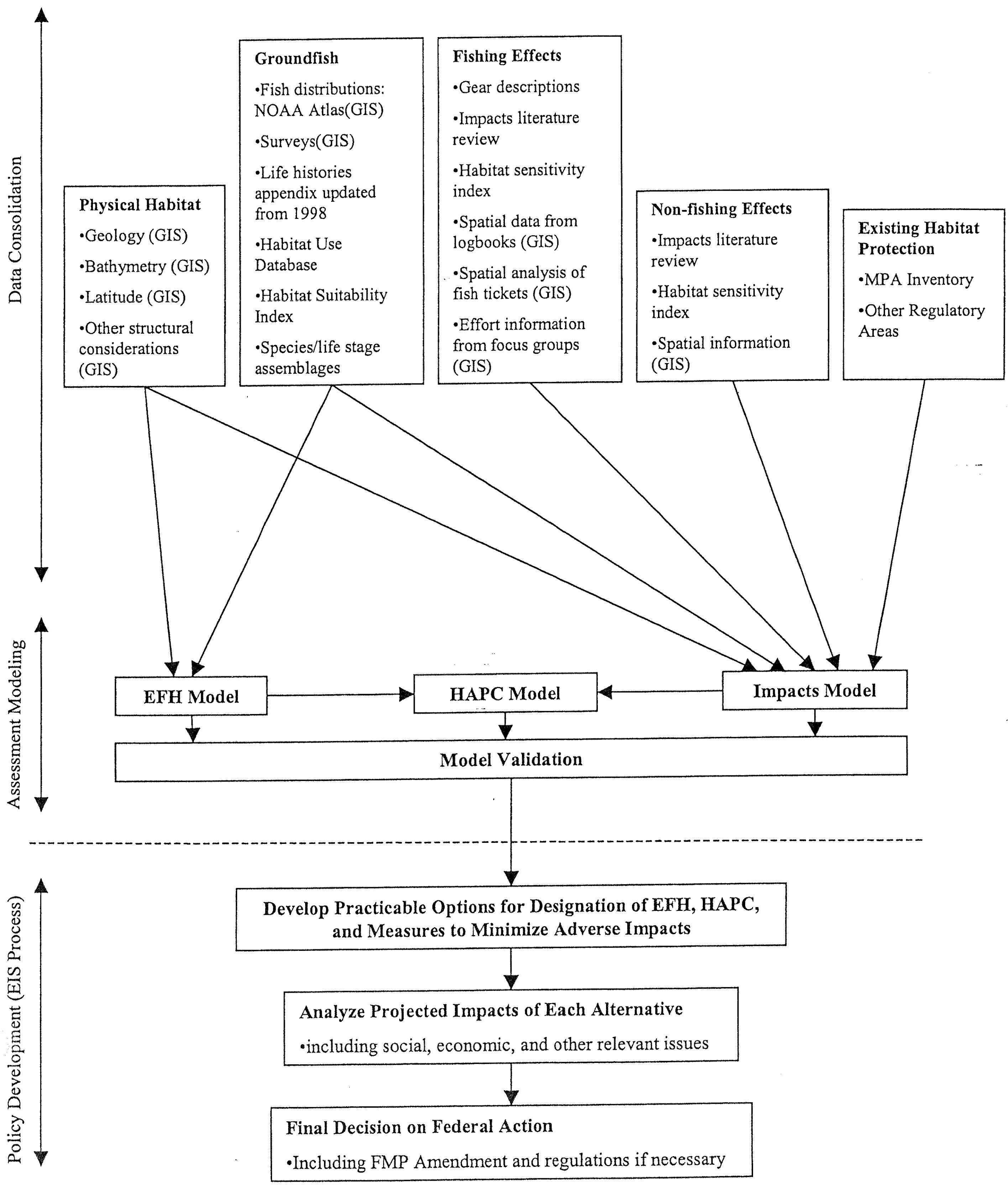


Exhibit B.11.c
Supplemental HC Report
June 2003

HABITAT COMMITTEE COMMENTS ON STATUS OF THE GROUNDFISH ESSENTIAL FISH HABITAT (EFH) ENVIRONMENTAL IMPACT STATEMENT (EIS)

The HC received a presentation on the groundfish EFH EIS that summarized the data gathering, GIS work, and modeling that is being done. This project represents a significant step forward in making new information available to the Council, including information on benthic substrates. The searchable databases and GIS-based maps also represent a major step forward in making the enormous quantity of existing groundfish data useable. This project will result in a useful tool not only for the EFH EIS process, but for many other Council applications.

A data quality layer for benthic substrates is an important component of the GIS data used in the modeling. This component is complete for Oregon and Washington. To increase the consistency and reliability of the model, it is important to complete this data quality layer for California. This will cost about $10,000. The Habitat Committee recommends that the Council ask NMFS to provide those funds.

PFMC
06/16/03

SCIENTIFIC AND STATISTICAL COMMITTEE REPORT ON STATUS OF THE GROUNDFISH ESSENTIAL FISH HABITAT ENVIRONMENTAL IMPACT STATEMENT

The Scientific and Statistical Committee (SSC) heard a presentation from Mr. Steve Copps, Dr. Graeme Parkes, and Ms. Allison Bailey who gave an overview of methodologies being developed to analyze West Coast groundfish essential fish habitat (EFH).

The SSC was impressed by the scope of the work in progress; however, due to time limitations at this meeting, the SSC was not able to delve into the details of the analyses to be performed. In order to provide useful advice, the SSC would like to schedule a longer, more in-depth discussion with the analytical team members to gain a better understanding of the methodologies to be employed.

During the short time available for discussion, the SSC raised the following points.

1. When using the NMFS triennial trawl survey data, the analysis should incorporate the latest updates, which reflect adjustments for "water hauls."

2. In the construction of fishing sensitivity indices, factors such as fishing strategies and gear type interactions should be considered.

3. When employing expert opinions to evaluate fishing effort, the analysis should strive to ensure consistency and should be representative on a coastwide basis.

PFMC
06/19/03

Draft Timeline and Major Milestones for the Environmental Impact Statement on Essential Fish Habitat for Pacific Coast Groundfish

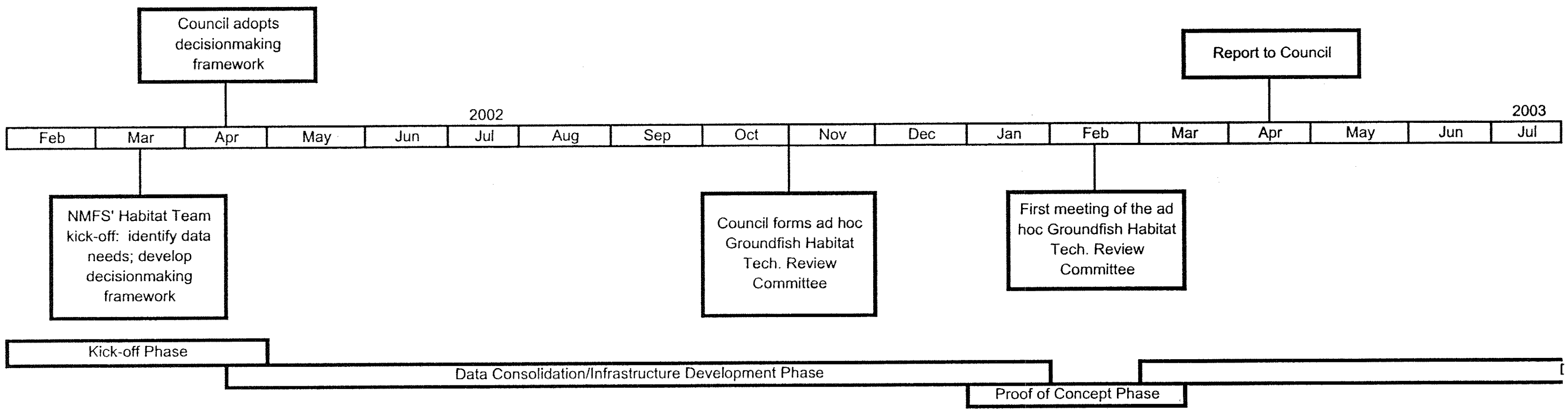
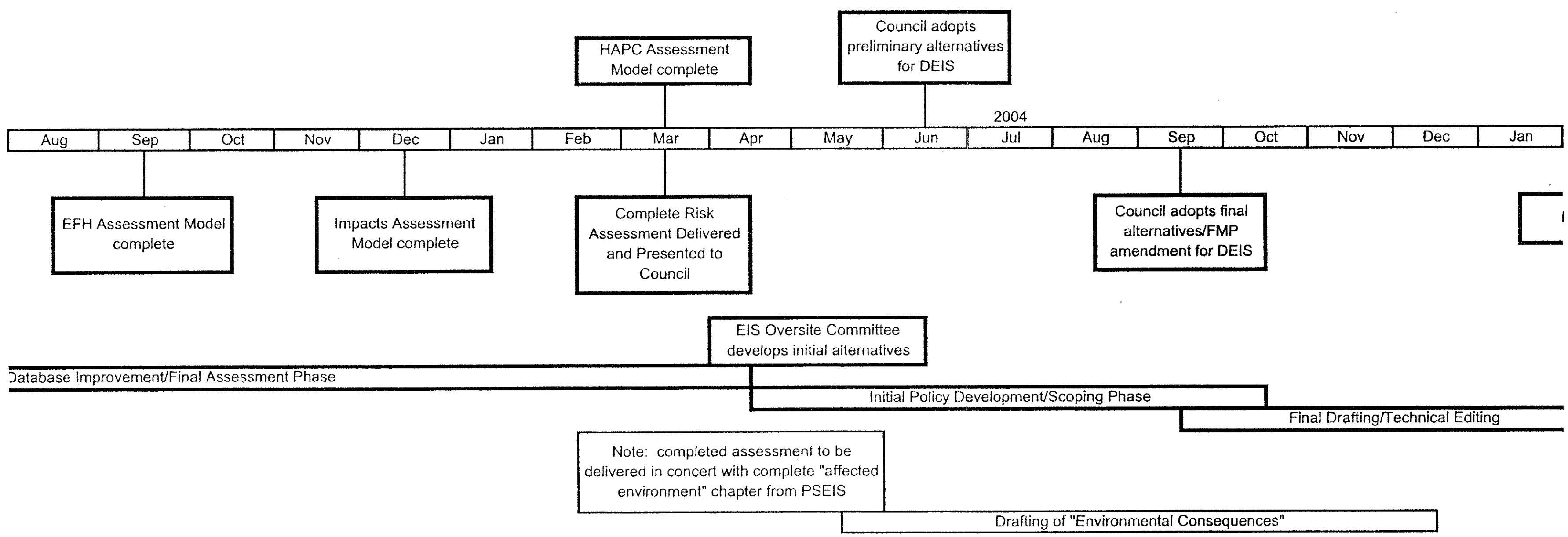


Exhibit B.11
Attachment 2
June 2003

Attachment 2

Draft Timeline and Major Milestones for the Environmental Impact Statement on Essential Fish Habitat for Pacific Coast Groundfish



Attachment 2

Draft Timeline and Major Milestones for the Environmental Impact Statement on Essential Fish Habitat for Pacific Coast Groundfish

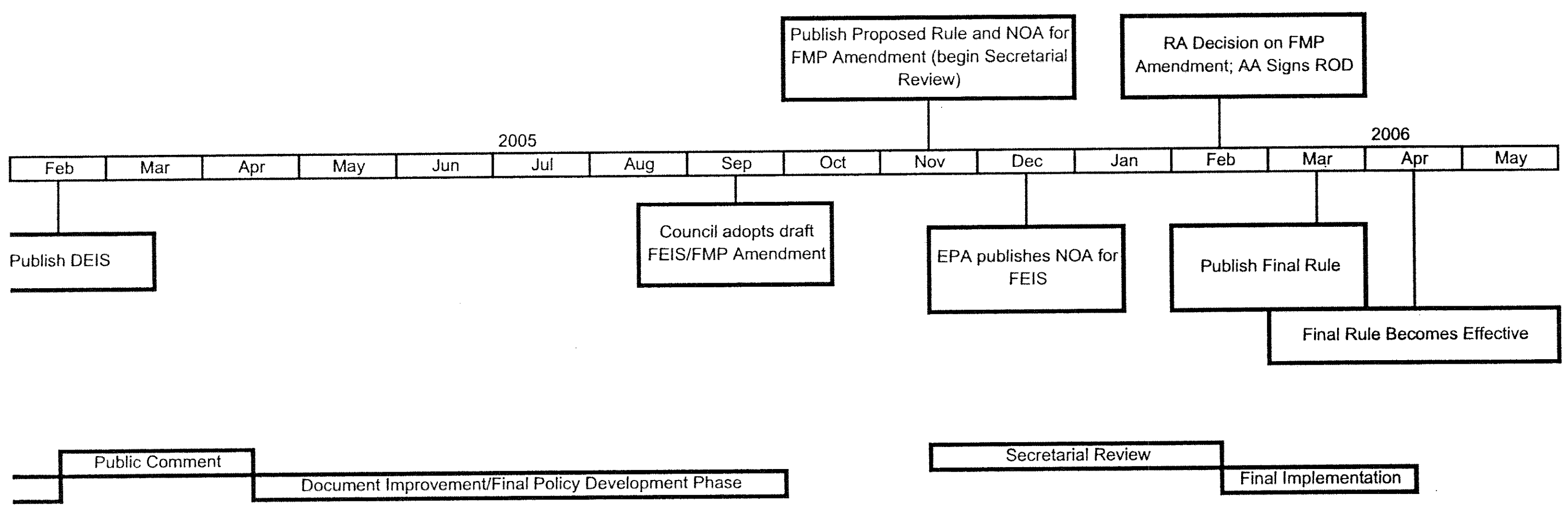


Exhibit B.12.c
Supplemental GAP Report
June 2003

GROUNDFISH ADVISORY SUBPANEL STATEMENT ON THE UPDATE ON GROUNDFISH FISHERY MANAGEMENT PLAN PROGRAMMATIC ENVIRONMENTAL IMPACT STATEMENT

The Groundfish Advisory Subpanel (GAP) received a briefing from Mr. Jim Glock on the groundfish fishery management plan (FMP) programmatic environmental impact statement (EIS). Six alternatives focusing on how to monitor and control bycatch of groundfish species were presented.

While the GAP agrees that achieving a sustainable and economically viable groundfish fishery depends on effective bycatch accounting and control, there are concerns with draft alternatives 4, 5, and 6 which focus on the use of bycatch caps. The concerns include the implications of using bycatch caps which will require increased observer coverage; there is no indication of who will bear the cost of this coverage, what that cost might be, or what benefits might offset the cost. The vessel-based bycatch cap alternatives (alternatives 5 and 6) would probably require 100% observer coverage, and alternative 4 would probably, at least require enhanced observer coverage. It is also unclear whether these alternatives would apply to the recreational fishery. Having vessel owners bear the cost of increased observer coverage is not a viable option for an industry already on the economic edge due as a result of current groundfish management decisions.

Alternative 6 also focuses on the use of "broad, long-term Marine Protected Areas (MPAs) encompassing primary habitat areas of all overfished groundfish stocks" as a means to control groundfish bycatch. The GAP believes that, due to a lack of compelling scientific information on the efficacy of MPAs to control groundfish bycatch, this strategy should only be considered as a last resort. The GAP also notes that we already have one of the largest MPAs in the continental United States off the West Coast - an area approximately the size of the states of Vermont, New Hampshire, Rhode Island, and Delaware combined.

Other alternatives that are not considered, but should be included in the programmatic EIS are gear modifications, full retention strategies, and alternative fishing strategies. The GAP recommends a refined analysis of current bycatch control strategies such as depth-based management which has not been adequately evaluated. The GAP also recommends there be a complete analysis - including social and economic impacts - of the individual sub-alternatives contained within the main alternatives.

PFMC
06/19/03

Exhibit B.13.b
Supplemental GAP Report
June 2003

GROUNDFISH ADVISORY SUBPANEL STATEMENT ON FINAL ADOPTION OF FMP AMENDMENT 16-1 AND AMENDMENT 16-2

The Groundfish Advisory Subpanel (GAP) reviewed the alternatives identified for fishery management plan (FMP) Amendments 16-1 and 16-2 and offers the following comments.

For FMP Amendment 16-1, under issue 1, the GAP recommends the Council adopt Option 1d, which would numerically specify T_{TARGET} and the harvest control rule in regulations. The GAP has consistently advocated that the Council leave itself as much flexibility as possible under the law and believes this option provides the most flexibility among the options presented.

For FMP Amendment 16-2, the majority of the GAP recommends adopting alternatives which correspond to the use of P_{MAX} = 60%. This is consistent with the advice the GAP has provided to the Council when reviewing rebuilding plans. Referring to the chart found on page 2-3 of Exhibit B.13, Attachment 2, this corresponds to the "Other Intermediate Alternatives" for darkblotched rockfish and Pacific ocean perch; and the "Council Interim Alternative" for canary rockfish and lingcod.

A minority of the GAP recommends adopting alternatives corresponding to P_{MAX} = 80% since these alternatives are more precautionary, and thus, more appropriate for rebuilding species.

PFMC
06/17/03

Exhibit B.13.b
Supplemental SSC Report
June 2003

SCIENTIFIC AND STATISTICAL COMMITTEE REPORT ON FINAL ADOPTION OF FISHERY MANAGEMENT PLAN AMENDMENT 16-1 AND AMENDMENT 16-2

The Scientific and Statistical Committee (SSC) reviewed Amendment 16 including Chapter 5, the cumulative impact analysis required for the Environmental Impact Statement (EIS). The SSC has seen most sections of this document previously, and our review and comments at this time are not comprehensive.

The SSC notes that rebuilding analyses for overfished stocks assessed this year are based on a range of alternatives for P_{MAX}, with one option consisting of the P_{MAX} specified in the interim rebuilding analysis. Options considered in Amendment 16-1 are primarily based on specification of T_{Target}.

The SSC considers the range of alternatives evaluated in the EIS appropriate. Alternatives that result in increased harvest of overfished stocks would also have the effect of freeing up available optimum yield for non-overfished stocks. The economic benefits of this potential additional harvest were not quantified in the cumulative impacts chapter. If resources are available for additional modeling, it would be worthwhile to quantify these impacts.

PFMC
06/19/03

05/30/2003 15:44 14159567441 CACMC

Exhibit B.13.c
Public Comment
June 2003

Advocates for Wild, Healthy Oceans

Pacific Regional Office
116 New Montgomery Street
Suite 810
San Francisco, CA 94105

415.979.0900 Telephone
415.979.0901 Facsimile
www.oceanconservancy.org

Formerly the Center for Marine Conservation

May 30, 2003

RECEIVED
MAY 30 2003
PFMC

The Ocean Conservancy

Sent via facsimile and U.S. mail
Dr. Donald McIssac
Pacific Fishery Management Council
7700 NE Ambassador Place, Suite 200
Portland, OR 97220

Dear Dr. McIssac:

The Ocean Conservancy is writing to provide the following scoping comments on the Pacific Fishery Management Council's (PFMC) preparation of an Environmental Impact Statement (EIS) for Amendment 16 to the Groundfish Fishery Management Plan (Amendment 16) governing the rebuilding of overfished groundfish species. According to the Notice of Intent (NOI) to prepare an EIS[1], this EIS will evaluate the environmental impacts stemming from adoption of rebuilding plans, in particular, the management targets that will be used to determine catch levels. The first EIS will most likely cover only four of the nine overfished species with subsequent EISs or EAs prepared for the remaining species.[2]

While we agree that analysis of a range of management target alternatives and choice of rebuilding strategies are crucial elements in rebuilding overfished species, management measures necessary to achieve these rebuilding targets must be part of Amendment 16 and its accompanying EIS. Rebuilding plans consisting of a target and rebuilding strategy only fall far short of an actual plan to return a species back to an applicable management level. We therefore recommend inclusion of a range of alternatives covering a variety of management measures necessary to achieve the proposed rebuilding targets and time periods. Furthermore, by including as many overfished groundfish species as possible in this EIS will allow the PFMC to take a holistic approach in designing management measures that will meet rebuilding targets and timelines.

Applicable Law

Pursuant to the Magnuson Stevens Fishery Conservation and Management Act (FCMA) the National Marine Fisheries Service (NMFS) and PFMC must prepare a fishery management plan, plan amendment or proposed regulations to rebuild any population of fish within one year of being identified as overfished by the NMFS.[3] Rebuilding measures must meet a number of criteria including specifying a time period for ending overfishing and rebuilding the fishery in as short a time as possible, not to exceed ten

1 68 FR 12889 (March 18, 2003)
2 *Id.*
3 16 U.S.C. §1854(e)

The Ocean Conservancy strives to be the world's foremost advocate for the oceans. Through science-based advocacy, research, and public education, we inform, inspire and empower people to speak and act for the oceans.

years, except in certain prescribed instances and allocate restrictions and recovery benefits fairly and equitably among sectors of the fishery.[4]

In addition, any fishery management plan amendments must establish a standardized reporting methodology to assess the amount and type of bycatch occurring in the fishery and include measures that minimize bycatch and unavoidable bycatch mortality to the extent practicable.[5] Furthermore, fishery management plan amendments must contain provisions to minimize, to the extent practicable, adverse impacts of fishing on essential fish habitat.[6]

According to the NOI, the PFMC has determined that Amendment 16 requires development of an EIS pursuant to the National Environmental Policy Act (NEPA). NEPA establishes a national policy that will encourage productive and enjoyable harmony between man and his environment, promote efforts which will prevent or eliminate damage to the environment and biosphere and stimulate the health and welfare of man and to enrich the understanding of the ecological systems and natural resources important to the nation.[7]

For major federal actions significantly affecting the quality of the human environment, a detailed statement (EIS) must be prepared that includes the environmental impact of the proposed action, any adverse environmental effects which cannot be avoided should the proposal be implemented, alternatives to the proposed action, the relationship between local short-term uses of the environment and the maintenance and enhancement of long-term productivity, and any irreversible and irretrievable commitments of resources which would be involved in the proposed action should it be implemented.[8] The EIS provides a full and fair discussion of significant environmental impacts and informs decision makers and the public of the reasonable alternatives which would avoid or minimize adverse impacts or enhance the quality of the human environment.[9]

The Council on Environmental Quality has developed a number of guidance documents for implementing NEPA, including two that are particularly applicable to the development of rebuilding plans for overfished groundfish species. These include *Incorporating Biodiversity Considerations Into Environmental Impact Analysis Under the National Environmental Policy Act*[10] and *Considering Cumulative Effects*[11]. We urge the PFMC to consult these guidance documents in preparation of this EIS.

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4 *Id.*
5 16 U.S.C. §1853(a)(11) and 16 U.S.C. §1851(a)(9).
6 *Id.* at §1853(7).
7 42 U.S.C. §4321
8 42 U.S.C. §4332
9 40 CFR §1502.1
10 Council on Environmental Quality, January 1993.
11 Council on Environmental Quality, January 1997.

Issues for Consideration in the Amendment 16 EIS

The EIS Must Explore a Full Range of Rebuilding Time Options with High Probabilities for Success

The EIS must explore a full range of rebuilding time periods with special emphasis on the FCMA which requires that rebuilding times be as short as possible considering a number of factors.[12] A range of rebuilding time periods and rebuilding strategies with accompanying analysis of direct, indirect and cumulative environmental impacts must be presented. Analysis of the rebuilding times and strategies must include both short and long term economic and ecological implications.

The EIS Must Explore a Full Range of Management Measures Necessary to Ensure a High Probability of Successfully Rebuilding Depleted Species Within the Rebuilding Target Time

Essential to the success of any rebuilding plan is ensuring that annual mortality levels of a depleted species are consistent with rebuilding goals, that abundant levels of prey species exist and that habitats used by depleted species and their prey are protected. Thus, the issues we recommend for analysis include management measures that will rebuild depleted populations by limiting total mortality (via direct catches and bycatch) to levels consistent with proposed rebuilding targets, measures that will minimize the incidental catch of a depleted species' prey species, and measures that will reduce impacts of fishing gears on the marine environment including an analysis of the past, present and reasonably foreseeable adverse impacts of fishing and non-fishing operations on habitats utilized by the depleted species.

In completing the EIS we recommend the analysis of the following management tools in meeting proposed rebuilding goals:

(1) Management measures that ensure rebuilding targets are met

These measures include, but are not limited to, limiting fishing effort via capacity reduction, time and area closures, a network of no take marine protected areas, trip or bag limits, and caps on total mortality ("hard" total allowable mortality levels);

(2) Management measures that reduce bycatch

These measures must reduce the incidental catch of both depleted species which are the subject of this amendment and prey species and other marine life through measures including, but not limited to, capacity reduction, time and area closures,

[12] 16 U.S.C. §1854(e)

a network of no take marine protected areas, trip or bag limits, caps on total mortality (bycatch caps on a fleet wide, sector wide and vessel level), and gear modifications;

(3) Management measures that reduce the adverse impacts of current fishing practices on habitats important to both depleted species and prey species

These measures may include, but are not limited to, reducing effort via capacity reduction or trip or bag limit reduction, time and area closures, a network of no take marine protected areas, gear modifications and prohibitions on fishing practices that adversely impact important habitats or prey species; and

(4) Measures that aid in enforcement of management measures

These measures include, but are not limited to, enforcement devices such as vessel monitoring systems.

The current management regime should serve as the "no-action" or "status quo" alternative for management measures designed to rebuild overfished species. Other alternatives should include a suite of management tools applicable to proposed rebuilding targets and timelines. Analysis of these alternatives must include cumulative effects and past present and reasonably foreseeable activities on the environment.

The EIS should also analyze current information sources necessary to both track rebuilding progress and ensure annual mortality goals are achieved. If information sources are lacking, the EIS should identify essential data collection elements and methods for collecting those elements such as methods for more accurately assessing effort, monitoring bycatch, identifying fishing locations and identifying important habitat areas.[13] These methods should include current efforts in addition to increased observer coverage, use of federal permits or licenses to better estimate total effort, use of vessel monitoring systems or other technologies to assess areas fished, and other appropriate methods.

Conclusion

The preparation of an EIS for Amendment 16 offers the PFMC an excellent opportunity to take a holistic look at the current groundfish management strategy and other potential scenarios to ensure that the nine overfished species of groundfish are returned to healthy levels by constraining fishing effort to an appropriate level, minimizing the incidental catch of both overfished groundfish and their prey species, and protecting habitats important to marine life from both fishing and non fishing operations. Considering the unfortunate state of the groundfish resource, this EIS presents a chance to reassess the efficacy of past management measures and focus on alternative scenarios that will ensure the successful restoration of overfished populations. We urge the PFMC to take full advantage of this exercise by not only including analysis of rebuilding target and time

[13] 16 U.S.C. §1853

period alternatives but also a full range of management measures that will ensure these targets and timelines are met.

We thank you for considering our comments and look forward to future work in protecting the marine life of the Pacific Ocean.

Sincerely,

Chris Dorsett
Pacific Fish Conservation Manager

Exhibit B.13
Attachment 1
June 2003

DRAFT

AMENDMENT 16-1

TO THE PACIFIC COAST GROUNDFISH FISHERY MANAGEMENT PLAN

PROCESS AND STANDARDS FOR REBUILDING PLANS

INCLUDING ENVIRONMENTAL ASSESSMENT AND REGULATORY ANALYSES

Prepared by
The Pacific Fishery Management Council
7700 NE Ambassador Place, Suite 200
Portland, Oregon 97220-1384

In Cooperation With
National Marine Fisheries Service

JUNE 2003

This document may be cited in the following manner:

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This document prepared by the Pacific Fishery Management Council pursuant to National Oceanic and Atmospheric Administration Award Number NA03NMF4410067.

COVER SHEET
AMENDMENT 16-1 ENVIRONMENTAL ASSESSMENT

Proposed Action:	This amendment to the Pacific Coast Groundfish Fishery Management Plan (FMP) addresses National Standard 1 in the Magnuson-Stevens Act by establishing procedures for adopting and periodically reviewing rebuilding plans for overfished groundfish stocks. It also specifies what elements of rebuilding plans will be incorporated into the FMP and federal groundfish regulations.
Type of Statement:	Environmental Assessment
For Further Information	
Pacific Fishery Management Council:	Kit Dahl Pacific Fishery Management Council 7700 NE Ambassador Place, Suite 200 Portland, OR 97220 (503) 820-2280 Kit.Dahl@noaa.gov
NMFS NEPA compliance:	Matthew Harrington National Marine Fisheries Service F/NWR3 7600 Sand Point Way Seattle, WA 98115 (206) 526-4742 Matthew.Harrington@noaa.gov

Abstract:

National Standard 1 in the Magnuson-Stevens Act requires conservation and management measures that prevent overfishing. Preventing overfishing also means returning stocks to a size capable of achieving maximum sustainable yield. In order to satisfy this mandate, rebuilding plans must be adopted for the nine Pacific Coast groundfish stocks that have been declared overfished by the U.S. Secretary of Commerce (Secretary).

Although the Council approved Amendment 12 in April 2000, which also specified a process for implementing rebuilding plans, it was subsequently challenged in Federal District Court. The judge found the rebuilding plans created in accordance with Amendment 12 did not comply with the Magnuson-Stevens Act because the plans did not take the form of a FMP, FMP amendment, or regulation. Therefore, the Council must specify rebuilding plans as a FMP or regulatory amendment. (Development of new FMP covering overfished groundfish species is not considered.)

Alternatives, or options, to satisfy the purpose and need of the proposed action are considered under four issues:

1. The form and content of rebuilding plans: Whether rebuilding plan elements should be incorporated into the FMP, federal groundfish regulations, or both, and what elements should be so incorporated.
2. The schedule for periodically reviewing rebuilding plans: Whether the Council or the Secretary should be responsible for periodic review, and under Council review the timing and elements reviewed.
3. Standards for determining if stock rebuilding is making adequate progress: Thresholds for determining when a rebuilding plan should be revised due to changed circumstances.

4. Endangered Species Act provisions: Whether or not provisions should be written into the FMP specifying the relationship between measures pursuant to an Endangered Species Act listing and rebuilding plan measures pursuant to the Magnuson-Stevens Act.

The Council chose the following preferred alternative: Under Issue 1 [not yet chosen]; under Issue 2, that stock rebuilding progress should be reviewed after new stock assessments while other stock rebuilding goals are reviewed every two years; under Issue 3, that each rebuilding plan will identify an adequacy of progress standard; and under Issue 4, that no Endangered Species Act provisions will be incorporated into the FMP.

The proposed action is procedural and, therefore, does not directly affect the human environment. The direct impacts affect the management regime are evaluated in terms of administrative capacity, adaptive management, public participation and rebuilding strategy. The preferred alternative [summarize after preferred option chosen]

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ABBREVIATIONS AND ACRONYMS

ABC	Allowable Biological Catch
CDFG	California Department of Fish and Game
CEQ	Council on Environmental Quality
CFR	Code of Federal Regulations
CMC	Center for Marine Conservation
CPS	Coastal Pelagic Species
DTS	Dover sole-Thornyhead-Sablefish
EA	Environmental Assessment
EEZ	exclusive economic zone
EFH	Essential Fish Habitat
EIS	Environmental Impact Statement
EO	Executive Order
ESA	Endangered Species Act
FMP	Fishery Management Plan
FONSI	Finding of No Significant Impact
GAP	Groundfish Advisory Subpanel
GMT	Groundfish Management Team
IPHC	International Pacific Halibut Commission
kg	kilogram
m	meter
Magnuson- Stevens Act	Magnuson-Stevens Fishery Conservation and Management Act
MBTA	Migratory Bird Treaty Act
MFMT	maximum fishing mortality threshold
MMPA	Marine Mammal Protection Act
MSA	Magnuson-Stevens Fishery Conservation and Management Act
MSST	Minimum Stock Size Threshold
MSY	Maximum Sustainable Yield
mt	metric ton
NAO	NOAA Administrative Order
NEPA	National Environmental Policy Act
NMFS	National Marine Fisheries Service

ABBREVIATIONS AND ACRONYMS (Continued)

NOAA	National Oceanographic and Atmospheric Administration
NOI	Notice of Intent
NRDC	Natural Resources Defense Council
NWR	Northwest Region
OY	optimum yield
PMCC	Pacific Marine Conservation Council
RFA	Regulatory Flexibility Act (or Analysis)
RIR	Regulatory Impact Review
SAFE	Stock Assessment Fishery Evaluation
Secretary	U.S. Secretary of Commerce
SFA	Sustainable Fisheries Act
SSC	Scientific and Statistical Committee
STAR	Stock Assessment Review Panel
STAT	Stock Assessment Team
USFWS	U.S. Fish and Wildlife Service
WOC	Washington-Oregon-California

1.0 Introduction

1.1 How This Amendment is Organized

This document provides background information about and analysis of changes to the Pacific Coast Groundfish Fishery Management Plan (FMP) incorporated as Amendment 16-1. The actual changes, or amended parts of the plan, appear in appendix A.

This document is one of a series of amendments numbered Amendments 16-1, 16-2 and 16-3. This amendment establishes a framework for the adoption of rebuilding plans for overfished species. Amendment 16-2 will adopt four rebuilding plans: darkblotched rockfish, Pacific ocean perch, lingcod and canary rockfish. Amendment 16-3 will adopt rebuilding plans for the remaining five overfished species. (If additional species are declared overfished, amendments to adopt rebuilding plans for them will continue this numbering system.)

FMPs and any amendments to them, must conform to the Magnuson-Stevens Fishery Conservation and Management Act (Magnuson-Stevens Act, or MSA), the principal legislation governing fishery management within the exclusive economic zone (EEZ), which extends from the outer boundary of the territorial sea to a distance of 200 miles from shore. In addition to addressing Magnuson-Stevens Act mandates, this document is an environmental assessment (EA), pursuant to the National Environmental Policy Act (NEPA). According to Council on Environmental Quality (CEQ) regulations, an EA provides "sufficient evidence and analysis for determining whether to prepare an environmental impact statement or a finding of no significant impact" and helps the agency compliance if an Environmental Impact Statement (EIS) is necessary (40 CFR 1509.9). A separate Finding of No Significant Impact (FONSI) has been prepared, based on the analyses in this EA. The document also contains information and analyses relevant to the Regulatory Flexibility Act (RFA) and Executive Order (EO) 12866 (Regulatory Impact Review [RIR]). These mandates require agencies to evaluate the economic impact of regulatory actions, especially on small entities.

The rest of this chapter discusses the reasons for changing the FMP. This description of purpose and need defines the scope of the subsequent analysis. Chapter 2 outlines different alternatives that have been considered to address the purpose and need. One of these alternatives is the Pacific Fishery Management Council's (hereafter, the Council) preferred alternative, which is recommended to National Marine Fisheries Service (NMFS) for adoption as a plan amendment. Chapter 3 describes the affected environment. This information provides the basis for the analysis contained in Chapter 4, which assesses the potential environmental and socioeconomic impacts of the alternatives outlined in Chapter 2. Chapter 5 details how this amendment meets ten National Standards set forth in the Magnuson-Stevens Act (§301(a)) and groundfish FMP goals and objectives. Chapter 6 provides information on those laws and EOs, in addition to the Magnuson-Stevens Act and NEPA, that an amendment must be consistent with, and how this amendment has satisfied those mandates.

1.2 Purpose and Need

1.2.1 Need (Problems for Resolution)

As of February 2002 the U.S. Secretary of Commerce (Secretary) had declared nine groundfish stocks overfished. These are: bocaccio (*Sebastes paucispinis*), canary rockfish (*S. pinneger*), cowcod (*S. levis*), darkblotched rockfish (*S. crameri*), lingcod (*Ophiodon elongatus*), Pacific ocean perch (*S. alutus*), widow rockfish (*S. entomelas*), yelloweye rockfish (*S. ruberrimus*) and Pacific whiting (*Merluccius productus*). These declarations, stemming from Magnuson-Stevens Act requirements, are based on overfishing criteria adopted by the Council under Amendment 11 to the Pacific Coast Groundfish FMP. The Magnuson-Stevens Act (§304(e)(3)) also requires councils to "prepare a fishery management plan, plan amendment, or proposed regulations" in order to prevent overfishing and implement a plan to rebuild the overfished stocks. The Council developed Amendment 12 to specify an effective process for implementing rebuilding plans. This amendment was approved by the Council in April 2000 and approved by NMFS on December 7, 2000. However, in Federal Court the Natural Resources Defense Council (NRDC), an environmental organization, challenged the legality of the provisions in Amendment 12 related to rebuilding plans,[1/] based on the Magnuson-Stevens Act and the NEPA. The judge found the rebuilding plans created in accordance with Amendment 12 did not comply with the Magnuson-Stevens Act, because the plans did not take the form of a FMP, FMP amendment, or regulation. Therefore, the Council must specify rebuilding plans as a FMP or regulatory amendment. (Development of new FMP covering overfished groundfish species is not considered.)

Rebuilding plans are mandated when the size of a stock or stock complex falls below a level described in the FMP as the Minimum Stock Size Threshold (MSST). Diminished stock size may be caused or exacerbated by fishing. Regardless of the cause of the decline, fishing mortality needs to be controlled to prevent further deterioration in the condition of the stock, and if the stock has been overfished, to allow it to rebuild.[2/] Amendment 11 to the groundfish FMP established the "status determination criteria" (including MSST) that are used to determine whether overfishing is occurring and whether a stock has reached an overfished state. Rebuilding plans specify how an overfished stock will be rebuilt.

The proposed action is needed because National Standard 1 in the Magnuson-Stevens Act requires conservation and management measures that prevent overfishing. Preventing overfishing also means returning stocks to a size capable of achieving maximum sustainable yield (MSY). In order to satisfy this mandate rebuilding plans must be adopted for stocks that have been declared overfished by the Secretary. First, a framework describing how rebuilding plans will be adopted and the contents of the plan that will be incorporated into the FMP or regulations must be established. This framework is needed to guide the development and adoption of subsequent rebuilding plans.

1.2.2 Purpose of the Proposed Action

The purpose of this amendment is to establish the process and standards by which the Council will specify rebuilding plans for groundfish stocks declared overfished by the Secretary. Both the procedural provisions and the standards established for rebuilding plans must meet the requirements of the Magnuson-Stevens Act (and, in particular, National Standard 1 and §304(e), covering overfishing) and should be consistent with FMP goals and objectives.

1.3 Background

1.3.1 Requirements for Rebuilding Plans

National standard guidelines specify how rebuilding should occur and, in particular, establish constraints on council action (50 CFR660.310(e)). Rebuilding should bring stocks back to a population size that can support MSY (B_{MSY}). A rebuilding plan must specify a target year (T_{TARGET}) based on the time required for the stock to reach B_{MSY}. This target is bounded by a lower limit (T_{MIN}) defined as the time needed for rebuilding in the absence of fishing (i.e., F = 0). Rebuilding plans for stocks with a T_{MIN} less than ten years must have a target less than or equal to ten years. If, as is the case with most of the groundfish stocks considered in this amendment, the biology of a particular species dictates a T_{MIN} of ten years or greater, then the maximum allowable rebuilding time, T_{MAX}, is the rebuilding time in the absence of fishing (T_{MIN}) plus "one mean generation time." Mean generation time is a measure of the time required for a female to produce a reproductively-active female offspring (Pielou 1977; and especially Restrepo *et al.* 1998) calculated as the mean age of the net maternity function (product of survivorship and fecundity at age). According to the Magnuson-Steven Act states the rebuilding time should be as short as possible, taking into account the status

1/ The amendment also removed FMP provisions that allowed foreign fishing on groundfish stocks. This part of the amendment was not challenged and these changes to the FMP stand.

2/ But when environmental changes affect the long-term productive capacity of the stock, one or more components of the status determination criteria may be respecified and the need for a reduction in fishing mortality reevaluated (50 CFR Section 600.310).

and biology of the overfished stocks and the needs of fishing communities (Sec. 304(e)(A)(i)). In most cases, because of the biology of the stocks and the needs of fishing communities, the rebuilding time, or the target year, will be greater than the minimum rebuilding time (T_{MIN}).

Because of the uncertainty surrounding stock assessments and future population trends (due, for example, to variable recruitment), these limits and the target need to be expressed probabilistically. At the outset of the rebuilding period T_{TARGET} should be set so there is at least a 50% probability of achieving it within the specified time period.[3/] (The nature of probabilities associated with T_{MIN}, T_{TARGET}, and T_{MAX} are discussed in section 3.1.2.2.)

National standard guidelines identify a "mixed-stock complex" exception to the definition of overfishing (50 CFR 660.310(d)(6)), which is applicable to some overfished groundfish species. Different fish assemblages—some with healthy stocks and some with overfished stocks—can co-occur in a mixed-stock complex, and thus both can be caught simultaneously. An optimum yield (OY) harvest for the healthy stock can result in overfishing the depleted stock. The guidelines allow councils to authorize this type of overfishing if three conditions are met. First, a FMP (or plan amendment) must assess the overall benefits of such a policy in comparison to other measures, such as reducing the OY for the healthy stock (50 CFR 660.315(f)(6)). Second, councils must consider mitigating measures that reduce overfishing by, for example, modifying fishing strategy or gear configuration. The benefits of mitigation must be compared to those determined in the preceding assessment; the measures would only be implemented if they will result in greater benefits. Finally, permitted overfishing cannot result in eventual listing of the species (or evolutionarily significant unit thereof) under the Endangered Species Act (ESA). This mixed-stock exception may be considered in formulating rebuilding plans and could allow some modification in the recovery trajectory of overfished stocks.

National standard guidelines also distinguish the activity of "overfishing" from the status of a stock characterized as "overfished." Overfishing is defined by the maximum fishing mortality threshold (MFMT); harvest mortality above this limit constitutes overfishing. A stock is considered overfished when its biomass falls below the MSST, which is defined as 25% of the unfished biomass for stocks managed under the groundfish FMP. Although sometimes causing confusion, this distinction is an important one. It can be seen that any combination of these two features may apply to a stock. For example a stock above the MSST may experience overfishing (because the MFMT is being exceeded). Conversely, an overfished stock (biomass below the MSST) may not be experiencing overfishing. In fact, stock rebuilding characterizes this second condition where historical overfishing has caused the stock to become overfished. Although overfishing is no longer occurring and the stock is rebuilding, the stock is considered overfished until it returns to the target biomass.

1.3.2 Summary of the Current Management Regime

Draft rebuilding plans and rebuilding analyses have been used since 2000 to guide the Council in deciding management measures for overfished groundfish stocks. Provisions in Amendments 11 and 12 of the FMP established a framework for their development and implementation, in a way thought to be consistent with the Sustainable Fishing Act ([SFA], which re-authorized the Magnuson-Stevens Act and added new provisions). As specified in these draft rebuilding plans, rebuilding management measures would be adopted through the Council's annual process of setting harvest specifications for the groundfish fishery. In addition to the draft rebuilding plans, rebuilding analyses, (which are written by the stock assessment authors) and the EA or EIS for each year's harvest specifications (used in the Council/NMFS decision making process) take into account the scientific and legal constraints on harvests imposed by the need to rebuild overfished groundfish fisheries. Although the Council has respected these constraints in its decisions to date, NMFS has the authority to reject these decisions because in the regulatory context they only represent recommendations to the Secretary.

3/ The use of a low bound 50% probability is not specified in regulations; it is the result of litigation (*Natural Resources Defense Council v. Daley, April 25, 2000, U.S. Court of Appeals for the District of Columbia Circuit*).

The Council has typically chosen a risk-averse strategy when deciding on harvest levels for overfished stocks, based on recommendations contained in rebuilding analyses and given by the Council's advisory bodies. Total mortality has been controlled by reducing trip and landing limits for co-occurring species in select target fisheries, gear restrictions (e.g., the small footrope specification for landing shelf rockfish), seasonal closures (e.g., the recreational groundfish fishery seasons adopted in California), and area closures (e.g., the Rockfish Conservation Area).

The actual discard rate (or bycatch) of fish species that are overfished, which may differ among the various groundfish fishery sectors, is a critical uncertainty that must be addressed if effective measures to control total mortality and thus achieve rebuilding objectives are to be adopted. Limited data have been available on which to base these estimates. Therefore, bycatch and discard rate assumptions have been contentious and the focus of some recent legal challenges. However, NMFS implemented an observer program in August 2001, which allows direct observation of commercial bycatch and discard. Data from this program will promote more informed management decisions and allow managers to more effectively control total mortality of overfished groundfish stocks.

1.3.3 Summary of Litigation over Amendment 12

In January 2000, NRDC along with other conservation organizations challenged the adequacy of Amendment 12 (*Natural Resources Defense Council v. Evans*) in Federal District Court. They claimed that rebuilding plans submitted pursuant to Amendment 12 were inadequate for two reasons. First, they did not take the form of FMPs, plan amendments, or regulations as required by the Magnuson-Stevens Act. Second, rebuilding plans could allow overfishing under the "mixed-stock exception." The NRDC argued the overfished species provisions in the SFA demonstrate Congress's intent to eliminate this exception so rebuilding plans should not entertain this exception. The Plaintiffs also argued the EA accompanying Amendment 12 failed to consider a reasonable range of alternatives as required by NEPA. The Court found for the Plaintiffs on the claim that rebuilding measures must conform to the Magnuson-Stevens Act-mandated format of a plan, amendment, or regulation and the NEPA-related claim of an inadequate range of alternatives. The Court decided the second Magnuson-Stevens Act-related claim, on the validity of the mixed-stock exception, was not ripe for judicial review because the exception had not yet been applied to Pacific groundfish management. In response to its findings, the Court ordered NMFS to revise Amendment 12 so the rebuilding plan implementation process accords with Magnuson-Stevens Act and NEPA requirements.

1.3.4 Development of Rebuilding Plan Adoption Strategy

Because of the litigation described above, in late 2001 work began on a new FMP amendment for the rebuilding plan adoption process that would be consistent with the Court's findings. The Council and NMFS published a Notice of Intent (NOI) to prepare an EIS on April 16, 2002 (67 FR 18576). According to this Notice, the EIS would evaluate two sets of alternatives: one set addressing the framework for rebuilding plan adoption (or the "process and standards") and a second set evaluating different rebuilding strategies that could be adopted as a rebuilding plan. (These strategies are described in terms of targets and limits, such as T_{TARGET}, T_{MIN}, and T_{MAX}, harvest control rules satisfying a given target, and potential management measures to constrain fishing mortality to levels determined by the harvest control rule.) Based on internal discussion, Council staff decided in late 2002 the process and standards alternatives should be analyzed in a separate environmental document. Staff determined the process and standards proposed action is not likely to have significant environmental impacts and, therefore, could be analyzed in an EA. This approach allows these alternatives to be evaluated, and the FMP amended on a more accelerated track. In addition to simplifying the adoption of the rebuilding plan framework, preparation of the subsequent amendments that actually adopt the rebuilding plans can be prepared in a manner that conforms to the already-adopted framework. Because of this change of strategy, NMFS and the Council published a second NOI on March 18, 2003, (68 FR 12888) and identified an additional public scoping opportunity. As described above in section 1.1, at least two related amendments will be prepared subsequent to this EA, adopting the rebuilding plans themselves.

1.4 Scoping Summary

1.4.1 Background to Scoping

The National Environmental Policy Act requires that the public and other agencies be involved in the decision making process. "Scoping" is an important part of this process. Scoping is designed to provide interested citizens, government officials, and tribes an opportunity to help define the range of issues and alternatives that should be evaluated in the EIS. NEPA regulations stress that agencies should provide public notice of NEPA-related proceedings and hold public hearings whenever appropriate during EIS development (40 CFR 1506.6).

The scoping process is designed to ensure that all significant issues are properly identified and fully addressed during the course of the EIS process. The main objectives of the scoping process are to provide stakeholders with a basic understanding of the proposed action, explain where to find additional information about the project, provide a framework for the public to ask questions, raise concerns, identify issues, recommend options other than those being considered by the agency conducting the scoping, and ensure that those concerns are included within the scope of the EIS review process.

On April 16, 2002, NMFS and the Pacific Fishery Management Council (Council) published a Notice of Intent (NOI) in the Federal Register announcing their intent to prepare an environmental impact statement (EIS) in accordance with the National Environmental Policy Act of 1969 (NEPA) for Amendment 16 to the Pacific Coast Groundfish Fishery Management Plan (Groundfish FMP). The FMP would be amended to establish procedures for periodic review and revision of rebuilding plans and incorporate rebuilding plans for overfished groundfish species.

NMFS and the Council subsequently decided to prepare two (or more) separate analyses for these actions. This document, Amendment 16-1, establishes the rebuilding plan adoption and review process, while subsequent amendments will adopt rebuilding plans. Therefore, on March 18 , 2003, NMFS and the Council published a second NOI (68 FR 12888). This NOI

- presented a schedule for a renewed scoping process, based on the change in approach;
- described a scoping meeting to be held on April 6, 2003;
- identified where additional information about the proposed project could be obtained;
- explained the roles of NMFS and the Council in the EIS and authorization processes;
- described the EIS process after scoping and presented a tentative EIS schedule;
- presented a brief summary of the history of rebuilding plans; and,
- described the alternatives being considered to date by NMFS and the Council for inclusion in the EIS.

Publication of the NOI announced public and agency scoping comment period that ended on May 30, 2003.

1.4.2 Council Scoping and Agency NEPA Scoping

The Council process, which is based on stakeholder involvement, allows a lot of public participation and public comment on fishery management proposals during Council, subcommittee, and advisory body meetings. The advisory bodies involved in groundfish management include the Groundfish Management Team (GMT), with representation from state, federal, and tribal fishery scientists; and the Groundfish Advisory Subpanel (GAP), whose members are drawn from the commercial and recreational fishery, processing, and conservation sectors. The Ad Hoc Allocation Committee, a subpanel of the whole Council, provides advice on allocating harvest opportunity among the various fishery sectors. These opportunities all constitute the broadly defined Council scoping process, not all of which focuses on the scope and content of NEPA analysis. The Council and its advisory bodies considered rebuilding plans, and took public comment on them, at six different meetings held in March, April, June, September and November 2002, and April 2003.

In addition, NMFS and the Council hosted a public scoping meeting on April 6, 2003 at the Red Lion Hotel in Vancouver, Washington specifically for the purpose of getting comments on the scope of the NEPA analyses for rebuilding plan related actions. Approximately 28 people attended. The meeting served two purposes: to listen to and record the public's comments about the proposed action, and to respond to requests for background information. NMFS and Council staff were available to answer questions and offer explanations. All comments were documented as part of the administrative record.

1.4.3 Summary of Scoping Comments Received by the Council

Written and oral comments were received from 18 different sources received during both Council scoping during and the public scoping meeting held on April 6. A summary of commenters is provided below.

Comment source	Number of
Agency	1
Commercial fishing sector	9
Conservation organizations	4
Municipal government	1
Processing sector	2
Tribes	1
TOTAL	18

The number of times an issue is raised during the scoping process provides an indication of the issues that commenters are most concerned about. Scoping also helps agencies eliminate from detailed study issues that are not significant (40 CFR 1501.4(g)).

1.4.3.1 Identification of Issues

Analysis of the comments received during the scoping process is an important step in identifying key concerns about the proposed project. The comments received during the scoping process were individually analyzed and can be separated loosely into four groups.

- Observations and opinions. These comments were not recommendations, but general observations and opinions about the management process, scientific validity, and other topics related to rebuilding plans.
- Issues outside the scope of these analyses in the EA and EIS.
- Recommendations relevant to the Amendment 16-1 EA.
- Recommendations relevant the Amendments 16-2 EIS.

Using these categories comments were screened to determine which recommendations were relevant to this EA analysis. They were brought forward and used to determine what types of environmental impacts would be evaluated.

1.4.3.2 Recommendations Brought Forward As Part of the Analysis

This section lists the recommendations used in structuring the environmental impact analysis and notes how they have been incorporated into this document. Although the comments summarized below are enclosed in quotes to set them off from the rest of the text, they are not taken verbatim from the written and oral comments received by the Council. Most have been reworded for clarity or brevity. Original written comments, and transcripts of oral comments, are available from the Council upon request.

<u>Endangered Species Act</u>

- If a higher standard for conservation is required under the Endangered Species Act (ESA) for a period of time until species are either de-listed or rebuilt, the Council should use that higher standard."

  The possibility of an ESA listing will be accounted for in the range of alternatives, specifically the options under Issue 4 (see Chapter 2).

Flexibility

- Commit to maintaining OYs or sticking to the T_{TARGET}."
- Rebuilding measures should be in the FMP so they have the best assurance of remaining in place."
- The habitat and bycatch and other management elements should be part of the groundfish FMP, so that those standards are more difficult to change than under regulation."
- Resist the temptation to maintain maximum flexibility in rebuilding plans; it's contrary to the Magnuson-Stevens Act and does not show a serious commitment to rebuilding."

These comments relate to the way in which rebuilding plans will be adopted, or come into effect, and the type of rebuilding strategy that will be pursued. These concerns will be addressed in the range of alternatives, specifically the options under Issue 1 in Chapter 2. Effects under this issue will be evaluated in Chapter 4.

Precautionary approach

- Reduce exploitation rates to compensate for missing or uncertain ecological information."
- The lack of comprehensive data on the marine environment and species sustainability demands an ecologically protective approach to rebuilding."
  These comments relate to the framework used for rebuilding overfished species, which will be discussed in Chapter 3.

Process

- Clearly define terms (like F, harvest control rule, harvest rule)."
- Include an end point for implementation in this process (don't keep it open-ended)."
- Make it clear to the public that there is a standard for P_{max}."

These comments relate to the process for adopting rebuilding plans and technical aspects of rebuilding, which will be discussed in Chapters 2 and 3.

Stock Assessment Timelines

- Coordinate re-evaluation of rebuilding measures with stock assessments (should be done every two years, or change the law)."
- Properly ensure that stocks are being rebuilt (by conducting stock assessments every two years)."

The schedule for evaluating rebuilding process will be part of the alternatives presented in Chapter 2. The options under Issue 2 cover different review schedules.

Science and data

- How do you measure whether fish are being rebuilt?"

Chapters 1 and 3 will describe the targets used to determine stock status.

1.4.4 Criteria Used to Evaluate the Impacts of the Amendment 16-1 Proposed Action

By screening and considering public comments and input from NMFS, Council staff developed criteria for assessing the impacts of the actions to be implemented under Amendment 16-1. The proposed action establishes a framework for adopting rebuilding plans; because it is primarily administrative, scoping determined that it would not directly affect the environment. For this reason evaluation criteria focus on effects to the management regime. These criteria are:

The effect on administrative capacity. Complicated procedures for adopting and amending rebuilding plans would require more staff time while simpler procedures would require less staff time. If more administrative capacity were devoted to adopting and amending rebuilding plans there would be less capacity to address other management priorities. This could indirectly affect the environment to the degree that un-addressed priorities have a beneficial impact.

The effect on adaptive management. If the rebuilding framework makes it difficult to change the key rebuilding targets (such as the year by which the stock should be rebuilt) that are used to guide rebuilding management measures, it will be difficult to adapt to changing environmental conditions that produce new values for these parameters. This makes the management framework less adaptive and could lead to a situation where management measures do not support rebuilding. Conversely, if rebuilding targets can be changed easily, short-term socioeconomic impacts could take precedence in decision-making over long-term socioeconomic and environmental benefits. This too is not adaptive, since fixed management goals provide a boundary for short-term management responses.

The effect on public participation. Generally, procedural complexity provides more opportunity for public participation and comment. For example, some processes require more Council meetings to make a decision or have a statutory public comment period. Greater public participation can have a number of indirect environmental benefits. First, it forces decision-makers to consider a proposed action from different perspectives, sometimes revealing an environmental impact that the decision-maker would not have otherwise considered. Second, participation can achieve a greater level of buy-in by stakeholders, which can reduce controversy and increase support for and compliance with management measures.

In addition to evaluating the effect of the proposed action on the management regime, using the three criteria outlined above, the EA will also consider the effect of the choice of rebuilding strategy on the potential for successfully rebuilding overfished stocks. The choice of strategy affects options covering the form and content of rebuilding plans and standards for determining the need to revise rebuilding plans. Different strategies will be evaluated in terms of the policy and procedural risks that rebuilding will not occur within the time period identified in the rebuilding plan.

2.0 PROCESS AND STANDARDS ALTERNATIVES

This Chapter presents alternative formats and procedures for developing rebuilding plans and implementing measures to rebuild overfished stocks. The following section presents four sets of options, organized around relevant issues. This allows the Council to structure a preferred alternative by combining options identified for each of the four issue categories.

This amendment also makes minor technical additions, corrections, and changes to the FMP. These changes are categorically excluded from analysis as described in Section 6.03.a.3(b)(2) of NAO 216-6. They are summarized in section 2.2 and documented in the amendatory language found in Appendix A, along with those substantive changes to the FMP approved under the authority of the Magnuson-Stevens Act. A separate memo to file has been prepared by NMFS NWR providing the rationale for categorically excluding these changes to the FMP.

2.1 Issues and Options

Options (alternatives) covering four issues related to the development and adoption of rebuilding plans are considered in this chapter:

- Issue 1: The form and required elements of rebuilding plans
- Issue 2: The process for periodically reviewing rebuilding plans.
- Issue 3: Defining events or standards that would trigger revision of a rebuilding plan.
- Issue 4: The status of rebuilding measures for species subsequently listed under the Endangered Species Act.

2.1.1 Issue 1- The Form and Required Elements of Rebuilding Plans

The Magnuson-Stevens Act requires that Councils or the Secretary take action to end overfishing and rebuild any stock that is overfished or approaching an overfished condition. The standard convention for actions taken to rebuild a stock has been termed the "rebuilding plan." Options under this issue encompass the Magnuson-Stevens Act mandate that rebuilding requirements take the form of a FMP amendment or regulation and the status quo where the rebuilding period was specified solely in policy documents. Three aspects of this issue may be distinguished. First, what rebuilding plan elements and supporting rationale should be incorporated into the FMP and/or regulations? Second, in which venue—the FMP or regulations—should specified rebuilding plan elements or other information appear? Third, if the limits and targets comprising the rebuilding framework can be numerically specified, should these values be included in the FMP or regulations?

From the Magnuson-Stevens Act and National Standard Guidelines (50 CFR 600, Subpart D) it appears the only specifically identified element of a rebuilding plan that must be set in the FMP or regulation is the rebuilding time (MSA 304(e)(4)(A)).[4/] However, when a stock has been overfished, the FMP must be amended

4/ While only the target rebuilding time must be part of a FMP or regulatory amendment, there are two constraints placed on Council actions to rebuild overfished species. First, remedial actions must fairly and equitably allocate restrictions and recovery benefits among sectors (MSA 304(e)(4)(B)). This appears to be a more specific application of National Standard 6 and not a new requirement to which councils or the Secretary must respond. Second, for fisheries governed under international agreements, the rebuilding action should reflect traditional participation by fishermen of the US relative to those of other countries (MSA 304(e)(4)(C)). None of the West Coast groundfish species are currently governed under international agreements. The groundfish species most likely to be the subject of a future international agreement is Pacific whiting. Halibut and salmon fisheries do come under international agreements and could be affected by the need to substantially restrict groundfish mortality.

or regulations implemented to "end overfishing and to rebuild affected stocks" (MSA Section 304(e)(3)(b)).[5/] Under the FMP as currently written, actions required to "end overfishing and rebuild the affected stock" are implemented by regulations under the annual management process, derived from the rules for specifying and managing for the OY. As specified in the National Standard Guidelines (50 CFR 600.310 (f)(1)), "in the case of an overfished fishery, [OY is constrained to an amount of harvest mortality] that provides for rebuilding to a level consistent with producing MSY in such fishery." The FMP also specifies that OYs will be constrained by rebuilding needs and fishery management regulations established to meet OY. These provisions therefore appear to meet the standards of Section 304(e)(3): that rebuilding measures be described in FMPs or regulations. However, under Amendment 12 to the groundfish FMP, the Council has set its rebuilding time targets during the annual specification process; these targets are not specified in the FMP or regulations. Thus the Council omitted from its FMP and regulations the elements required to be part of a rebuilding action. In addition, NMFS has published ancillary guidance describing a number of other parameters not identified in the Magnuson-Stevens Act that should be included in rebuilding plans (Restrepo *et al.* 1998).

The language in the Magnuson-Stevens Act states that rebuilding measures (and specifically, the "time period for ending overfishing and rebuilding the fishery") may be adopted as a FMP, FMP amendment or regulation. The options described below do not consider developing a new FMP for overfished species. According to these options, rebuilding measures would be described in the existing groundfish FMP, in regulations, or some combination of these two documents. As a general proposition, the FMP describes procedures for managing the fishery and serves as a code obligating the Council and fishery managers to follow these procedures and manage according to specified goals and objectives. Regulations are broader in application, serving as laws governing the behavior of the general public, or in this case that segment of the public utilizing certain fishery resources. The options outlined below also contemplate using regulations to promulgate a relatively narrow subset of a rebuilding strategy: the numerical values for the harvest control rule and target year.

Tables 2.1 and 2.2 illustrate the range of possible elements that may be considered part of a rebuilding plan. The options presented below outline which of these elements would be incorporated in the FMP, regulations or some combination of these two documents. The term "elements" includes narrowly defined parameters and management measures that would be used to achieve rebuilding targets. These parameters are derived from National Standard Guidelines and the rebuilding analysis methodology (detailed in section 3.1.2.2); they provide a general framework for determining how overfished stocks may be rebuilt and numerical values can be determined for these parameters. Which of these parameters to incorporate into the FMP and/or regulations, and how to specify them, has been a subject of considerable deliberation in developing this FMP amendment. As discussed in section 3.1.2.2, the numerical values associated with these parameters are almost certain to change as new stock assessments increase our understanding of the status of overfished stocks. If these values are numerically specified in the FMP/regulations the FMP may have to be amended frequently in order to update these documents each time new values are calculated. This argues for a "flexible" approach that would limit the number of numerically specified parameters; instead, parameters are defined by a formula or algorithm relating the parameter to some other measure. Conversely, there is concern that if these parameters are not specified there will be no fixed guideposts for managers, who might otherwise emphasize the short-term benefits of higher harvests over the long-term goal of rebuilding overfished stocks. This concern favors a "fixed" approach where the value of these parameters would be specified in the FMP/regulations. By the same token, management measures could be described generally or specifically. Tables 2.1 and 2.2 give examples of how these elements might be described under a flexible strategy versus a fixed strategy. Table 2.1 also provides definitions for the terms used to describe rebuilding plan parameters discussed in the options below.

Based on these considerations, the following four options have been identified:

Option 1a There is no framework for specifying the form of rebuilding plans (status quo). The FMP as amended by Amendment 12 directs the Council to prepare and adopt rebuilding plans as policy guidance documents as described in FMP Section 5.3.6 (Stock Rebuilding Requirements).

5/ CFR 50 Section 600.310 (e)(4)(ii) states that "in cases where overfishing is occurring Council action must be sufficient to end overfishing."

However, the Court set aside the relevant parts of Amendment 12 and remanded it (see Section 1.3.3 of this document) without proposing specific changes to FMP language. For the purposes of describing the status quo, the remand can be interpreted to mean that all references in the FMP to rebuilding plans only implemented as part of the annual management process are struck out. Therefore, although the FMP describes the contents of rebuilding plans, it does not describe their form and there is no framework for rebuilding plan adoption. Currently management measures described in section 6.2 of the FMP—including automatic actions, notices, abbreviated rulemaking actions, and full rulemaking actions—are used to implement interim rebuilding plans. Thus, each rebuilding plan would need to comply with the Magnuson-Stevens Act, but without any additional description of the process in the FMP.

Option 1b **Numerically specify P_{MAX}, T_{MIN}, T_{MAX}, and T_{TARGET}, describe the harvest control rule, and outline the methods used to calculate B_{MSY} in the FMP.** Current guidelines in the FMP with respect to rebuilding plan goals and objectives and the contents of rebuilding plans (sections 5.3.6.1 and 5.3.6.2 of the FMP[6/]) would be retained as a guide to formulating rebuilding plans. In order to comply with the court order, references to rebuilding plans as policies or principles implemented through annual management would be stricken. Section 5.3.6.2 of the FMP would be amended to state that for each overfished species the numeric value of P_{MAX} (as either a decimal fraction or percent), and T_{MIN}, T_{MAX}, and T_{TARGET} (as dates) would be specified in the FMP. (These values could be incorporated in tabular format.) This section would also state that the FMP would describe the harvest control rule (e.g., as a rate, constant catch or some combination thereof) and the methods used to calculate B_{MSY} (including relevant formulas). The numerical value associated with the harvest control rule and for B_{MSY} would not necessarily have to be specified. Rebuilding plan adoption would entail amending the FMP to include these specified values in the FMP. If the harvest control rule for a given overfished species was specified in the FMP, and a new stock assessment showed the specified harvest rate would result in the stock reaching the target biomass later than the specified T_{TARGET}, then the recomputed harvest rate satisfying T_{TARGET} would apply until the FMP could be amended to correct specified parameter values.

Option 1c **Numerically specify T_{TARGET} and the harvest control rule in federal groundfish regulations.** The FMP would be amended to state that for each overfished species the target rebuilding year (T_{TARGET}) would be specified (as a date) and the harvest control rule described (e.g., as a rate, constant catch or some combination thereof) and an appropriate numerical value specified in federal groundfish regulations. FMP language also would be revised to better describe the contents of rebuilding plans, the adoption process, and, as above, to strike any language at variance with the court order. If, after a new stock assessment, computations reveal the specified harvest control rule would result in the stock reaching its target biomass later than the specified T_{TARGET}, the harvest control rule would be re-specified in federal groundfish regulations through full (notice and comment) rulemaking. The FMP would also describe the following circumstances under which the target year could be changed: (1) after a new stock assessment, re-computed parameters result in a T_{TARGET} greater than T_{MAX}; (2) due to a change in parameters resulting from a new stock assessment, the corresponding OY for the overfished species would result in substantial negative socioeconomic impacts. This second circumstance would have to be supported by commensurate analysis. (These circumstances are exemplary; the Council could change the target year for other reasons, if justifiable through commensurate analysis.) If the Council recommended such a change in the target year, these changes would also be made through full (notice and comment) rulemaking. All other rebuilding plan elements, and updates to rebuilding plans, would be published in the Stock Assessment Fishery Evaluation (SAFE) document.

6/ As mentioned in section 2.2 and shown in Appendix A, these section numbers would change in the amended FMP.

Option 1d Numerically specify T_{TARGET} and the harvest control rule in federal groundfish regulations. In addition, describe the methodology for computing rebuilding parameters and the numerical values for these parameters at the time of rebuilding plan adoption in the FMP. This Option is similar to Option 1c, except that additional information describing the status of the stock would be included in the FMP. This would include estimates at the time the rebuilding plan was adopted of: unfished biomass (B_0) and target biomass (B_{MSY}), the year the stock would be rebuilt in the absence of fishing (T_{MIN}), the year the stock would be rebuilt if the maximum time period permissible under National Standard Guidelines were applied (T_{MAX}) and the year in which the stock would be rebuilt based on the application of stock rebuilding measures (T_{TARGET}). These estimated values serve as management benchmarks. The FMP would not be amended if, as is likely to happen, the values for these parameters change after new stock assessments. This point cannot be over-emphasized because changing these values in the FMP would require frequent amendments. Instead, updated values would be published in the SAFE document. The FMP would also include a description of how these parameters are computed. If the computational method differs for a particular species, then these differences would be described in the FMP. Like Option 1c, both the target rebuilding year (T_{TARGET}) and the harvest control rule would be specified in federal groundfish regulations. As discussed above, full (notice and comment) rulemaking would be used to change the harvest control rule specification in federal groundfish regulations if a new stock assessment reveals the current value would result in the stock reaching its target biomass later than the specified T_{TARGET}. Similarly, the FMP would also describe two circumstances under which the target year could be changed: (1) after a new stock assessment, re-computed parameters result in a T_{TARGET} greater than T_{MAX}; (2) due to a change in parameters resulting from a new stock assessment, the corresponding OY for the overfished species would result in substantial negative socioeconomic impacts. This second circumstance would have to be supported by commensurate analysis. (These circumstances are exemplary; the Council could change the target year for other reasons, if justifiable through commensurate analysis.) If the Council recommended such a change in the target year, these changes would also be made through notice and comment rulemaking.

Currently, rebuilding actions are implemented through the annual process of specifying management measures, as described in Section 6.2.1 of the FMP. Options 1b-1d identify different ways that substantiative elements could be incorporated into the FMP, regulations, or both, in order to obligate the Council and NMFS to manage towards identified targets.

When thinking about the various rebuilding parameters describing how a stock will be rebuilt, it is important to recognize that some of the terms introduced and described above represent policy decisions at the national level and the Council ***does not have a choice*** in setting their values. The dates for T_{MIN} and T_{MAX} are determined based on guidelines established at the national level. Mean generation time is a biological characteristic that cannot be chosen by policymakers. Thus, the Fishery Council cannot choose these values and then use them as a basis for management. Defined in national guidelines, T_{MIN} is a consequence of the productivity of the fish stock and is calculated by fishery biologists based on information they get from a particular stock. Similarly, T_{MAX}, which is calculated from T_{MIN}, does not represent a Council choice.

Fundamentally, when developing a management strategy the Fishery Council is able to choose a harvest control rule (which may be expressed as a fishing mortality rate or by some other means), and the corresponding annual level of fishing. This ***does*** represent a Council choice because managers have the means to limit the amount of fish that are caught. However, when rebuilding overfished species it is possible to think about how to set these fishing limits in different ways. The Council could base their management strategy on either the value of T_{TARGET}, the probability of reaching target biomass in the maximum permissible period (P_{MAX}), or the fishing mortality rate, keeping in mind these three values cannot be chosen independently of one another. In other words, the Council may choose one of these values and derive the other two from it, but they cannot choose the values for two of these terms independently of the third. T_{TARGET} must be the management target, given its name and the fact the Magnuson-Stevens Act states that a time period must be identified. However, it should be apparent the Council could base their choice of T_{TARGET} on P_{MAX} or the harvest rate since all three of these terms are related to each other. If the Council based their decision on P_{MAX}, for example, the corresponding target year and harvest rate could be easily determined through the rebuilding analysis.

While targets and limits would be described and/or specified under these options, none of the options would require the specific management measures used to achieve these targets be described in the FMP or regulations. Rebuilding plans (and the FMP) could contain general discussion of the types of management measures that will be used, based on the a revised enumeration of rebuilding plan contents in section 4.5.3.2 of the revised FMP (see Appendix A). Although not required, rebuilding plans could identify specific management measures, other than those usually implemented through annual/biennial management, that would be incorporated into the FMP and would be applied in addition to existing management measures identified in the FMP and/or established through the annual/biennial management cycle.

Although the management process may not change very much if rebuilding plan elements become part of the FMP or regulations (since the Council already adheres to interim rebuilding plans when developing annual management measures), public perceptions about the process could be influenced. If more elements are specified in the FMP or regulations, members of the public that are skeptical the Council will adhere to policies intended to rebuild stocks may be reassured. In addition, any changes to the rebuilding strategy, would be accompanied by a more extensive process with greater opportunity for public comment.

The administrative cost associated with a more involved process to incorporate rebuilding plan elements and subsequently update them can be measured as the direct value of the time and various expenses associated with the management process. Where administrative resources are limited, the costs can also be evaluated in terms of the lost opportunity for addressing other policy problems in the fishery. For example, the time and resources needed to amend a rebuilding plan may detract from managers' ability to improve capacity controls in the fishery. In this example the opportunity costs of the administrative action may be viewed as the difference in net benefits between the status quo capacity controls and the improved capacity controls that are delayed because of the need to modify a rebuilding plan.

Table 2.1. Parameters that describe the projected growth of the overfished stock towards its rebuilt state. The fixed and flexible specifications are exemplary and do not apply to any actual rebuilding plan or overfished stock.

Parameter	Description	Example of a Fixed Specification	Example of a Flexible Specification
B_0	Unfished stock biomass.	1,000 mt	The product of SPR in an unfished state and the average recruitment during the early years of the fishery.
B_{MSY}	Target stock biomass.	500 mt	40% of B_0 (or $B_{40\%}$)
T_{TARGET}	The target year by which the stock will be rebuilt.	50 years (or 2049)	The median rebuilding year for a specified probability.
T_{MIN}	The time needed to rebuild the stock in the absence of fishing, with a 50% probability.	41 years (or 2040)	The time the stock would be rebuilt in the absence of fishing with at least a 50% probability.
T_{MAX}	The maximum allowable rebuilding time under National Standard guidelines. If T_{MIN} is less than ten years, then T_{MAX} equals ten years. If T_{MIN} is equal to or greater than ten years than T_{MAX} equals T_{MIN} plus one mean generation time.[7/]	58 years (or 2057)	The time needed to rebuild the stock with at least a 50% probability.
Mean Generation Time	A measure of the time needed for a female to replace herself with an equivalently productive female.	17 years	Include explicit formula.
P_{MAX}	The estimated probability of reaching T_{MAX}, may not be less than 50%.	52%	P_{MAX} must remain >50%.
Rebuilding Harvest Control Rule	The harvest control rule that will be followed to rebuild a stock in for a given P_{MAX} and T_{TARGET} years. A harvest control rule associates a given stock size (or stock size proxy) with a given level of fishing mortality and a given level of potential harvest.	E = 0.27	A constant harvest rate sufficient to rebuild by T_{TARGET} with probability P_{TARGET}

7/ This formula is derived from Magnuson-Stevens Act language, which states that stocks will be rebuilt within ten years "except in cases where the biology of the stock of fish, other environmental conditions, or management measures under an international agreement in which the United States participates dictate otherwise" (Sec 304(e)(4)(a)(ii)).

Table 2.2. Management measures that could be detailed in rebuilding plans mentioned in the FMP, MSA, and/or identified through scoping. The fixed and flexible specifications are exemplary and do not apply to any actual rebuilding plan or overfished stock.

Element	Description	Example of a Fixed Specification	Example of a Flexible Specification
Allocation	MSA §304(E)(4)(b)); Allocations or allocation priorities for overfished species where specific allocations or allocation priorities have not already been specified under the procedures of the FMP or in the FMP. NOTE: Under other Options 1a-1d specific allocations are specified under existing FMP provisions or the allocation framework and implemented in conjunction with the annual process for setting OY.	"A specified percentage of the OY will be allocated to limited entry trawl."	"Limited entry trawl fisheries will be given preference for available OY"
Bycatch	**Include consideration** of the • the **adequacy of information** on bycatch and bycatch mortality. Measures needed to acquire the bycatch information necessary to adequately implement the harvest control rule may be considered as part of the rebuilding plan or in a separate plan pr regulatory amendment. Adopt risk averse harvest levels sufficient to account for uncertainty about bycatch. • the need for management measures to **minimize bycatch** and minimize the mortality of unavoidable bycatch as part of the rebuilding plans. Measures needed to minimize bycatch or the mortality of unavoidable bycatch may be considered as part of the rebuilding plan or in a separate plan or regulatory amendment.	"Finfish excluders must be used by the shrimp trawl fleet."	"Bycatch will be minimized through future gear modifications."
Habitat	Include specific habitat protection measures.	A specified portion of EFH for an overfished species is closed to fishing.	"Measures to minimize impacts to overfished species' habitat will be evaluated."
Closed Areas	Include consideration of the contribution areas closed to groundfish fishing might make to rebuilding the stock (closed areas could range in extent to restricting all fishing, i.e. no-take marine reserves). Include such measures in the plan as appropriate.	A marine reserve will be created in an identified area.	"Marine reserves will be evaluated as part of a species' rebuilding strategy."

2.1.2 Issue 2- The Process For Periodically Reviewing Rebuilding Plans

Although the Magnuson-Stevens Act requires the Secretary review rebuilding plans at least every two years (§304(e)(7)), an equivalent obligation is not assigned to the councils. Nonetheless, periodic Council review is advisable because changing environmental conditions and unanticipated events make it unlikely that overfished stocks will rebuild precisely to the trajectory that is forecast at the outset of the rebuilding period. Reviews allow the Council to decide if rebuilding measures need to be modified, which would likely entail a FMP or regulatory amendment, or both, depending on the options chosen above. Issue 3 is closely related to the periodic review process because options for the standards triggering a revision are outlined.

Option 2a **The Council reviews rebuilding plans at least every two years (status quo).** Currently, the FMP states "Rebuilding plans will be reviewed periodically, at least every two years, and the Council may propose revisions to existing plans at any time...." For the purposes of the status quo this is interpreted as Council review. Although not explicitly stated in the FMP, for this analysis it is assumed that rebuilding plans are reviewed with respect goals 1-5 defined in Section 5.3.6.1 of the current FMP. (Section 4.5.3.1 under the revisions proposed in Appendix A.) These goals are:

(1) Achieve the population size and structure that will support the maximum sustainable yield within the specified time period.
(2) Minimize, to the extent practicable, the social and economic impacts associated with rebuilding, including adverse impacts on fishing communities.
(3) Fairly and equitably distribute both the conservation burdens (overfishing restrictions) and recovery benefits among commercial, recreational and charter fishing sectors.
(4) Protect the quantity and quality of habitat necessary to support the stock at healthy levels in the future.
(5) Promote widespread public awareness, understanding and support for the rebuilding program.

Option 2b **(Council-preferred) The Council reviews rebuilding plan goals 2-5 every two years, but goal 1 only with new stock assessments.** As with option 2a, rebuilding plans are reviewed at least every two years to determine the success of the management measures in meeting rebuilding plan goals 2-5 defined in Section 5.3.6.1 of the FMP. New stock assessment data will be used to determine the success of the management measures in meeting the rebuilding plan goal 1. The Council may propose revisions to existing plans at any time, although in general this will be occur only during the annual/biennial management process. Any revisions to the rebuilding plan must also be approved by NMFS.

Option 2c **The Council reviews rebuilding plan goals 2-5 every two years; goal 1 is reviewed after stock assessments conducted according to a schedule described in the rebuilding plan.** This is the same as Option 2b except that a schedule for stock assessments is specified in the rebuilding plan and driven by the stock dynamics. For example, more frequent reviews and assessments could be conducted for more productive stocks. The schedule is also structured so that stock assessments and rebuilding plan reviews occur more often as T_{TARGET} draws closer.

Option 2d **The Council reviews rebuilding plan goals 2-5 every two years; goal 1 is reviewed after stock assessments conducted according to a pre-specified schedule described in the FMP.** This is the same as the preceding option except the FMP would specify the following assessment schedule for all overfished stocks: every four years when T_{MAX} is 20 years or more away and then every two years until the stock is rebuilt.

Option 2e **The Council will defer review to the Secretary.** The Council may propose revisions to existing plans at any time but these must be approved by NMFS. Each year the Council will compare actual harvest mortality to the harvest mortality goals identified in the rebuilding plan. They will also evaluate progress in rebuilding the stock biomass to the MSY level after each new stock assessment. This would be described in annual SAFE documents and the ongoing social and economic impacts of harvest policies necessary to rebuild overfished species would be evaluated in aggregate as part of annual specification of harvest regulations, which is supported by a NEPA analysis. The SAFE document should assist the Secretary in conducting Magnuson-Stevens Act-mandated two-year reviews (§304(e)(7)). A draft of any Secretarial review will be provided to the Council so they can make comments before it is finalized.

For options 2b, 2c, 2d, and 2e the Council's annual SAFE document will provide (1) the most recent information available on the best estimate of total fishing mortality for comparison to target fishing mortality levels described in the rebuilding plan; (2) the most recent assessment of stock size compared to the expected stock size for the rebuilding trajectory; (3) information on allocation and the social and economic status of the fishery. As noted, this information, and the record of Council actions to protect habitat and promote public awareness of rebuilding programs, would also support the Magnuson-Stevens Act-mandated Secretarial review.

New assessments can result in better estimates of biological parameters or fisheries descriptors. Once incorporated into a new rebuilding analysis, this can result in a dramatic change in rebuilding parameters such as the estimated probability that a stock can rebuild in the time specified, in comparison to previous analyses. For example, as a result of the most recent canary rockfish assessment (Methot and Piner 2002) scientists concluded the stock was less productive (in terms of expected recruitment) than previously thought because of a new estimate of the steepness of the spawner-recruit curve. This in turn increased the estimated value for T_{MIN}, and thus other rebuilding parameters. In addition, a new estimate of selectivity (the size or age classes typically removed by fishing) for a given fishery or the removals allocated to different fisheries with different selectivity patterns can change the estimated rebuilding time even though total catch remains the same. Again citing the most recent canary rockfish assessment, if the estimated proportion of total catch taken by recreational fisheries increases, the target rebuilding year will be delayed because of the generally smaller size (corresponding to younger fish) that recreational fishers take in comparison to commercial fisheries.

Long-term stock assessment schedules would be established under Option 2c and 2d. This approach would be difficult to implement because NMFS cannot commit resources to such a specific schedule over the long term.

The choice between these options will mainly affect administrative burden, and to a certain degree, the distribution of that burden among agencies. Under Options 2a through 2d, the Council would formally review rebuilding measures at least every two years; these reviews would provide much of the information needed by the Secretary for his Magnuson-Stevens Act-mandated biennial review. Although the Council would not conduct a formal review under Option 2e, the analyses and information resulting from the harvest specification process would allow the Council and the Secretary to evaluate rebuilding progress and performance. More frequent review would increase administrative burden; and if such reviews required more extensive revision of the FMP or regulations (depending on the options chosen under Issue 1) this too would result in a heavier workload.

2.1.3 Issue 3- Amending Rebuilding Plans and Adequacy of Progress

Issue 2 contemplates periodic reevaluation of rebuilding measures. It is expected the rebuilding plans would be revised (and necessary FMP or regulatory amendments made) when these periodic reviews reveal a significant discrepancy between current stock status (most likely expressed as the probability of achieving rebuilding within the target time period) and that projected in the original rebuilding plan or in earlier reviews. In most cases the harvest strategy can be adjusted during the annual specification process (or at any other time if necessary) so that rebuilding targets can be met, although this could also require a FMP or regulatory amendment (based on the option chosen under Issue 1). However, there may be times when new information results in a change to some other crucial parameter (B_0 for example), affecting a whole range of other parameters. In these cases the rebuilding plan would be revised, and the FMP and/or regulations amended to change those elements incorporated therein. The options outlined below detail various standards that could be used to decide if such revisions and amendments are necessary.

Option 3a **No standards to evaluate rebuilding progress (status quo).** Currently, the FMP does not describe a standard to evaluate the adequacy of rebuilding measures and determine if rebuilding parameters or management measures need to be changed.

Option 3b **A standard based on a minimum P_{MAX} value.** If the probability of achieving T_{MAX} falls below 50% (the required minimum value), then progress will be considered inadequate and the harvest control rule must be adjusted to increase the probability of rebuilding within the maximum time to at least 50%. Other needed changes to rebuilding measures would also be considered. Depending on what options are chosen under Issues 1 and 2, FMP and/or regulatory amendments may be required.

Option 3c **A standard based on the specified P_{MAX} value.** This option is identical to option 3b except the probability of achieving T_{MAX} established in each species-specific rebuilding plan (as modified during previous reviews) is used as the standard. If the measured value is below this value then the procedures identified under option 3b would be implemented.

Option 3d **Rebuilding plans will be revised whenever new information from stock assessments or rebuilding analyses reveals a significant change in rebuilding parameters.** The Council, in consultation with the Scientific and Statistical Committee (SSC) and Groundfish Management Team (GMT), will determine on a case-by-case basis whether there has been a "significant" change in a parameter.

Option 3e **(Council-preferred) A specific standard for determining when progress has been adequate is established for each plan.** No generic standard is identified in the FMP for all overfished species. Instead, the FMP would require that each rebuilding plan identify such a standard from a list of possibilities based on the options outlined above.

Options 3b and 3c bracket a range of other possible policies; for example, a required rebuilding plan revision could be triggered by some other probability value, such as one halfway between the specified value (P_{MAX}) and the minimum value (50%). Generally, a standard that allows the probability to deviate significantly from the specified value would risk triggering a sudden, substantial change in the harvest policy with attendant disruptive effects on fisheries. For example, if a specified P_{MAX} of 80% declines over several years to a value below 50%, the required harvest policy change at that point would result in a sudden large reduction in that year's OY, with attendant effects on the fishery. On the other hand, this strategy, by giving relatively wide latitude for changes in P_{MAX}, would lessen the frequency of required revisions to the rebuilding plan (and attendant FMP and regulatory amendments), reducing administrative burden.

Options 3d and 3e would allow relatively more flexibility by giving the Council some control over when and whether to revise rebuilding plans. Option 3e emphasizes a procedural approach that relies on judgements made as part of the Council process. Like the choice of other more flexible components of a rebuilding process and standards framework, there is some risk the public will not trust these judgements. Option 3e maintains flexibility by allowing standards to better match the characteristics of a particular overfished stock.

Generally, the choices reflected in these options represent tradeoffs between the rebuilding objectives, the social and economic needs of fishing communities, and benefits of the fishery to the nation. In developing rebuilding plans the Council chooses a harvest policy (harvest control rule) that accords with a given rebuilding time and probability. A determination the rebuilding plan can be allowed to fall behind schedule so long as the probability of rebuilding in T_{MAX} is more than 50%, implies that administrative opportunity costs are sufficiently high and the short-term benefits to the community are likely to be sufficiently important that harvest levels specified in the control rule should be maintained as long as the minimum rebuilding standard is being met. (But as noted above, this approach could result in sudden large and disruptive changes in harvest policy.) In contrast, selection of a more rigid standard would entail frequent rebuilding plan revisions and FMP or regulatory amendments, implying the administrative opportunity costs of frequent revision and amendment are low enough and potential lost opportunity from not re-evaluating the rebuilding program (in terms of future returns to the fishery for example) are so high that rebuilding measures should be re-evaluated whenever stock increases fall behind schedule.

2.1.4 Issue 4- ESA Listed Species

Option 4a **(Council-preferred) No special provisions (status quo).** There are no special provisions for rebuilding plans for species listed under the Endangered Species Act.

Option 4b **ESA jeopardy standards or recovery plans take precedence if they establish a higher standard.** A jeopardy standard or recovery plan for an overfished stock listed under the ESA will supercede the rebuilding plan only if that standard is more restrictive than what would be required for that species under the Magnuson-Stevens Act. If the species were de-listed, but still not considered recovered under the Magnuson-Stevens Act and the original rebuilding plan, then that plan would again determine harvest policy and other management measures until the stock is fully rebuilt. After de-listing, the rebuilding plan may need to be revised to take into account the changed status of and new information about the overfished stock.

Under Option 4a (status quo), if a groundfish stock is listed, the Council might have to develop another plan amendment to address the listing and jeopardy standard or recovery plan. Before such an amendment was approved there could also be some uncertainty about how these species should be managed in the event of a listing. Option 4b anticipates the possibility that a groundfish species could be listed under the ESA and establishes a contingency for dealing with such an event. This option is similar to a provision in the Salmon FMP under which escapement goals for a particular stock are automatically replaced by the jeopardy standard or recovery plan when a stock is listed, except that measures under the Magnuson-Stevens Act would take precedence if they establish a higher standard than the ESA. Option 4b would reduce future administrative costs by obviating the aforementioned plan amendment and by clarifying procedures and processes in the event of a listing. This would facilitate quicker reaction by the Council to any requirements of any such jeopardy standard or recovery plan.

2.1.5 Summary of the Impacts of the Options

The environmental impacts of the options are evaluated in Chapter 4. The proposed action is procedural and, therefore, does not directly affect the human environment. The direct impacts affect the management regime are evaluated in terms of administrative capacity, adaptive management, public participation and rebuilding strategy. These direct impacts are summarized in Table 2-3.

Table 2-3. Summary of the direct impacts of the options on the management regime.

Options	Administrative Capacity	Adaptive Management	Public Participation	Rebuilding Strategy Considerations
Option 1a	Lowest impact.	Most flexibility of options.	Opportunities for public comment on strategic changes limited to Council process, and EIS if prepared.	Strategy not clearly defined. Targets relatively easy to change.
Option 1b	Greatest impact.	Least adaptive, unless FMP not amended to update specified parameters.	Opportunity for public comment during FMP amendment process	T_{TARGET} likely management target. Could be changed as part of FMP amendment updating parameter values, if sufficient analysis to support.
Option 1c	Moderate impact because adjustment of strategy part of biennial specifications process.	Very adaptive; harvest rate adjusted to rebuild by target year; opportunity to adjust target, if supported by analysis	Opportunity for public comment through notice and comment rulemaking, in addition to Council process, and EIS if prepared.	Manage to T_{TARGET} but could keep F constant in certain circumstances.
Option 1d	Same as Option 1c	Same as Option 1c	Same as Option 1c. Information in FMP allows public to gauge rebuilding success.	Same as Option 1c. Information in FMP allows tracking of changes in strategy.
Option 2a	Cursory review possible if no major issues.	Easier to respond to changing conditions.	Reviews by advisory bodies, Council subject to public comment.	N/A
Option 2b	Review linked to goals, could require more scrutiny than status quo.	Most adaptive because stock status review tied to need assessment.	Public scrutiny reduced because stock status review less frequent than 2 years.	N/A
Option 2c	Same as Option 2b	Less adaptive than status quo and Option 2b.	Same as Option 2b.	N/A
Option 2d	Less burden if status quo assessments more frequent than 2/4 years.	Least adaptive option.	Least opportunity for public review, except Option 2e	N/A
Option 2e	Least burden on Council, but shifted to NMFS.	Neutral effect.	Least opportunity for public review	N/A

Options	Administrative Capacity	Adaptive Management	Public Participation	Rebuilding Strategy Considerations
Option 3a	Lack of standards could increase burden if process more controversial.	Lack of benchmarks not adaptive.	Process less transparent without standards.	No decision framework for adjusting targets.
Option 3b	Could increase burden if difficult to implement, controversial.	Less flexibility than Option 3d; benchmark "floor" provides flexibility, but could result in abrupt change in OYs.	Benchmark allows public to evaluate rebuilding progress.	Benchmark only relevant in limited circumstances.
Option 3c	More frequent, but smaller adjustments in harvest rate results in burden less or equal to Option 3b.	More adaptive than Option 3b because adjustments more frequent.	Same as Option 3b	Benchmark reached more frequently than Option 3b, but limited use under constant T_{TARGET} strategy.
Option 3d	Likely to increase GMT and SSC workload in comparison to Options 3b and 3c.	More flexible than Options 3c and 3d, adaptiveness depends on development of benchmarks.	If GMT, SSC deliberations not transparent could cause mistrust.	Easier to develop standards consistent with rebuilding strategy.
Option 3e	Adds to work in developing rebuilding plans, but could reduce need for changes later on if generic standards do not match specific stock circumstances.	Most adaptive if pre-specified benchmarks more appropriate than "ad hoc" benchmarks developed under Option 3d	Same as Option 3b, 3c.	Includes all considerations outlined for other Issue 3 options.
Option 4a	Potential future workload greater than Option 4b.	See below.	Opportunity to comment on adoption of ESA provisions in Amendment 16-1.	N/A
Option 4b	Potential future workload less than Option 4a.	Little effect since ESA mandates apply no matter what FMP states.	Opportunity to comment on future amendment to incorporate ESA considerations.	N/A

2.2 Summary of Minor Technical Additions, Corrections and Changes to the FMP

As noted at the beginning of this chapter, various changes will be made to the FMP as part of this amendment that are not substantiative in the sense of affecting fishery management policies, procedures or measures. They are therefore categorically excluded from analysis based on the criteria established in Section 6.03.a.3(b)(2) of NAO 216-6, and 40 CFR 1500.4(p), 1508.4 and other sections of CEQ regulations. As noted above, NMFS has prepared a memo to file providing a rationale for this categorical exclusion. These proposed changes are summarized here and documented in Appendix A, which contains the amendatory language.

Goal 1 and Objective 3, related to overfishing and rebuilding are amended to better-reflect the intent of the Magnuson-Stevens Act.

The species list in section 3.1. of the FMP, species managed by this FMP, is not consistent with the groundfish species list in the annual specification and management measures (FR 67 10490; March 7, 2002) or the list at 50 CFR 660.302. Misspellings are corrected and the following rockfish are specifically identified: chameleon (*Sebastes phillipsi*), dwarf-red (*Sebastes rufianus*), freckled rockfish (*Sebastes lentiginosus*), halfbanded (*Sebastes semicinctus*), pinkrose (*Sebastes simulator*), pygmy (*Sebastes wilsoni*), swordspine (*Sebastes ensifer*), widow (*Sebastes entomelas*), yelloweye (*Sebastes ruberrimus*) yellowmouth (*Sebastes reedi*), and yellowtail (*Sebastes flavidus*).

The terms "maximum fishing mortality threshold" (MFMT) and "minimum stock size threshold" (MSST) are used in the National Standard Guidelines and are intended for use as benchmarks to decide if a stock or stock complex is being overfished or is in an overfished state. The terms used to describe these same thresholds in the FMP are different from those used in the National Standard Guidelines (i.e., MFMT is the same as the F_{MSY} control rule described in the FMP and MSST is the same as the overfished/rebuilding threshold described in the FMP.) To address consistency in terminology, the equivalent terms are defined in Sections 4.1and 4.4 of the FMP.

The National Standard Guidelines suggest the annual SAFE document contain a description of each stock or stock complex (50 CFR 600.315 (e)(3)). Because the MFMT and MSST are important benchmarks used to determine if overfishing has occurred or if a stock or stock complex is in an overfished state, Section 5.2 of the FMP, will state the SAFE document list the MFMT and MSST for stocks or stock complexes to be listed in SAFE documents. In addition, the last paragraph of Section 5.2 regarding the SAFE document availability and completion schedule is out of date and does not reflect the SAFE document schedule for 2002 and beyond. This language is changed to reflect the current schedule.

Sections 4.2, 4.3.1, and 4.5.1 of the FMP list, summarize and/or reference the F_{MSY} proxies adopted in 1998. The 1998 values are used throughout these sections as examples in the describing F_{MSY} proxies. In spring 2000, the Council's SSC sponsored a workshop to review the Council's groundfish exploitation rate policy. For 2001 and beyond, the Council adopted the SSC's new recommendations for harvest policies of: F40% for flatfish and whiting, F50% for rockfish (including thornyheads) and F45% for other groundfish such as sablefish and lingcod (66 FR 2338, January 11, 2001). The 1998 F_{MSY} proxy values used as examples in the FMP are updated to reflect the Council's current policy.

References to an at-sea observer program in Sections 4.3.1.3, 4.4.2, and 4.6 indicate that no observer program exists from which data are available to upgrade stock assessments and evaluate overfishing. This text is outdated and is updated to reflect the implementation of an at-sea observer program in 2001. Section 6.5.1.2 does not indicate the groundfish observer program is mandatory. The sentence "The Regional Administrator <u>may</u> implement an observer program through a Council-approved federal regulatory framework" is changed to "The Regional Administrator <u>will</u> implement..." to indicate the current observer program is mandatory.

Chapter 4 contains several references to Council use of the mixed stock exception for setting OYs. These references do not comply or reference the current standards for invoking the mixed stock exception. The text is updated to reflect the standards for invoking the mixed stock exception.

Although Chapter 5 is entitled "Specification and Apportionment of Harvest Levels," and describes the annual management process, it includes numerous references to the development of rebuilding plans, which will not be on an annual cycle. Additionally, discussion of some topics is spread through numerous sections. Currently, Chapter 4 is a one-page chapter in which optimum yield is discussed in general terms while the considerations and constraints that go into establishing OYs are specified in Chapter 5. A reorganization of Chapters 4 and 5 will: (1) place in Chapter 4 all considerations and constraints that go into establishing OYs, including the process and standards for establishing rebuilding plans; (2) place all provisions related to the annual/biennial management process in Chapter 5; and (3) reorganize the sections to construct a more concise document.

The Council may either (1) not approve these changes to the FMP, which would maintain the status quo, or (2) approve any or all of these changes:

a) Revise the list of species managed under the FMP.
b) Address differences in the use of the terms MFMT and the minimum stock size threshold (MSST) and the National Standards Guidelines.
c) Change SAFE document Section 5.2 to include a description of the MFMT and MSST.
d) Update last paragraph of Section 5.2 regarding the SAFE document availability and completion schedule.
e) Update Sections 4.2, 4.3.1, and 4.5.1 of the FMP to include the Council adopted the SSC's new recommendations for harvest policies of: F40% for flatfish and whiting, $F_{50\%}$ for rockfish (including thornyheads) and $F_{45\%}$ for other groundfish such as sablefish and lingcod.
f) Update the references to an at-sea observer program in sections 4.3.1.3 , 4.4.2, 4.6, and 6.5.1.2; and
g) Reorganize Chapters 4 and 5 to produce a more concise document.

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3.0 AFFECTED ENVIRONMENT

This chapter describes the affected environment, which is the baseline environmental condition. The baseline represents the status of environmental attributes at a time before the proposed action is implemented, and in Chapter 4 serves as a point of comparison to evaluate possible significant impacts. (The baseline differs from the *Status Quo*, which predicts a future environmental state in the absence of any action alternative.) Because the proposed action is procedural, it will not directly affect the biological or sociological environment. It will affect the management regime in terms of capacity, flexibility and public perceptions. Therefore, the affected environment description in this chapter focuses on these management-related issues. For information on the biological and socioeconomic environment the reader may consult the EIS re analyzing the 2003 harvest specifications and management measures for the Pacific Coast groundfish fishery (PFMC 2003). It provides a detailed description of the habitat, species, fisheries and fishing communities, and management issues related to groundfish. This material is incorporated by reference. In addition, an EIS is being prepared in connection with Amendment 16-2, which evaluates rebuilding plan alternatives for darkblotched rockfish, Pacific ocean perch, canary rockfish and lingcod. It is being prepared concurrently with this EA. Because the rebuilding measures adopted in those rebuilding plans are expected to directly affect the human environment, that EIS describes those resources. This chapter is divided into two main sections describing the management regime, and issues related to the choice of rebuilding strategy. Chapter 4, evaluating the environmental impacts of the alternatives, has a corresponding structure.

3.1 Current Management Regime

The process and standards for adopting rebuilding plans, comprising the proposed action, directly affects the management regime. In Chapter 4 effects to the management regime are evaluated in terms of three issues: administrative capacity, flexibility or adaptive management, and public participation. Baseline information related to these three issues is provided here.

3.1.1 Administrative Capacity

Administrative capacity is a measure of the time available to and productivity of the administrators of the management regime. This can be attributed to each element of the management system: Council members, advisory bodies, Council staff, NMFS staff and state agency staffs. Capacity is more or less a constant, because the Council meets for defined periods of time and staffs have some total amount of work time. (This assumes no significant expansion in the number of staff.) Because capacity is fixed and administrative capacity fully utilized, the time cost of any management measure actually represents a tradeoff: time spent on one task means less time spent on another. Procedural measures can be assessed in terms of complexity; the more complex the task of implementing and "maintaining" the procedure the more organizational capacity will be required. This means that organizational attention and capacity is shifted away from other tasks that may be equally pressing or important. The allocation of resources among different tasks can have difficult-to-predict indirect effects on the environment if the implementation of management measures are delayed or organizations do not have the opportunity to address broad issues strategically.

NMFS and the states have researchers and professional staff that participate in the formulation of management measures (for example, by conducting the stock assessments used to determine optimum yields). Council advisory bodies, such as the GMT and GAP also play a central role in identifying management targets and measures, and conducting the necessary supporting analyses. All of these personnel may contribute to the preparation of amendment documents. However, the task of preparing the analytical and informational documents required when amending a FMP and promulgating regulations falls mainly on the professional staff employed by the Council and NMFS. (Within NMFS, staff at the NWR are responsible for actions related to the groundfish FMP.) Generally, Council and NWR staffs divide responsibility for preparing of groundfish-related FMP amendment documents, with one or the other office taking the lead. In addition, if a particular action requires the promulgation of regulations, NMFS NWR staff are responsible for preparing these regulations.

The Council has two staff officers working on groundfish, who devote essentially 100% of their time to groundfish-related tasks. (Time spent on FMP/regulatory amendments is limited by a range of other responsibilities, such as staffing workshops and advisory body meetings and preparing briefing materials for Council meetings.) Two economists carry out economic analysis in support of a range of Council actions but devote between 35% and 50% of their time to groundfish-related actions. One staff officer ensures that Council processes and documents comply with NEPA-related regulations and also spends about 35%-50% of his time working on groundfish-related matters. Three other professional staff devote a small amount of time to groundfish-related work, with the primary responsibilities elsewhere.

NMFS NWR has five staff that spend part or all of their time on groundfish-related analysis and regulatory implementation, although not all of their groundfish workload is associated with Council activities. (This excludes fishery scientists working for NMFS who conduct stock assessments and related scientific tasks.) The NWR also has a NEPA coordinator responsible for the development and review of analytical documents and agency NEPA procedures. While Council staff prepare amendment documents (including required environmental and regulatory analyses) and support the Council decision-making process, NMFS staff are responsible for tasks related to the implementation of regulations. They also prepare amendment documents but are less involved in Council administrative support, for example by staffing Council meetings.

It is very difficult to assess the capacity of these resources, for example in terms of the number of amendments or actions that can be completed in a given time period. In part this is due to the wide variation in the complexity of different management actions and the fact that no one person works full time on a single action; usually several actions are ongoing and other tasks are also part of staff duties. Taking the staff identified above as a whole, at least 20% and possibly as much a third of their time of is directly related to the preparation of the analyses and documentation necessary to implement an amendment or action. (This estimate includes other activities such as rulemaking, including the implementation of seasonal management.) It is also important to note that fishery scientists at NMFS and state agencies carry out much of the analyses supporting management decision-making.

One can also evaluate capacity in terms of the time needed to implement a management action. This also varies tremendously, depending on the nature and complexity of the action. Implementation of periodic or seasonal management has to be completed in a relatively short time period because of the need for fishing regulations to be in place at the beginning of the season. For this reason, a substantial portion of staff resources may be taken up for a relatively short period of time. For example, during the second half of 2002 close to half the staff capacity described above was committed to implementation of groundfish specifications and management measures for 2003. FMP amendments are typically on a more extended schedule, driven in part by Council deliberation and decision-making and also the review requirements within NMFS. Generally speaking, it takes at least six to nine months to implement a FMP amendment, although it is not uncommon for a year or more to elapse because of Council deliberations and the availability of staff to do the work. (This amendment offers a good example. Work began in late 2001 and final approval is expected some time in the latter half of 2003. This extended period is due to the need for the Council to deliberate and the fact that for much of the second half of 2002, most staff time was devoted to implementation of 2003 specifications and management measures.)

A fair assessment would be that Council and NMFS staff have the capacity to complete one or two groundfish FMP amendments per year, if they are of moderate complexity. It should also be noted that a more regulatory amendments—which effect changes in federal regulations as opposed to the FMP—are usually completed in a given time period. NMFS staff bear a larger share of the work needed for these actions than Council staff does. Considering Council and NMFS staffs together, groundfish-related action requiring notice and comment rulemaking requires an equivalent amount of staff capacity.

3.1.2 Adaptive Management

The concept of adaptive management was first developed in the 1970s (Holling 1973) and has been applied widely. Adaptive management assumes uncertainty, promotes "learning" strategies, and envisions a cyclical management process in which management measures are refined in response to new information and understanding of the managed system. A review of adaptive management of Columbia River salmon (Lee and Lawrence 1986) describes it as "a policy framework that recognizes biological uncertainty, while accepting the congressional mandate to proceed on the basis of the 'best available scientific knowledge.' An adaptive policy treats the program as a set of experiments designed to test and extend the scientific basis of fish and wildlife management." Gunderson (1999) argues that flexibility in management institutions and system resilience are key determinants of adaptive management success. Managing to rebuild overfished species populations is fraught with uncertainty because of the difficulty in predicting future performance. Stock performance depends on the nature of ecosystem resilience. As first described by Holling (1973), resilience may either be interpreted as a return to some "global" equilibrium following perturbation (such as fishing down one population in the system) or in terms of multiple equilibria where future states are unpredictable. For example, the role environmental regimes play in determining recruitment is at best poorly understood, which limits the accuracy of unfished biomass estimates. This limits managers' ability to realistically plan for a future end state of stock recovery. Policy makers may be tempted to replace ecosystem uncertainty with "spurious certitude": "Perhaps the most common solution is to replace the uncertainty of resource issues with the certainty of a process, whether that process is a legal vehicle—such as a new policy, regulation, or lawsuit (Rodger 1997)—or a new institution—such as a technical oversight committee or science advisory committee" (Gunderson 1999, p. 2). Given the long time horizons involved in rebuilding some overfished groundfish populations, uncertainty about future stock performance, and uncertainty about ecosystem performance, a flexible, or adaptive, management regime will be important.

Nyberg (1999) outlines six steps in the adaptive management cycle. (Other authors have posited similar steps (c.f. Olsen 1993).). Rebuilding mandates and the institutional structure of federal fisheries management (including the Council system) provide all the "pieces" to construct these steps: problem identification, program design, implementation, monitoring, evaluation, and adjustment of the management regime, which initiates a new round in the cycle of steps just described. Monitoring and evaluation are the key steps differentiating adaptive management; and flexibility—which makes the regime easier to change in response to new information—is a valuable attribute in these steps. The scenarios presented in this analysis all incorporate procedures to update rebuilding plans, and adjust management measures, in response to new information about overfished stocks. For all scenarios, flexibility of response is constrained by the range of management tools that are both legal and practical. What varies is the procedural complexity entailed in adapting management measures in response to new data. This is a correlate of administrative cost discussed above. More complex procedures will require more administrative resources. (On the other hand, they may force better problem assessment and redesign as part of the adaptive cycle.) Generally, then, flexibility and administrative cost are inversely correlated.

Groundfish management rests on a framework described in the FMP, which allows management targets (OY levels for managed species) to be specified annually, based on regular stock assessments. A range of management measures are then available, which also can be modified annually, in order to constrain fisheries to these targets. (As discussed below, groundfish management is shifting to a two-year cycle.) The adoption of rebuilding plans establish longer term targets for overfished stocks. More generally, the management framework establishes a target biomass, B_{MSY}, and according to the "40-10 rule" even stocks above the overfished threshold but below target biomass are subject to precautionary management. In the rebuilding analyses, the P_{MAX} value is used to determine the fishing mortality rate (F) that is estimated to allow the stock to rebuild to the target given that probability and T_{TARGET} defined as the median rebuilding year. This F is then applied to current estimates of stock size to arrive at its OY or current-year management target. This process allows adaptive management over the longer term because annual targets are tied to a probability-based measure of stock recovery.

The management process is subdivided into two components: developing scientific information and making management recommendations. Stock assessments (and rebuilding analyses) are science driven. They arrive at an estimate of a sustainable yield for a stock (OY) within the management framework. Because of scientific uncertainty, stock assessment results may be presented as a range of values, providing policymakers with an implicit or explicit (as in the case of rebuilding analyses) tradeoff between risk and short-term benefits. The results of this scientifically driven part of the process are then used by the Council in their policymaking capacity. In addition to risk/benefit tradeoffs, the Council also considers the allocation of fishing opportunity and formulates the management measures intended to achieve scientifically-determined targets. The next three subsections describe stock assessments, rebuilding analyses, and Council decision-making.

3.1.2.1 The Stock Assessment Process

Stock assessments for Pacific Coast groundfish are generally conducted by staff scientists of CDFG, Oregon Department of Fish and Wildlife, Washington Department of Fish and Wildlife, Oregon State University, University of Washington, and the NMFS Southwest, Northwest, and Alaska Fisheries Science Centers. These assessments describe the condition or status of a particular stock and report on its health. This allows biologically sustainable harvest levels to be forecast; scientists can then make management recommendations to maintain or restore the stock. If a stock is determined to be overfished (less than 25% of its unfished biomass), a rebuilding analysis and a rebuilding plan are developed.

For more than 20 years, groundfish assessments have primarily been concentrated on important commercial and recreational species. These species account for most of the historical catch and have been the targets of fishery monitoring and resource survey programs that provide basic information for quantitative stock assessments. However, not all groundfish assessments use the same level of information and precision.

Quantitative and nonquantitative assessments are used for groundfish stocks. For stocks that are assessed quantitatively, scientists use life history data to build a biologically realistic model of the fish stock for these stock assessments; they then calibrate the model so that it reproduces the observed fishery and survey data as closely as possible. Recently similar, but more powerful, models using state-of- the-art software tools have been developed. Assessment models and results are independently reviewed by the Council's Stock Assessment Review (STAR) Panels. It is the responsibility of the STAR Panels to review draft stock assessment documents and relevant information to determine if they use the available scientific data effectively to provide an accurate assessment of the condition of the stock. In addition, the STAR Panels review the assessment documents to ensure that they are sufficiently complete and the research needed to improve assessments in the future is identified. The STAR process is a key element in an overall process designed to make timely use of new fishery and survey data, to analyze and understand these data as completely as possible, to provide opportunity for public comment, and to assure the assessment results are as accurate and error-free as possible.

Following review of assessment models by the STAR Panels, and subsequently the GMT and SSC, the GMT uses the reviewed assessments to recommend preliminary ABCs and OYs to the Council. The SSC comments on the STAR review results and the GMT recommendations. Biomass estimates from an assessment may be for a single year or an the average of the current and several future years. In general, an ABC will be calculated by applying the appropriate harvest policy (MSY proxy) to the best estimate of current biomass. ABCs based on quantitative assessments remain in effect until revised by either a full or partial assessment.

Full assessments provide information on the abundance of the stock relative to historical and target levels, and provide information on current potential yield. Scientists conduct partial assessments when they do not have enough data for a full assessment. Even full assessments can vary widely in reliability because of the amount of data available for modeling. Council-affiliated scientists conduct several assessments each year. Individual stocks may be periodically reassessed as often as every year—currently only the case for Pacific whiting—to every two to four years. However, some species have been assessed only once.

Stocks with ABCs set by nonquantitative assessments typically do not have a recent, quantitative assessment, but there may be a previous assessment or some indicators of the status of the stock. Detailed biological information is not routinely available for these stocks, and ABC levels have typically been established on the basis of average historical landings. Typically, the spawning biomass, level of recruitment, or the current fishing mortality rates are unknown.

Many species have never been assessed and lack the data necessary to conduct even a qualitative assessment, such as a general indication in biomass trend. ABC values have been established for only about 26 stocks. The remaining species are incidentally landed and usually are not listed separately on fish landing receipts. Information from fishery-independent surveys are often lacking for these stocks, because of their low abundance or invulnerability to survey sampling gear. Precautionary measures continue to be taken when setting harvest levels (the OYs) for species that have no or only rudimentary assessments. Since implementation of the 2000 specifications, ABCs have been reduced by 25% to set OYs for species with less rigorous stock assessments, and by 50% to set OYs for those species with no stock assessment. At-sea observer data will be available for use in the near future to upgrade the assessment capability or evaluate overfishing potential of these stocks.

3.1.2.2 Rebuilding Analyses

In the case of overfished species, stock assessment results form the basis of a rebuilding analysis, which in turn is used to develop rebuilding policies and choose the rebuilding target identified in each rebuilding plan. The elements of rebuilding analyses are described in the SSC Terms of Reference for Rebuilding Analyses (SSC 2001). This guidance has been incorporated into a computer program for conducting rebuilding analyses (Punt 2002b). In the analysis the probability the overfished stock will reach the target biomass defining a rebuilt stock (B_{MSY} or $B_{40\%}$) is determined in the absence of fishing (T_{MIN}) and the maximum permissible rebuilding time under National Standard Guidelines (T_{MAX}). The target rebuilding year (T_{TARGET}) is determined based on these limits and the probability of achieving the target biomass by T_{MAX} (denoted P_{MAX}). Probability statements are an estimate that something may happen (in this case, that stocks will reach a given size in a specified time period) and thus also the level of risk associated with a given action. When interpreting rebuilding analyses it is important to understand how probability statements are derived, distinguish the basic policy choice from those parameters determined by national policy, identify different sources of uncertainty, and appreciate that even "fixed" values can change as the system (or fish stock)—and our understanding of it—change over time.

The rebuilding analysis program uses "Monte Carlo simulation" to derive a probability estimate for a given rebuilding strategy. This method projects population growth many times in separate simulations. It accounts for one source of uncertainty about future stock status by randomly choosing the value of a key variable—in this case total recruitment or recruits per spawner—from a range of values. These values can be specified empirically, by listing some set of historical values, or by a relationship based on a model. The SSC recommends the rebuilding analyses use historical values. Because of this variability in a key input value, each individual simulation, or "case," will show a different pattern of population growth. As a result, a modeled population may reach the target biomass in a different year in each of the cases in the Monte Carlo simulation. Figures 3-1 shows the results of five such cases from a hypothetical rebuilding analysis. (The values do not represent any of the actually overfished species.) The horizontal line at 0.4 represents target biomass. It can be seen that population increases steadily in each case, but at a different rate because of differences in the number of recruits in each future year for each case. Case #1 reaches the target biomass soonest, in 2025, while case #5 takes the longest, reaching the target in 2048.

The number of cases that reach the target biomass in any year can be computed and these values cumulated, or successively added together, starting with the first year set for the simulation and running out to some maximum number of years (which could be the case in which the population took the longest time to reach the target biomass or a predetermined maximum value). This cumulative probability shows the number of cases that have reached the target biomass in all the years up to and including the specified year, which is also an estimate of the probability the stock will rebuild by that year.

Figure 3-2 illustrates this concept of cumulative probability. The percent of simulations reaching the target biomass in each year, for some specified fishing mortality rate, is represented by the vertical bars. The five cases shown in the previous figure are plotted along with the other 995 cases that are part of this Monte Carlo simulation. The years in which the five cases in the previous figure reached the target biomass are highlighted in this figure. Case #3, for example, along with 26 other cases (that weren't plotted in the first figure), make up the bar tallying the number of cases rebuilt in 2032. The ascending solid line sums simulations that have reached the target biomass in any of the preceding years, even if biomass declines below the target in subsequent years. This ascending line represents the rebuilding probability. (It is important to note the calculated cumulative probability includes cases reaching the target biomass in any previous year. Species with highly variable recruitment may achieve the target biomass and subsequently fall below it, even in the absence of fishing. If these cases were excluded, the probability of recovery in any given year would likely be lower, depending on species being modeled.)

This technique can be used first to calculate T_{MIN} in probabilistic terms, which is defined as the time needed to reach the target biomass in the absence of fishing with a 50% probability. (It may be said that the 50% value represents "even odds"; it is equally likely the stock has rebuilt or not rebuilt in this year. In all other years it is either more or less likely the stock has rebuilt.) Thus, in a Monte Carlo simulation with 1,000 cases where the fishing mortality rate (F) is set to 0, the number of cases reaching the target biomass in a given year can be cumulated. In Figure 3-3 T_{MIN} is determined by finding the year in which this cumulative value equals 500 (or 50%). In other words, in half the simulations the target biomass was reached in some year up to and including the computed T_{MIN}. Given T_{MIN}, and assuming that it is greater than or equal to ten years (as is the case with most of the overfished groundfish stocks), T_{MAX} is computed by adding the value of one mean generation time. Figure 3-3 shows a T_{MIN} of 15 years (or 2014 if the stock were declared overfished in 1999). A mean generation time of 17 years is added to compute T_{MAX}.

After determining T_{MAX}, multiple Monte Carlo simulations are conducted, varying the fishing mortality rate. This determines the relationship between F and the probability of the stock being rebuilt by T_{MAX}, which is P_{MAX}. Figure 3-4 displays the results of three hypothetical simulations for fishing mortality rates resulting in P_{MAX} values of 90%, 70% and 50% (the minimum permissible rebuilding probability). Since a higher P_{MAX} probability must be achieved by lowering the fishing mortality rate (other things being equal) there is a tradeoff between fishery harvests and rebuilding speed in probabilistic terms. As we reduce fishing, the likelihood the stock will recover in this maximum time period increases.

Once probability distributions have been computed, like those plotted in Figure 3-4, a corresponding T_{TARGET} can be determined for distributions representing different harvest rates (F) and corresponding P_{MAX} values. T_{TARGET} is defined as the median year in each probability distribution, which is simply the year by which half of all cases have already rebuilt, and is unique for a given F and P_{MAX}. Figure 3-4 shows how this is computed for the three plotted fishing mortality rates and corresponding P_{MAX} probabilities. As expected, if we apply the lowest of the three plotted fishing mortality rates (in other words, limit fishing the most), the stock will rebuild the fastest (or more accurately, has the highest probability of rebuilding by T_{MAX}). The target year for the lowest fishing mortality is 25 years. (To determine the actual target year, we add this value to the year in which the stock was declared overfished. Continuing with the example above, if the stock was declared overfished in 1999, then the target year is 2024.) Not surprisingly, this strategy also results in the highest P_{MAX}, equal to 90%. The fishing mortality rate associated with the 70% P_{MAX} value gives a later target year: 2028. Finally, T_{TARGET} equals T_{MAX} for the highest allowable fishing since the P_{MAX} value—50%—is the same probability used to determine T_{TARGET}.

From a policymaking standpoint, the essential tradeoff is between a given level of fishing mortality and the probability the stock will be rebuilt within the maximum permissible time period (P_{MAX}), and the related target year. Although computationally there is a prescribed relationship, with P_{MAX} as an input value, policymakers may wish to base their decisions on F, as expressed in the harvest control rule or simply choose a given target year and determine from it the associated P_{MAX} and F. Figure 3-5, taken from the canary rockfish rebuilding analysis, illustrates this tradeoff. It shows the relationship between any OY level in the current year, P_{MAX} and T_{TARGET}.

As the preceding discussion suggests, probability statements about T_{MAX} tell us the likelihood of an outcome based on our understanding of a fish stock and our ability to model how that stock will grow over time. Since our understanding of these population characteristics is imperfect, some sources of uncertainty are not captured in the aforementioned probability statements. First, inputs to the rebuilding analysis are to a greater or lesser degree best estimates of true values. This applies to basic biological parameters, such as fecundity, that are used to model population growth. Population projections also depend on an estimate of the size and age structure of the modeled stock at the outset of the projected time period, derived from the most recent stock assessment. Similarly, the biomass target ($B_{40\%}$) requires an estimate of the equilibrium population size that would be reached in the absence of fishing (see below). In all these cases the best estimate may not coincide with the true value. The Monte Carlo simulation used in the rebuilding analyses only considers uncertainty about future recruitment, so inaccuracy in the estimation of both species and stock-specific variables will not be captured in resulting probability statements. Finally, there is some uncertainty (or variability) inherent to the Monte Carlo simulation because any one simulation will not include all possible outcomes (or cases). This variability can be assessed by performing several simulations and measuring the variation in the output value (fishing mortality for a given T_{MAX} probability) among these simulations (Punt 2002a). This type of assessment can be used to establish a range around a point estimate (the mean value) expressing the likelihood the true value falls within that range.[8/]

New information may result in new estimates of biological and stock parameters, and assessed uncertainty in the Monte Carlo simulation tells us something about the range of possible outcomes. But rebuilding trajectories will also change over time with new stock assessments and as historical data (such as total catch estimates for past years) replace projected values. The time limits and target—T_{MIN}, T_{MAX}, and T_{TARGET}—fall along a time scale that begins when the stock is declared overfished (y_{decl}).[9/] Because the rebuilding analysis is usually conducted from one to several years after y_{decl}, a more recent stock assessment may allow population growth to be projected from the most recent year for which stock structure data (such as mortality, weight, and number of animals for each age class in the population) are available. In subsequent analyses (conducted as new stock assessment data become available), the pool of historical recruitment values will likely differ (with addition of the most recent years' data) and the there will be fewer years for which population growth is projected. (This assumes that T_{MAX} is not re-computed because, for example, changes in stock structure produce a different value for mean generation time.) It is highly likely the new analysis will suggest a different level of fishing mortality to achieve the same P_{MAX} and by extension T_{TARGET}. Conversely, if the policymaker wishes to continue with the same harvest policy—a given fishing mortality rate for example—P_{MAX} and T_{TARGET} would likely be different in the new analysis.

Estimation of Unfished Biomass

Target biomass is directly related to B_0, or unfished biomass. (It is expressed as a percentage of this value.) Target biomass in turn affects the rebuilding trajectory described by T_{MIN}, T_{MAX}, and T_{TARGET}. B_0 is rarely known absolutely; instead, it is calculated based on the relationship between the number of spawning fish and resulting recruits to the fishable population. Modelers choose a time period for which data are available and fishing effort has been at a stable and relatively moderate level. However, biologists are not sure of how important environmental conditions are to survival and growth, versus spawning population size. (A hypothesis favoring spawning population size as the determinant of recruitment is called a "density dependent" spawner to recruitment relationship. For groundfish this relationship is believed to be positive: a larger spawning population results in greater total recruitment.) These considerations complicate the choice of the time period used as basis for unfished biomass computations. For Pacific Coast groundfish these two factors have historically had potentially confounding effects. A large-scale regime shift began in 1977; many scientists believe that generally warmer water produced less favorable conditions for groundfish (Hare and Mantua 2000). The period after 1977 also saw a decline in groundfish populations due to increased fishing effort. If an environmental explanation is favored, one would choose a long time series that encompassed recruitment both before and after 1977 in order to account for the impact of the environmental change. However, this will result in a relatively lower value for B_0 than only using recruitment values before 1977 when biomass and recruitment were closer to an unfished state. The SSC also discussed a third approach in its Terms of Reference (SSC 2001), using spawner-recruit models instead of relying solely on empirical data. These models are problematic because they mathematically presuppose a certain spawner-recruit relationship. The

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8/ These assessments demonstrates three important points. First, different modeled species will produce different degrees of variability when comparing Monte Carlo simulations because of the underlying variability in the input recruitment data. Second, for a given species and P_{MAX} increasing the number of cases in a simulations decreases uncertainty (or relative variability). But this decrease is not constant; increasing the number of cases in a simulation beyond a certain number produces diminishing returns in terms of reducing uncertainty. Finally, for a given species and number of cases in the Monte Carol simulation, choosing a lower P_{MAX} increases certainty (by decreasing the range of possibly "correct" values for fishing mortality, or OY).

9/ National Standard guidelines identify the initial rebuilding year, for the purpose of calculating targets, as the year in which rebuilding measures were first implemented. For overfished Pacific groundfish this would be the year in which interim rebuilding plan measures were implemented as part of the annual management process. In most cases this was the either y_{decl} or the following year.

overfished species being modeled may not exhibit this relationship because of its particular biology and ecology. The SSC recommended determining B_0 based on the density-dependent hypothesis and, therefore, using earlier data (resulting in relatively large values for B_0). Although, as discussed above, the determination of B_0 is not a policy choice, its value does influence policy choices since other parameters, such as target biomass, are defined in relation to B_0.

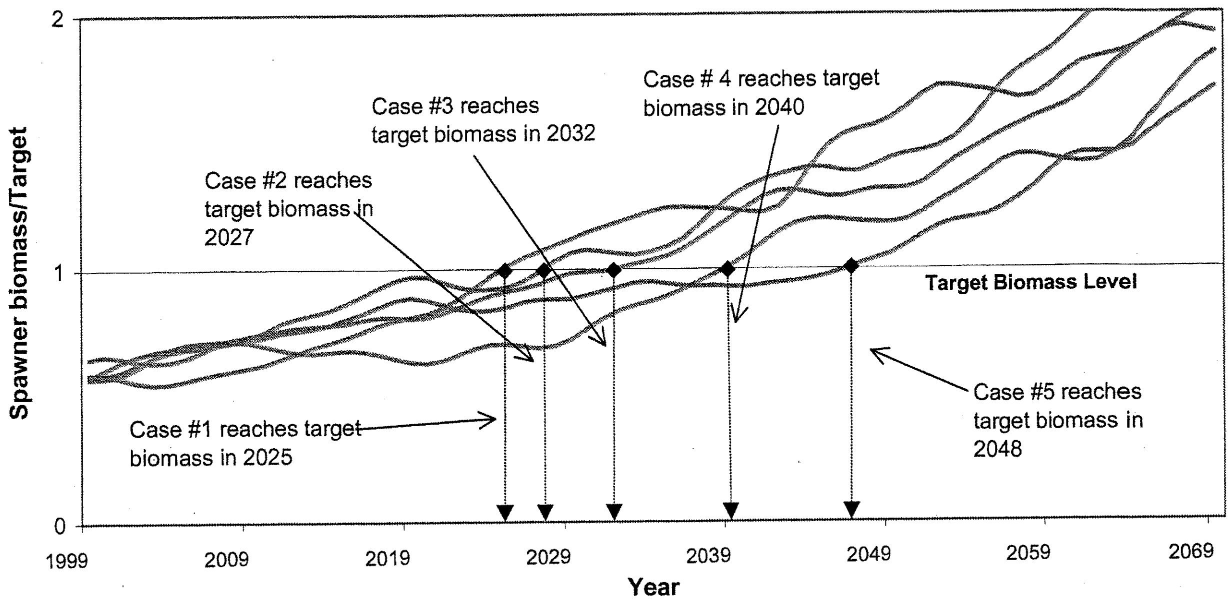

FIGURE 3-1. Example of five cases from a Monte Carlo simulation.

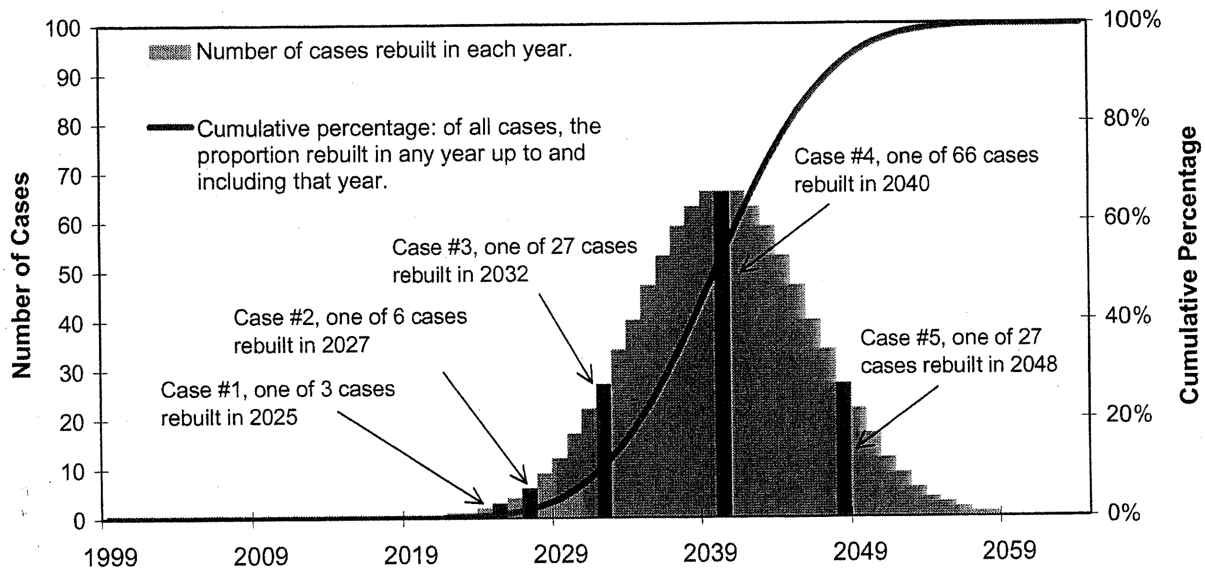

FIGURE 3-2. How cumulative probability is calculated in a Monte Carlo simulation.

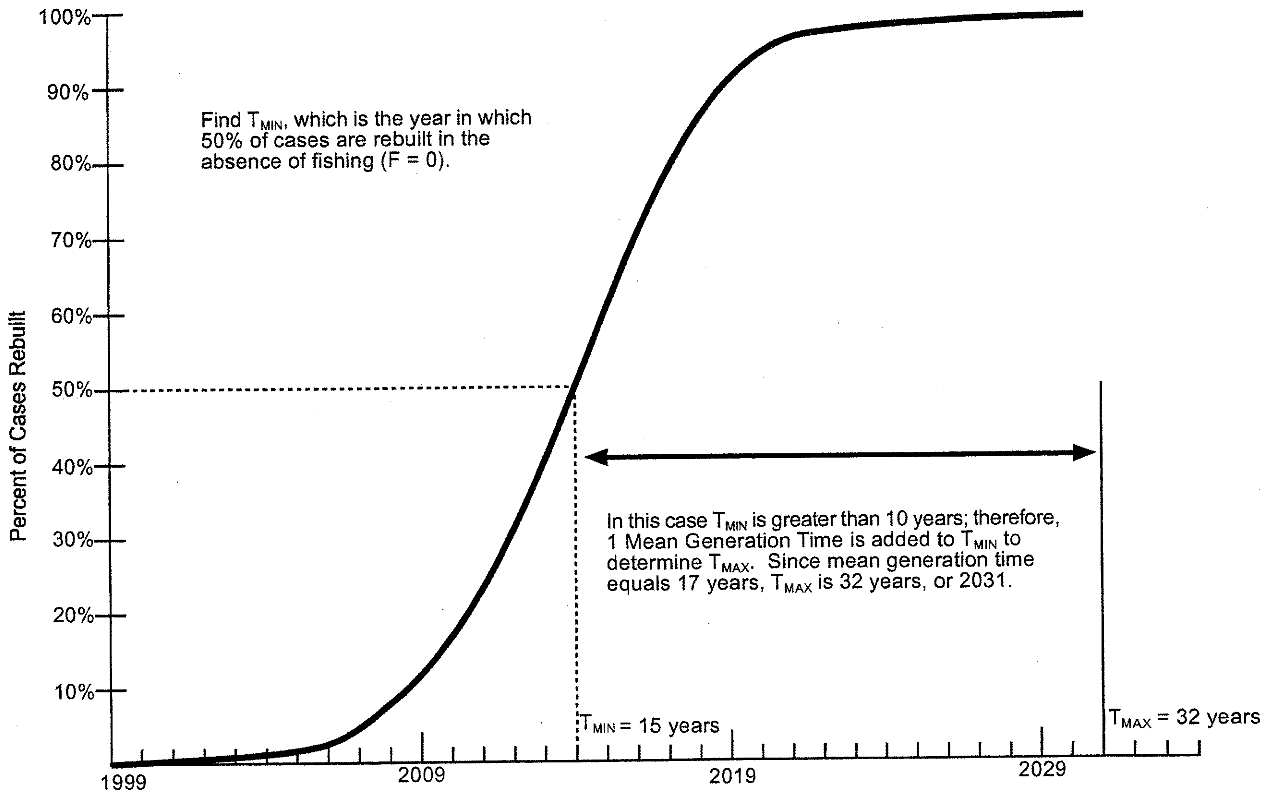

FIGURE 3-3. Calculation of the minimum rebuilding time, T_{MIN}.

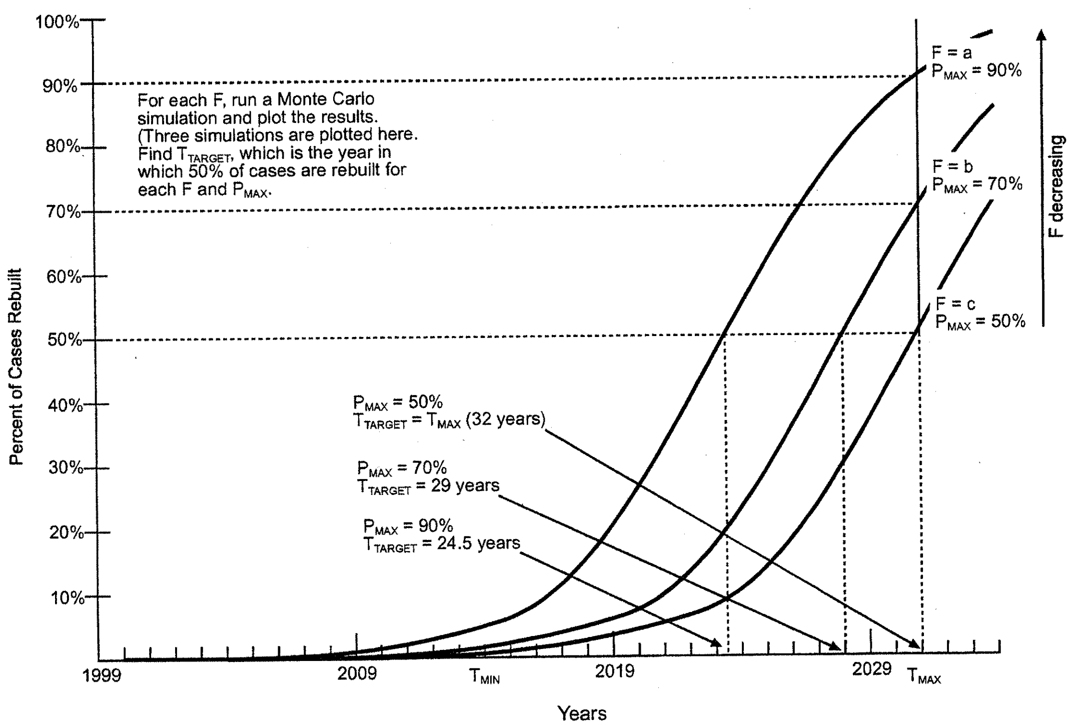

FIGURE 3-4. Computation of the rebuilding probability (P_{MAX}) and the median rebuilding year (T_{TARGET}).

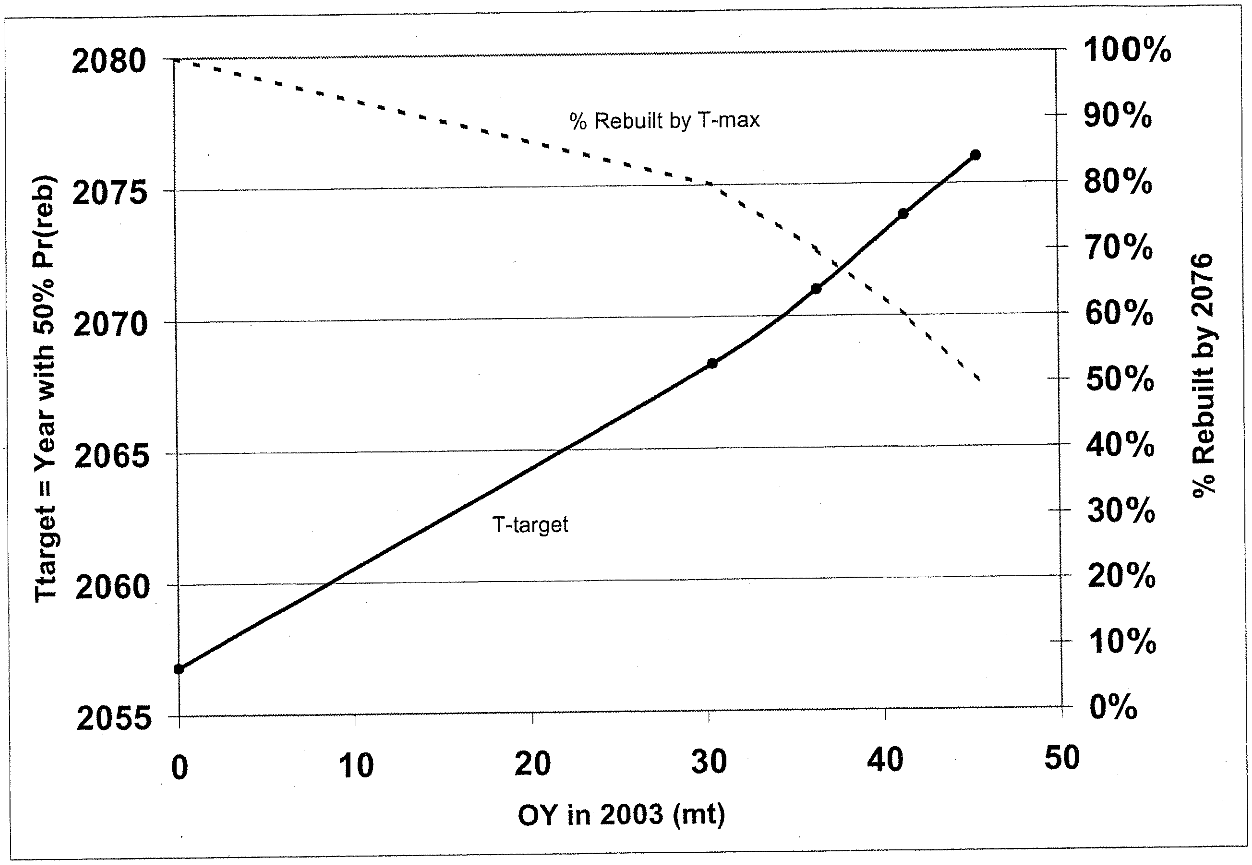

FIGURE 3-5. Tradeoff between OY in 2003, T_{TARGET} and T_{MAX} from the canary rockfish rebuilding analysis (Methot and Piner 2002).

3.1.2.3 Council Decision-making

Periodic Management

Groundfish management is mainly implemented through a framework in the FMP, which allows the Council to recommend new fishing regulations, as long as these measures fall within the range of the principles and policies described in the FMP. Section 6.2 in the groundfish FMP also describes different procedures for establishing and adjusting management measures. To date, this type of "seasonal" management has been implemented through regulations promulgated annually, covering a fishing year, which corresponds to the calendar year. This process requires at least two Council meetings followed by notice and comment rulemaking. Notice and comment rulemaking requires publication of a proposed rule in the *Federal Register* commencing a 30-day public comment period, followed by publication of the final rule, with any modifications stemming from public comment. Once this process is completed, regulations may come into effect. To change rebuilding measures incorporated into regulations this full rulemaking process would be followed. Other actions, such as inseason management changes, may be implemented through more abbreviated processes. But these procedures would not be applicable to rebuilding measures. As noted in Chapter 2, the same notice and comment rulemaking process used to implement periodic management could be used to change the rebuilding strategy and implement rebuilding measures.

In November 2002, the Council approved Amendment 17 to the groundfish FMP, changing the process for developing groundfish specifications and management measures so that measures could be established for two years, rather than one year. This will provide more time for the Council and NMFS to work on other critical groundfish issues. This schedule also allows enough time for NMFS to publish a proposed rule in the *Federal Register* and take public comment before its final decision on whether to approve the Council recommendations. Because of limited amount of time between a final Council decision and the beginning of the new fishing year, and a lawsuit requiring NMFS to use notice and comment rulemaking, the agency had to implement an emergency rule for the first two months of 2003. This allowed the fishing season to commence while comment continued on the final rule for the rest of the fishing season (March-December). Promulgating both rules results in a procedurally complex and administratively burdensome process. The difficulty of an annual process is compounded by the fishing industry's strong desire the fishing season correspond to the full calendar year in order to assure consistent supply to processors and markets. As management becomes more complex, there is not enough time in a one-year cycle to complete all of the required components, starting with completed stock assessments and ending with annual regulations. In recent years management measures (primarily bag limits and seasons) have also been applied to recreational fisheries, adding to this complexity.

The Council's preferred alternative for Amendment 17 (subject to approval by the Secretary) would establish a biennial management cycle for groundfish, beginning with the 2005-2006 fishing years. Under this alternative, a three Council meeting (November-March/April-June) process would be used to prepare biennial management measures. OY values for managed species would be established for each fishing year during this two-year management period. That is, two one-year OYs would be specified for each managed species.

To ensure the Council could respond to significant changes in a fishery, the Council also included in Amendment 17 a process for reviewing fishing levels during the multi-year management period to ensure sufficiently conservative harvest levels in order to protect and rebuild overfished species. These checkpoints would consider whether new science or assessment information should be used to alter harvest levels. The Council asked the GMT (in consultation with the SSC and GAP) to develop thresholds for determining whether mid-process changes are necessary.

FMP Amendments

Annual management allows adaptation to short-term changes in the status of stocks and the fisheries exploiting them (tied to long-term targets in the case of stocks below the target biomass). Broader changes to the management regime require FMP amendments. (Regulations also may be amended to effect such a change. Generally speaking, the FMP governs the management regime while regulations specify public conduct—in this case, what fishermen may or may not do.) Council Operating Procedure 11 describes the process for amending the FMP (PFMC 2000). An issue identified by advisory bodies or the public is taken up at the first meeting where the need for action is considered along with possible alternatives. A draft amendment package is then prepared for Council review at a second meeting. During this meeting the Council selects a preferred alternative, if possible, and adopts the draft amendment for public review. Staff then prepare a final draft amendment, which is made available for public comment. Public hearings are held during a third Council meeting and the Council adopts the final amendment for implementation by the Secretary. After the third meeting, Council staff make any needed nonsubstantive additions and changes and transmit the document to NMFS for review. Given this process, aside from any staff time needed to prepare the analyses and supporting documentation, Council decision-making can take six to eight months. This is the minimum time within which three meetings could occur given the Council meeting schedule (bearing in mind that groundfish issues are usually kept off the agenda during the Council's March meeting). For example, about six month would elapse if initial consideration occurred at the April meeting, then the June and September meetings were used to complete the process. Of course, the Council may not be able to consider an action during three successive meetings because of the total time available for the meeting agenda or because requisite document drafts are incomplete. This would lengthen the schedule still further. Additional time is also needed after the Council's final decision to prepare the NEPA document submitted to NMFS to start agency implementation procedures.

3.1.3 Public Participation

An often-cited work on citizen participation (Arnstein 1969) proposes an eight-rung "ladder of participation" (see Figure 3-6). The lowest two rungs represent nonparticipation; public involvement is a means for the organization to persuade or manipulate the public. The next three rungs represent different levels of "tokenism"; an organization may offer opportunities for the public to comment, or express their views on a decision, but there is no guarantee their concerns will be heeded by decision-makers. The last three rungs represent successively higher degrees of true citizen power, to the degree that they have either delegated decision-making authority or actual control over the process. The Council process lies somewhere on the upper rungs of what Arnstein labels tokenism or at the lowest rung of citizen power, labeled partnership (citizens can negotiate with power-holders but do not have ultimate authority). It is also worth mentioning the large body of literature on common property resource institutions (see Ostrom *et al.* 2002 for a recent review), if for no other reason than Arnstein's typology begs the question of what constitutes the potentially enfranchised public. This literature is concerned with arrangements for controlling access to and use of resources that are not privately held. From this perspective "citizen involvement" may be cast in terms of such arrangements and correlated institutions. Fishers—those directly exploiting the resource either commercially or recreationally—tend to be more active in the Council process because of their activities may be directly affected. The broader public, represented to some degree by different environmental groups, have a more diffuse interest in the marine ecosystem and the array of nonextractive or nonmonetary benefits derived from it.

The Council process offers range of forums for public participation, related to Arnstein's ladder of participation. Council members membership is meant to represent a range of stakeholders (although some argue that representation is insufficiently diverse). The GAP reflects the perceptions and opinions of representatives of industry, recreationalists and other constituents on the committee; consensus statements from this body can directly influence Council members' decisions. (Technical bodies, such as the GMT and SSC similarly promote consensus on scientific issues.) Meetings of these bodies are open to the public, allowing limited participation by nonmembers and, at a minimum, public scrutiny of discussion and decisions. Comments from the public at large, through letters to the Council in advance of meetings and during comment periods at meetings can be collectively influential. The public also has the chance to lobby members of advisory bodies and the Council during meetings but outside established, formal public comment periods. Once the Council passes on its decisions to NMFS, as recommendations, there are opportunities for the submission of written comments during the rulemaking process. The most visible, and formalized, venues for public participation through commenting are associated with decision-making (either by the Council or NMFS). More complex decision processes (for example, involving multiple stages of review and revision by advisory bodies and the Council) generally afford more opportunity for public comment.

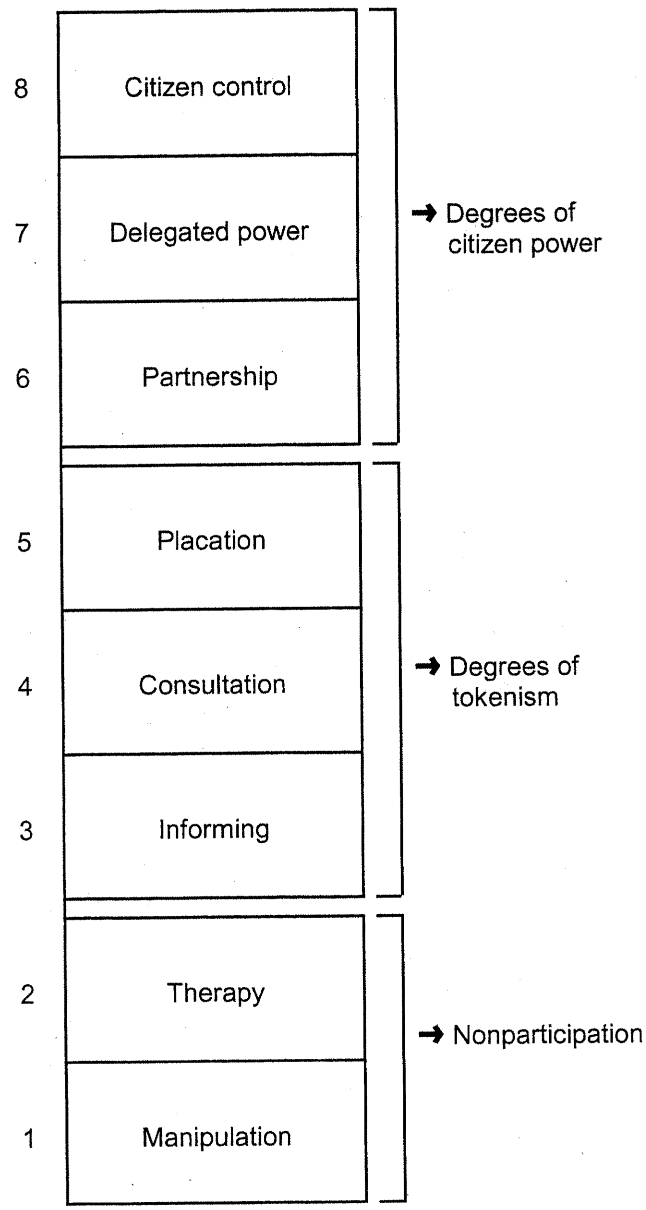

Figure 3-6. Levels of citizen participation (Arnstein 1969, p. 217).

Trust is an important corollary of public participation that can play out in a variety of ways. Interest groups and stakeholders who believe they have some influence over decisions are likely to put greater trust in the process. By reducing conflict, influence can stem controversy. (It should be emphasized that in the policy arena conflict and controversy are not necessarily bad things. They force more careful consideration of an issue from different perspectives. This may result in more equitable decisions.) On the other hand, those groups who believe themselves lacking in influence will seek greater transparency and certitude. Transparency allows the public to determine what factors (especially those that are explicitly "political") influence decision-making. Certitude reassures those with less influence that decisions are constrained by explicit rules limiting their scope. Constraints may be external—imposed by legal requirements for example—or self-imposed so that a course of action is fully or permanently determined. As implied in the previous discussion of adaptive management, this type of certitude can be an institutional response to uncertainty, and one that runs counter to adaptive response. This is especially the case if interest groups see uncertainty as a means for specific groups with opposing interests to unduly influence decision-making. This may be an important factor in relation to rebuilding measures because of the high degree of uncertainty about stock status in the future. Uncertainty could be seen to enlarge the range of potentially defensible decisions. Similarly, invoking adaptative strategies might be seen as an opportunity to accommodate a given set of interests. This aspect of participation, as it relates to controversy, is also evaluated by assessing "certitude," or the degree to which decisions are constrained by established policies. (These are constraints over and above those established by the Magnuson-Stevens Act and National Standard Guidelines.) This characteristic will also tend to vary inversely with flexibility (adaptability).

3.2 Evaluation of Rebuilding Strategies

As discussed in Chapter 2 and section 3.1.2.2, the different parameters used to characterize rebuilding can be assigned to different categories. First, there are biological parameters that describe the underlying characteristics of the stock. Unfished biomass, and by extension the target biomass, and mean generation time fall into this category. Second, there are the two limits—T_{MIN} and T_{MAX}—established by national policy, which denote the minimum possible and maximum allowable rebuilding times. None of these parameters represent a policy choice available to the Council. Finally, there are the strategic parameters, which, along with any adopted management measures, represent a rebuilding strategy. These parameters are F (or a specified harvest control rule), P_{MAX} and T_{TARGET}. As discussed in Chapter 2, the Council may choose any one of these three values as the basis for their rebuilding strategy, although T_{TARGET} needs to be specified in order to comply with language in the Magnuson-Stevens Act. At the request of Council Staff, Dr. Andre Punt of the University of Washington School of Fisheries and Aquatic Sciences simulated results of holding any one of these values constant (i.e., using it as the basis for the management strategy) as new stock assessments add new information about recruitment.

The simulation assumes that stock assessment scientists have perfect information about the current age-structure of the population, historical spawning biomass (including the unfished spawning biomass), and historical recruitment. Thus, biological and national policy parameters do not change. Although this is unlikely to be the case, it allows the analysis to focus on the tradeoffs of using different strategic parameters. The simulations assume, however, the stock assessment scientists do not know the stock-recruitment relationship (and hence future recruitment), and must therefore predict future recruitment by assuming the ratio of the number of recruits to spawning biomass size is a constant value. Put another way, there is a true relationship between population size and structure and recruitment, but scientists do not know the parameters for this relationship. Instead, stock assessment scientists use a model representing their current (and incomplete) understanding of the truth.

New recruitment values are added to the projection every three years, mimicking the availability of new estimates from a typical stock assessment cycle (which in reality can vary between two and four years for groundfish). For the simulations where it is held constant, P_{MAX} is set at arbitrarily at 60%. T_{TARGET}—the median rebuilding year for this P_{MAX}—is calculated to be 86 years. (The simulation begins in year 44 of a rebuilding period with a T_{MAX} of 91 years). The F calculated for the initial three years of the simulated period is used to simulate a constant F strategy. In order words, the calculations are based on setting P_{MAX}, T_{TARGET} or F when the first rebuilding analysis is done and not changing the specified value thereafter.

3.2.1 A Constant F Versus Constant T_{TARGET} Strategy

Figures 3-7 through 3-9 display the results of these simulations. Figure 3-7 displays projected population growth under each strategy. Figures 3-8a and 3-8b show the effects of the different strategies on OY and F, respectively. Figures 3-9a and 3-9b show the effects of the different strategies on T_{TARGET} and P_{MAX}. Looking at all of the figures it can be seen that no matter what parameter is held constant the relationship between P_{MAX} and T_{TARGET} does not differ by much. This is reflected in the fact the lines representing these two parameters (dashed or dot-dashed) substantially overlap. In terms of rebuilding strategy, therefore, the essential tradeoff is between managing to a constant F (putting strategic emphasis on the harvest control rule) or T_{TARGET} (as determined for a given P_{MAX}). As seen in Figure 3-7, holding F constant, based on stock condition at the outset of the simulated period, results in faster rebuilding to the target biomass. Larger increments of the population are not removed by fishing as it reaches the target size; as a result, in this simulation at least, the population reaches its target size well before T_{MAX} and continues growing. A constant

T_{TARGET} strategy allows F to increase as population approaches the target biomass, based on the 60% probability of achieving it within 91 years (T_{MAX}).

Figure 3-7a shows the effect on annual OYs. Under a constant T_{TARGET} strategy larger biomass increments are removed as the population increases, resulting in the steady increase in OYs seen in Figure 3-8a. OYs are also more variable since F is adjusted up or down in response to changes in recruitment. Figure 3-8b is similar, displaying the change in F, rather than OYs. The horizontal solid line in this figure represents the value of F under a constant F strategy. (By definition, a constant value results in a horizontal line.) A T_{TARGET} (or P_{MAX}) strategy allows F to increase so that a larger fraction of the stock is taken, resulting in decreasing population growth rates as the biomass target nears. The stair-step appearance of F under a constant T_{TARGET} (or P_{MAX}) strategy in this figure simply reflects the fact the same newly computed F is applied during each year in each successive three-year period after a stock assessment. In both figures it can be seen that F, and the resulting OY, have to be adjusted downward after some assessments due to modeled variability in recruitment.

Figures 3-9a and 3-9b show the same relationships in terms of T_{TARGET} and P_{MAX} respectively. In Figure 3-9a the solid line shows the estimate of the target year is successively lowered under a constant F strategy. Estimates of T_{TARGET} under a constant P_{MAX} strategy differ little from the initially computed value. In Figure 3-9b the solid line simply shows that under a constant F strategy P_{MAX} rapidly reaches 100%, because the target biomass is reached much sooner. Again, the relationship between P_{MAX} and T_{TARGET} (represented by the difference between the dot-dashed and dashed lines) varies only slightly due to modifications in recruitment values used in the projections.

In summary, assuming perfect information, there is no scientific basis for favoring one rebuilding strategy over the other. However, they have different implications from a policy perspective. A constant F strategy results in faster rebuilding and more stable OYs year to year. But over time these OYs remain lower than under a constant T_{TARGET} strategy, at least until the stock reaches its target biomass when the MSY harvest rate can be applied. Under the T_{TARGET} strategy, F is adjusted after every assessment so the target biomass will be reached in the target year (with a 50% probability, since it is defined as the median year for any P_{MAX} probability distribution). As a result, OYs will increase as F is readjusted, as long as the population grows, but—by definition—this strategy aims to restore the stock to its target biomass by the target year and not at any earlier date.

3.2.2 Implications of Rebuilding Analysis Input Estimation Errors

As noted above, this simulation assumes perfect information about the input values for the analysis. In some cases stock productivity may be under- or over-estimated, as revealed by subsequent assessments. Obviously, over-estimating productivity for some period of time would have graver consequences than under-estimating it. The current status of bocaccio rockfish offers an instructive, although extreme example of the effect of estimation errors. This species was declared overfished in 1999. In subsequent years recruitment was over-estimated, harvest levels set too high, and these levels exceeded. In addition, a change in the way rebuilding analyses are structured had an important effect on rebuilding prospects. Previously, T_{MIN} was recalculated starting from the year in which the rebuilding analysis was conducted. The analysis was revised to fix the starting point for the analysis at the year when the stock was declared overfished (in this case 1999) and account for actual harvests in subsequent years up until the year when the analysis is performed. As a result, a revised 2002 rebuilding analysis (MacCall and He 2002), accounting for the over-harvest in the intervening years, shows that even in the absence of fishing P_{MAX} is less than 50%. This is because the limits (T_{MIN} and T_{MAX}) were calculated based on existing recruitment data while the P_{MAX} calculation accounts for the excessive harvests. A less anomalous situation could arise if T_{MAX} is lowered because new estimates of stock productivity are higher (in other words, productivity was previously under-estimated); a constant T_{TARGET} strategy could result in a target year that is now greater than T_{MAX}. Conversely, the estimate of unfished biomass could be lowered due to new estimates of compensatory effect or other limiting ecological factors. This would also result in a target year greater than T_{MAX} under a constant T_{TARGET} strategy.

Both strategies entail similar risks in cases where stock productivity is over-estimated. A constant F strategy is more conservative in that additional surplus production is not removed as the stock approaches the target biomass. However, any over-estimation of F would apply to the period from the most recent stock assessment. If the over-estimation were small, it would have a slight effect during that period and be overtaken by a slightly delayed increase in stock size. If the over-estimation was large, overfishing could occur, preventing stock growth. Pursuing a constant T_{TARGET} strategy would entail similar risks. The most important assumption in any strategy is that regular stock assessments provide a feedback loop allowing more or less continuous adjustment (at the interval of regular stock assessments) of the fishing mortality rate. Under a constant F strategy such an adjustment would only occur if recruitment had been over-estimated in the last assessment, resulting in an F that was too high. Therefore, in practice OY is likely to change under a constant F strategy as additional information allows better estimation of the current age-structure of the population. This isn't apparent in the figures because perfect information about the current state is assumed. Under a constant T_{TARGET} strategy F would be adjusted after each stock assessment so the stock rebuilds by the target year; estimation errors could also be compensated for as part of this adjustment.

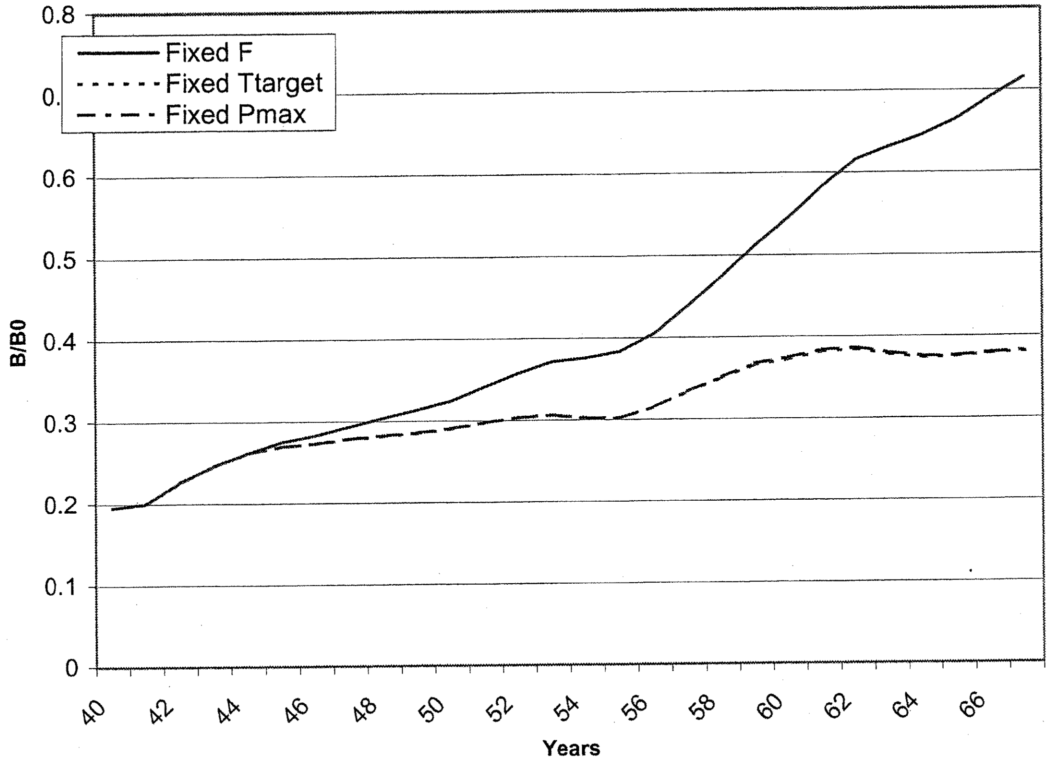

FIGURE 3-7. Biomass trajectories under different strategies.

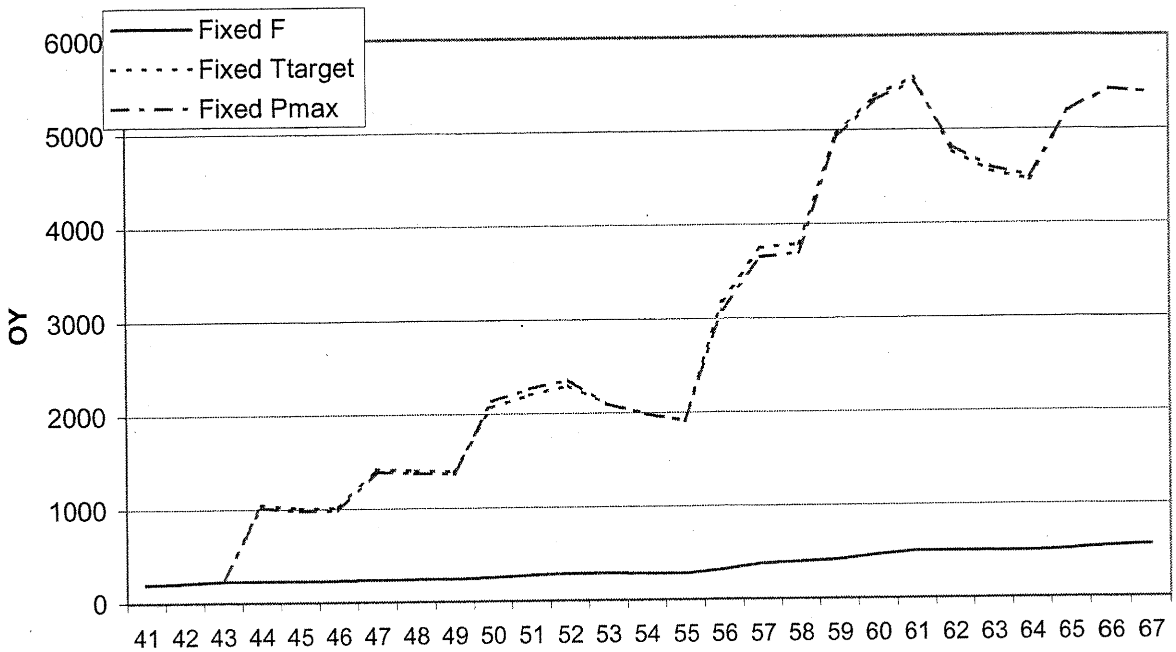

FIGURE 3-8a. Change in catch (OY) over time under different strategies.

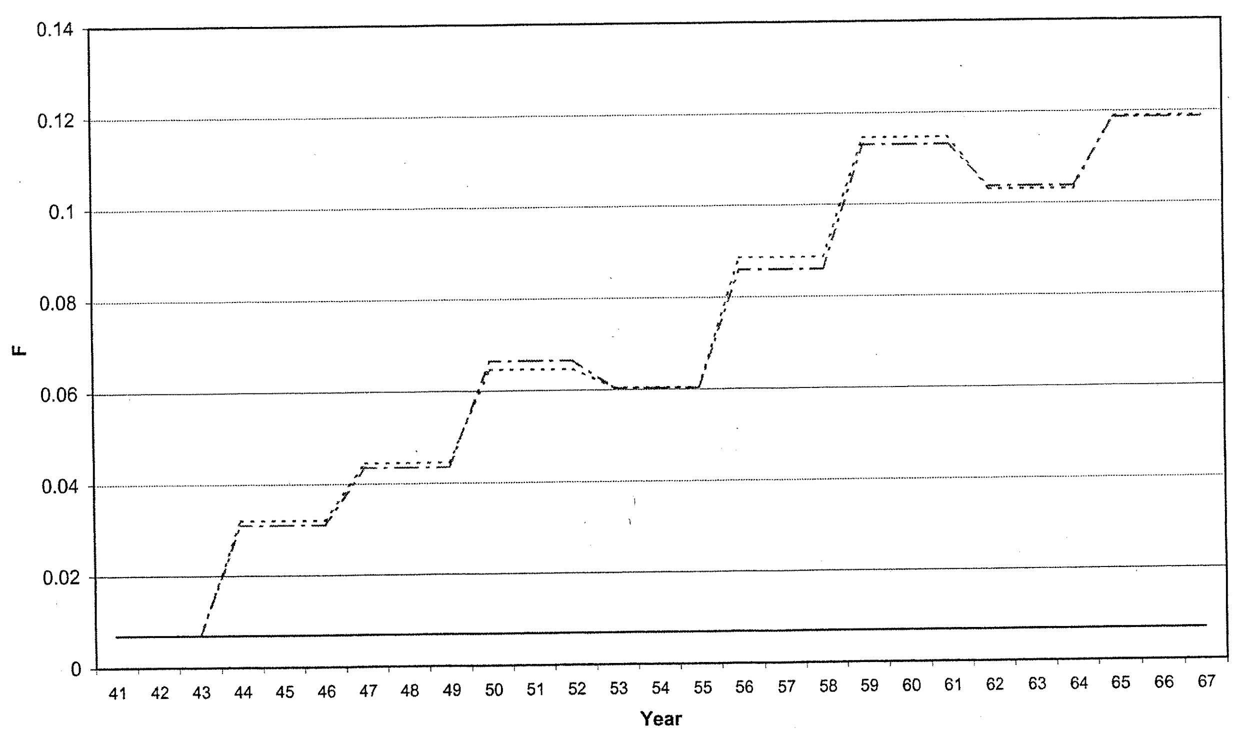

FIGURE 3-8b. Change in F rate over time under different strategies.

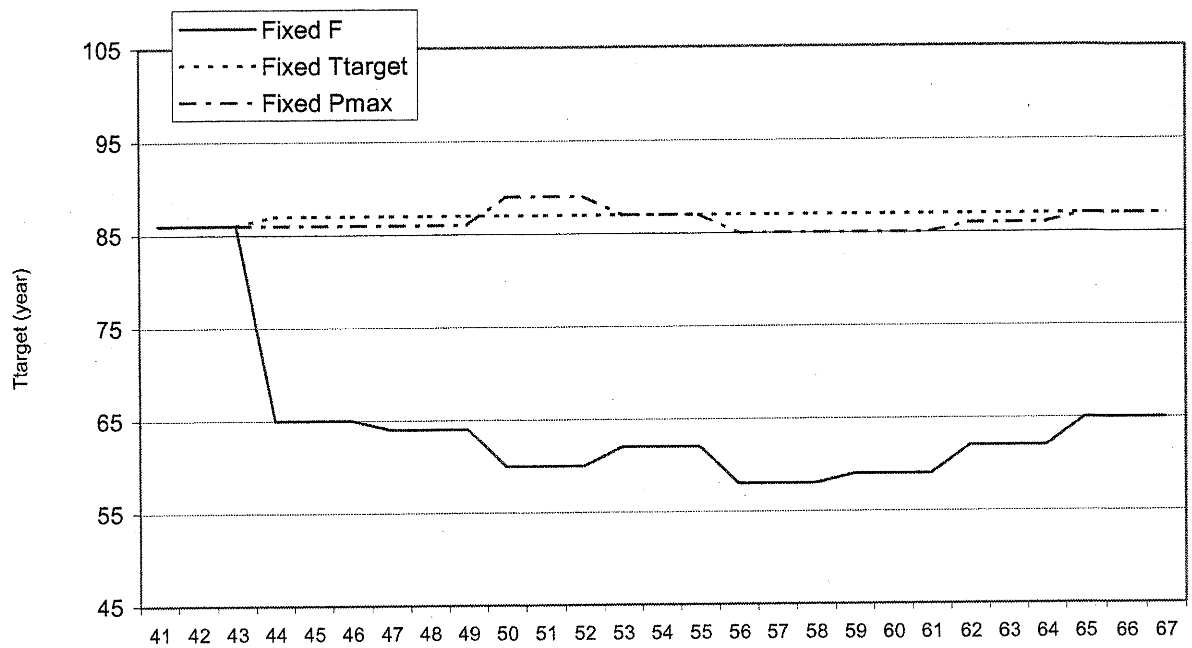

FIGURE 3-9a. Change in T_{TARGET} over time under different strategies.

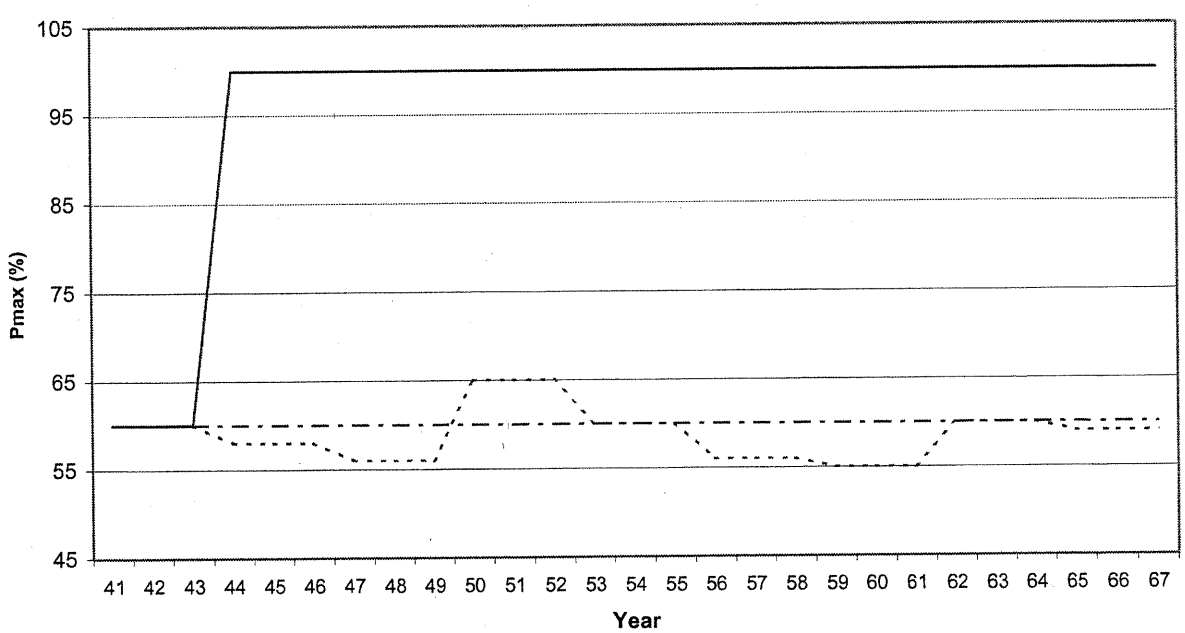

FIGURE 3-9b. Change in P_{MAX} over time under different strategies.

4.0 ENVIRONMENTAL CONSEQUENCES

The environmental consequences of the proposed action are evaluated in terms of direct, indirect and cumulative impacts. Direct impacts "are caused by the action and occur at the same time and place" while indirect impacts "are caused by the action and are later in time or father removed in distance"(40 CFR 1508.8). Cumulative impacts result from the "incremental impact of the action when added to other past, present, and reasonably foreseeable future actions" including activities of agencies and individuals other than the action agency (which in this case is NMFS). The proposed action is procedural in nature: it specifies how rebuilding plans will be adopted and periodically reviewed but does not specify the content of individual rebuilding plans (the value of parameters like P_{MAX}, T_{MAX} and T_{TARGET}, for example). For this reason the proposed action will not have any direct impacts on the human environment. Its effects may be construed as either indirect, since they will occur at a later time and place through the implementation of rebuilding plan measures, or cumulative, since the total impact includes the combined effect of rebuilding plan measures as "reasonably foreseeable future actions."

While not directly affecting the environment, the proposed action will affect the management regime. First, the adopted framework affects how rebuilding strategies will be developed—in terms of the targets and management measures that will be used. Second, the proposed action can be evaluated in terms of the issues discussed in section 3.3: administrative capacity, adaptive management, and public participation. The options described in Chapter 2 will have varying effects on workload, the degree to which management can adapt to changed conditions, and how much the public, through the Council process, will have assurances that social goals (e.g., resource conservation versus resource use) will be met. These effects could in turn affect the environment based on what management actions can be undertaken given the distribution of institutional resources. Simply put, fixed administrative capacity represents a zero sum game: the time that participants devote to implementing, reviewing and amending rebuilding plans is time taken away from other management initiatives. This expenditure of administrative capacity and management flexibility represents a tradeoff against the obligation to adhere to targets and the opportunity for periodic review, which allows some public participation through the Council process.

These considerations form the basis of the analytical framework underpinning this chapter. Section 4.1 evaluates each set of options in terms of their effect on the management regime, using the issues outlined in section 3.1. Section 4.2 discusses the potential effects of different rebuilding strategies (in terms of what rebuilding parameter the strategy is based on) and of uncertainty as affected by future stock assessments, based on the discussion of the constant F versus constant T_{TARGET} strategies in section 3.2. Section 4.3 evaluates cumulative effects to the environment, based on future management priorities identified by the Council and the likelihood that different sets of options will diminish the ability to address these priorities.

4.1 Effect on Management Regime

4.1.1. Issue 1: The Form and Content of Rebuilding Plans

4.1.1.1 Option 1a (Status Quo)

There is no framework for specifying the form of rebuilding plans.

Administrative Capacity. This option makes the least demands on administrative capacity in that no additional amendments are needed to implement rebuilding plans, which are implemented through periodic (biennial starting in 2005-2006) management. According to the Court, however, this approach violates the Magnuson-Stevens Act.

Adaptive Management. This option offers the most flexibility for the same reason that it is less demanding of administrative capacity. Rebuilding measures would be easier to change in response to new information or changed environmental conditions, because the FMP and/or regulations do not contain the specified targets, limits and management measures constituting the rebuilding strategy. However, this option is probably less adaptive overall if rebuilding strategies are easily modified in response to the social costs involved in achieving those targets. For example, if the target year is regularly delayed in order to avoid the costs associated rebuilding by then, the original management goal of rebuilding the stock within a certain time period may not be achieved.

Public Participation. Without FMP amendments or notice and comment rulemaking, there is limited opportunity for public comment directly related to a chosen rebuilding strategy. Comments would have to come as part of the biennial specification of harvest levels and associated management measures. In comparison to the other options, this option affords the least opportunity for public participation. As noted above, public skepticism the Council will stick to rebuilding targets may be higher under the status quo.

4.1.1.2 Option 1b

Numerically specify P_{MAX}, T_{MIN}, T_{MAX}, and T_{TARGET}, describe the harvest control rule, and outline the methods used to calculate B_{MSY} in the FMP.

Administrative Capacity. This option would entail the highest administrative cost of all the Issue 1 options. Numerically specifying both those parameters specified by national policy (T_{MIN} and T_{MAX}) and more than one of the strategic parameters (F, P_{MAX}, and T_{TARGET}) in the FMP would almost guarantee subsequent amendments after every new stock assessment of an overfished species. The values of T_{MIN} and T_{MAX} are likely to change if, for example, new values are added to the pool of recruitment values used in the rebuilding analysis. Furthermore, as discussed in section 3.1.2.2, for any given value of F, P_{MAX} or T_{TARGET}, the other two values are likely to change if the underlying biological information, derived from stock assessments, is updated.

Adaptive Management. This option is less flexible of all the Issue 1 options for the same reasons that it adds to administrative cost: it would be more difficult to revise the parameters specified in the FMP. This approach is also the least adaptive, if management had to conform to the parameter values in the FMP, even if they were incorrect but had not yet been updated by amendment. Alternatively, this option could function similarly to Option 1d in practice, if it were recognized that management measures could conform to updated parameters values rather than those in the FMP that had become outdated in the absence of an amendment to correct them. In comparison to the status quo, this option would specify rebuilding strategy parameters (T_{TARGET}, P_{MAX}) and entail a greater obligation to manage to these targets. This could serve adaptive management by establishing fixed benchmarks for monitoring and evaluation.

Public Participation. To the degree the FMP would have to be amended more frequently in response to changes in specified parameter values, this option would provide more opportunities for public participation than the status quo. Given that parameter values are updated through the rulemaking process under options 1c and 1d, with the attendant opportunity for public comment both during the Council process and rulemaking, there may be little difference between these three options in this regard. It is also unclear that specifying a greater number of parameters aside from the target year (or F), would help to reduce public skepticism any more than specifying the strategic parameters.

4.1.1.3 Option 1c

Numerically specify T_{TARGET} and the harvest control rule in regulations.

Administrative Capacity. Except for the status quo, this option is likely to entail the least administrative cost of all the Issue 1 options, although it is difficult to distinguish from Option 1d in this regard. It would specify only the target year and the corresponding harvest control rule (which could be describe as F). Generally, any specification of the harvest control rule (especially a numerical specification of F) would likely have to be changed after new stock assessments, which would be accomplished through the same notice and comment rulemaking process used for biennial management. T_{TARGET} would only be changed in unusual circumstances and thus infrequently, if at all. Combining these changes with rulemaking for biennial management would involve moderately less administrative cost than a FMP amendment in terms of the procedural requirements and supporting analysis.

Adaptive Management. This option and Option 1d generally allow the same level of flexibility. This option would require notice and comment rulemaking to change specified parameters, the same process that would be required under Option 1d. As noted, if resulting OYs in a given year were so low the Council wanted to change them to mitigate socioeconomic impacts, T_{TARGET} would have to be re-specified in regulations. If regulations could not be amended in advance or as part of the annual (or biennial) management process, the Council could be obligated to manage according to draconian targets. Generally, this option is very adaptive because it specifies key strategic elements and allows a high degree of flexibility in achieving those targets. In an extreme situation (OYs engendering severe socioeconomic impacts for example) targets could be modified, but not without the deliberations and analysis required as part of rulemaking.

Public Participation. As discussed above under Option 1b, the three action options are likely to afford comparable levels of public participation.

4.1.1.4 Option 1d

Describe computation methods for rebuilding parameters in the FMP and specify initial values in the FMP and regulations. Update harvest control rule and T_{TARGET} through rulemaking.

Administrative Capacity. The key difference between this option and Option 1c is that additional material would be incorporated into the FMP as part of rebuilding plan adoption. Rebuilding plan adoption would involve FMP amendments, with a moderate increase in administrative cost in comparison to Option 1c. As discussed above, by updating these parameters through the same rulemaking process used for biennial management, the additional administrative cost (above that devoted to periodic management) would be moderate. An EIS was prepared for 2003 management measures (PFMC 2003). If this level of analysis is needed in future years, this represents a fairly large "fixed cost," suggesting relatively low "marginal cost" for including parameter updates.

Adaptive Management. This option is also similar to Option 1c in terms of flexibility and adaptive management, except the management framework is more fully described in the FMP. This added description would support adaptive management because it allows a high degree of flexibility while clearly specifying at a more formal level the governing principles for managing overfished species (in terms of calculation and use of rebuilding parameters). Description of other rebuilding plan elements, such as particular management measures intended to achieve rebuilding targets, could also be described in the FMP and would better fit into the framework implemented under this option than under the other options. Specified parameter values would be "exemplary," allowing both the public and managers to refer to historical benchmarks over the course of the rebuilding period. At the same time, there would be a similar level of flexibility, as discussed above, to modify strategic parameters in response to new data and/or changing conditions.

Public Participation. As discussed above under Option 1b, the three action options are likely to afford comparable levels of public participation.

4.1.2 Issue 2: Periodic Review and Amendment of Rebuilding Plans

In general, a more rigid review schedule is likely to increase administrative opportunity costs. The frequency of reviews increases total workload, and could preclude the management regime from addressing other management issues arising in the future. If managers decided these issues had to take precedence, departing from a mandated schedule could require a FMP amendment to change the review schedule, adding another impediment to addressing the priority issue that had arisen. Without an amendment more beneficial tasks might have to be set aside in order to conduct reviews.

4.1.2.1 Option 2a (Status Quo)

The Council reviews rebuilding plans every two years.

Administrative capacity. Currently the FMP states the Council will review rebuilding plans at least every two years but does not specify that rebuilding plan goals should be the basis of such a review (although these are logical criteria for a review). Therefore, the Council could choose to use the goals identified in the FMP but is not obligated to do so. In the absence of any major issues arising in connection with a particular rebuilding plan, this would allow the Council to conduct a relatively cursory review. In terms of administrative capacity, this would be especially desirable if administrative resources would be better committed to some other management task.

Adaptive management. Flexibility in regard to workload prioritization, discussed above, could also make it easier to respond to changing conditions with respect to the fisheries ecosystem as a whole in comparison to Options 2b through 2d. However, the lack of standards based on FMP-specified goals, a feature of those three options, could make consistent evaluation more difficult. Monitoring and evaluation is an important aspect of adaptive management.

Public participation. It is likely the review task would be carried out by Council advisory bodies (SSC, GMT, GAP) with their recommendations forwarded to the Council for action. All these venues are open to the public and have opportunities for public comment. (Advisory body meetings tend to be more informal and thus afford somewhat greater exchange with nonmember participants. Public comment periods on the Council floor allow issues to be aired in front of a larger audience.) If two-year reviews indeed addressed all five FMP-specified goals this would allow the most frequent participation across a range of issues.

4.1.2.2 Option 2b (Council-preferred).

The Council reviews progress toward stock rebuilding (goal 1) only when a new stock assessment has been completed. The remaining FMP-specified goals are reviewed every two years.

Administrative capacity. This option entails more administrative cost than the status quo because it explicitly links rebuilding plan review to existing FMP-specified goals. Therefore, the Council would be under some obligation to conduct more detailed reviews than under the status quo. To a large extent, the evaluation of stock rebuilding (goal 1) would likely be linked to the kind of "adequacy of progress" standard adopted under Issue 3 (below). It is likely that if these standards were met, the rebuilding plan review would be relatively cursory.

Adaptive management. This option is the most adaptive because it includes particular standards on which to evaluate rebuilding plans, but ties them to stock assessments that are scheduled according to future determinations of need and available institutional resources.

Public participation. All of the options (except Option 2e) mandate some level of review by the Council every two years, except that under the status quo, this review is presumed, based on the Magnuson-Stevens Act rather than specified in the FMP. However, this option, and options 2c and 2d, do not mandate review of stock rebuilding (goal 1) every two years; instead evaluation is tied to stock assessments. Currently, in principal at least, stock assessments are to be carried out on a two-year to four-year rotating schedule for all assessed stocks, although the actual frequency can vary. (Whiting, for example, is assessed annually.) Thus, this option would afford marginally less frequent opportunity for the public to learn about and comment on this central issue.

4.1.2.3 Option 2c

The Council reviews progress toward stock rebuilding (goal 1) only when a new stock assessment has been completed. However, unlike Option 2b each rebuilding plan will describe the stock assessment schedule for that species. The remaining FMP-specified goals are reviewed every two years.

Administrative capacity. This option entails more administrative cost than the status quo for the same reasons put forth for Option 2b. It is likely that any stock assessment schedule outlined in a rebuilding plan would not differ substantially from the existing schedule, so there is unlikely to be any meaningful difference in terms of workload when compared to Option 2b.

Adaptive management. This option is somewhat less adaptive than the status quo and Option 2b in that it would require each plan to pre-specify a stock assessment schedule. It would be difficult to anticipate future contingencies, both in terms of stock status and management priorities, that might recommend that assessments be carried out more or less frequently than what was specified.

Public participation. For the reasons discussed under Option 2b, this option might afford marginally less opportunity for public participation than the status quo. However, as just mentioned, it may be that a specified schedule for stock assessments would result in stock assessments as frequently or more frequently than the status quo. If this were the case, then there were would be no great difference in terms of public opportunity to comment on stock rebuilding in comparison with the status quo.

4.2.2.4 Option 2d

The Council reviews progress toward stock rebuilding (goal 1) only when a new stock assessment has been completed. However, the FMP will describe a stock assessment schedule applying to all overfished species. The remaining FMP-specified goals are reviewed every two years.

Administrative capacity. The proposed FMP-specified stock assessment schedule under this option is every four years for the first 20 years of rebuilding and every two years thereafter until the stock is rebuilt. Of the currently overfished stocks, all but two will take more than 20 years to rebuild. This suggests slightly less of an administrative cost in comparison to the other alternatives, assuming a two- to four-year review cycle (based on stock assessments) for those species versus four years under this options for most overfished species for the foreseeable future.

Adaptive management. This option is the least adaptive because it specifies a generic stock assessment schedule for all overfished species. It is very likely that stock assessment priorities for different overfished species will change over time. For example, a stock that is rapidly recovering or for which managers have a high degree of confidence in the assessment may not need to be assessed as frequently as stocks that do not appear to be responding to rebuilding measures or where their status is less certain. Conversely, managers might want to assess stocks that are rebuilding rapidly (as is the case for lingcod) more frequently than every four years. Under this option, managers would be constrained in the allocation of institutional resources based on current priorities.

Public participation. To the degree the mandated four year stock assessment results in less frequent opportunities for the public to evaluate and comment on the efficacy of rebuilding efforts, this option would result in less opportunity for public participation in comparison to all of the options except perhaps Option 2e.

4.1.2.4 Option 2e

The Council defers all rebuilding plan reviews to the Secretary of Commerce.

Administrative capacity. This option places the least burden on Council administrative resources since the review could be deferred to the Secretary and would therefore allow other management issues to be more effectively addressed. However, this represents a shifting of the administrative cost, not any reduction in it. (Such a deferral would most likely shift review obligation to staff at NMFS NWR, who substantially contribute to Council-related business anyway.)

Adaptive management. In comparison to the other alternatives, this option has a neutral effect on adaptive management. Reviews would likely be conducted (by the Secretary) more frequently than under Options 2b-2e, but no specific criteria (such as FMP-specified goals) would be used in the review. On the other hand, under this option the Council would conduct annual reviews tied to more specific benchmarks (projected harvest mortality and biomass), which would support adaptation of management measures.

Public participation. This option is likely to afford the least opportunity for public participation since the review would be carried out internally by the agency, without direct Council oversight. However, the Council would have the opportunity to comment on the Secretarial review before its publication, allowing some opportunity for public participation through the Council process.

4.1.3 Issue 3: Amending Rebuilding Plans and Adequacy of Progress

4.1.3.1 Option 3a (Status Quo)

The FMP does not describe a standard to evaluate the adequacy of rebuilding measures.

Administrative capacity. A lack of standards results in uncertainty about when targets (e.g., target year, P_{MAX}) need to be adjusted because of differences between the projected and actual rebuilding trajectory. That uncertainty will need to resolved and will be an issue of controversy until standards are established either explicitly or through practice. The development of alternative management policies in an environment where these standards are not well-specified results in a more difficult, complex and contentious process.

Adaptive management. Although the lack of a standard could allow more flexible response to changes in stock status, the lack of benchmarks could make it harder to determine when adaptation is needed. Furthermore, because "adequate progress" is currently unspecified, standards could develop during the rebuilding plan review process. These ad hoc standards could be relatively inflexible in comparison to those deliberately planned in advance. Thus there is considerable uncertainty about the current baseline. This makes it difficult to use status quo as a baseline for comparison; therefore, other options will be compared to Option 3d.

Public participation. Currently there is no definition of adequacy of progress and the specification of such a definition in a public forum does not appear to be required under the Magnuson-Stevens Act, with such a determination left to the Secretary. A Council definition of adequacy of progress may not constrain the Secretary; however, Secretarial approval of the Council definition may place some additional justification burden on the Secretary if at some future time the Secretary were to select some other measure of the adequacy of progress.

4.1.3.2 Option 3b

If P_{MAX} falls below 50% the harvest rate strategy must be adjusted.

Administrative capacity. By establishing a single standard in advance, alternative standards will not have to be evaluated in the individual rebuilding plans or during their implementation. On the other hand, if this standard does not perform well in practice, the Council will have to devote administrative resources to revising FMP-mandated standards, instead of attending to other management priorities. Using a 50% probability standard could also allow a significant mismatch to develop between the actual harvest rate and the rate needed to achieve the target. This could necessitate a relatively large one-time change in harvest levels (once the 50% threshold is reached), which would be disruptive to the fishery. However, under the framework outlined under Options 1c and 1d F would be re-specified on a fairly regular basis (after a new assessment and as part of biennial management) in order to achieve the rebuilding target. This would make it unlikely that P_{MAX} would fall below 50% unless there were serious estimation errors in past assessments. Although not directly affecting administrative capacity (in comparison to the other options), the controversy resulting from a steep drop in OY could engender greater deliberation, requiring more administrative resources. It is difficult to assess the relative effect in relation to the status quo. By itself, establishing a standard will not entail any additional administrative cost. These costs could increase, however, if measures needed to meet the standard are difficult to implement or controversial. Alternatively, greater certainty about what standard will be used to adjust management measures, in comparison to the status quo, could lower administrative costs, by lowering uncertainty and controversy in comparison to the status quo.

Adaptive management. Compared to Option 3d, there would be less flexibility for developing measures of adequacy that might be more tailored to the conditions and characteristics of a particular species. By setting a "floor" triggering a required response, this option establishes a benchmark for adaptive response. Otherwise, it gives the Council some flexibility to increase the harvest rate above planned levels if the stock is recovering more rapidly than expected. With experience, the degree to which this flexibility to increase harvest rates is advisable could be assessed and limited by future amendment.

Public participation. By setting a single standard, both Option 3b and 3c present a relatively straightforward way for the public to evaluate management performance in terms of stock rebuilding. However, in comparison to 3d, these options provide less opportunity for the public to participate in the evaluation process for the same reason that managers would have less flexibility in how they evaluate rebuilding progress.

4.1.3.3 Option 3c

If P_{MAX} falls below the specified value, the harvest rate strategy must be adjusted.

Administrative capacity. This option is similar to Option 3b, but is likely to lead to more frequent adjustment in the harvest strategy because any deviation would have to be addressed, increasing administrative cost. Conversely, these adjustments would not be as large than under that option, making them easier to implement.

Adaptive management. Although similar to Option 3b, this option is preferable to Option 3b with respect to adaptive management, because the harvest rate is continuously adjusted in response to new information. Because harvest rate changes are incremental, OYs would likely vary less dramatically than under Option 3b where a large adjustment would have to be made once the rebuilding probability falls to 50%.

Public participation. Effects on public participation are the same as under Option 3b, above.

4.1.3.4 Option 3d

The Council in consultation with the SSC and GMT will decide on a case-by-case basis whether a significant change in a rebuilding plan parameter requires the plan to be revised/amended.

Administrative capacity. This option is similar to the status quo in that no standard is identified; instead an evaluation process is mandated. It is likely that these advisory bodies would fall somewhere in between Options 3b and 3c in terms of the frequency with which they would recommend revision. Although this option is more general, allowing the SSC and GMT to weigh in on any change in a parameter, P_{MAX} is likely to be the primary factor in their deliberations. They would likely evaluate the tradeoff between frequent change and disruptive change, choosing some intermediate frequency. This option would likely increase GMT and SSC workload, in comparison to Options 3b or 3c, because it not does not provide specific guidance. Therefore, these committees would have to develop their own criteria.

Adaptive management. This option is more flexible than either Option 3b or 3c because an assessment would be made through an expert process, based on current information. However, if no benchmarks are developed through the procedure specified here, the validity of assessments would be difficult to evaluate. Also, as discussed under the status quo and Option 3e, "ad hoc" standards could be less adaptive, or at least less flexible, than those specified in advance.

Public participation. If the process for evaluating rebuilding progress is not transparent with clearly identified benchmarks the public could view the management process with skepticism and mistrust. Conversely, Council processes are very open to public observation and any decision process within the SSC and GMT would be subject to scrutiny and comment. This could give the public a greater hand in the evaluation process.

4.1.3.5 Option 3e (Council-preferred)

The FMP would require that each rebuilding plan identify a standard based on predetermined list of possible standards.

Administrative capacity. Given the variety of ways in which rebuilding harvest control rules might be specified and the appropriate way of specifying the control rule may vary between stocks, it is possible that establishment of a generic adequacy of progress standard for all rebuilding plans will lead to standards that do not match well with the rebuilding harvest control rule. In such an instance, an amendment to the process and standards portion of the FMP would be required, generating more administrative costs, or there would be inefficiencies resulting from the mismatch between the control rule and adequacy standard. Requiring the specification of an adequacy standard in each rebuilding plan means that there will be some additional administrative costs associated with the development of the individual rebuilding plans, as compared to status quo (where no such standards are established) or as compared to options 3b and 3c (where the standards are established as part of the process and standards section of the amendment). However, over the long term costs could be lower if there is a better match between the characteristic of the stock and the standard established for it.

Adaptive management. On the surface, this option provides less flexibility than Option 3d, because the choice of benchmarks or evaluation methods is limited to a pre-specified list. If the list of predetermined standards are more effective than "ad hoc" standards that would be developed under Option 3d, and represent the different characteristics of overfished species (e.g., life span, recruitment variability), this option would be the most adaptive.

Public participation. This option is similar to Option 3b and 3c because standards are determined in advance. This would make it easier for the public to evaluate the management process but limit its influence over it.

4.1.4 Issue 4: ESA Listed Species

4.1.4.1 Option 4a (Status Quo and Council-preferred)

There are no special provisions in the FMP for the listing of overfished species under the Endangered Species Act.

Administrative capacity. The FMP and rebuilding plans will need to be amended if a rebuilding species is listed under the ESA.

Adaptive management. See discussion under Option 4b.

Public participation. There is no difference between Option 4a and 4b except for the timing of public participation. This process and standards amendment provides opportunity for public comment on the approach for handling ESA species. Without this provision, action would need to be taken at some future time if a groundfish species were listed under the ESA and there would likely be similar opportunity at that time for public comment on the proposed provision. The public would also be able to comment as NMFS develops jeopardy standards and recovery plans, which are developed outside the Council process.

4.1.4.2 Option 4b

If a stock is listed under the ESA, the rebuilding plan defaults to the jeopardy standard or recovery plan developed under the ESA.

Administrative capacity. FMPs will not need to be amended if a rebuilding species is listed under the ESA. The administrative costs associated with such and FMP amendment would be directed to other management activities to benefit the fishery.

Adaptive management. Addressing the effect of ESA listing on rebuilding plans would reduce any future workload associated with a FMP amendment needed to specify this contingency. This would provide the Council with more flexibility to address other management issues. Overall, there may be little or not effect on adaptive management since both rebuilding requirements and ESA action flow from federal law and managers would have to comply with both.

Public participation. See above.

4.2 Effects of the Choice of Rebuilding Strategy

The options under Issue 1 and Issue 3 can be evaluated in terms of the choice of parameters that serve as targets, thus constituting the strategic framework. Issue 1 deals with those parameters that will be incorporated into the FMP or regulations, with some implication of how they will be used as management targets. Issue 3 covers the standards that would be used to during periodic reviews to determine whether a rebuilding plan needs to be revised. Although closely related to Issue 3, Issue 2—covering the timing of periodic reviews—does not directly relate to the choice of strategic parameters. Issue 4 options address provisions in the FMP for possible ESA listing of overfished species and, therefore, do not bear on the choice of strategic parameters.

4.2.1 Issue 1 Options

Issue 1 options are evaluated in terms of the policy and procedural risks that rebuilding will not occur within a time period "as sort as possible," recognizing mitigating biological and socioeconomic factors. These risks are evaluated by assessing how the framework identifies management targets, circumstances where targets could be changed, and the level of analysis required to make such a change.

Option 1a: Status quo. Currently, the FMP establishes a general framework for rebuilding. Although the FMP states that rebuilding plans "will specify a time period for ending the overfished condition and rebuilding the stock," this time period is not specified in the FMP or regulations. When setting 2003 annual specifications, P_{MAX} was the principal parameter used to structure harvest specification (OY) alternatives. This suggests more flexibility in terms of choosing and changing targets during each management cycle. For example, a new stock assessment and rebuilding analysis could substantially increase short-term costs in terms of lowering the OY for a particular species in order to rebuild by the target year. The Council might recommend a later target year or lower P_{MAX} to achieve a higher OY during the impending management cycle. It would not be necessary to amend the FMP or regulations to make such a change. The Council would likely base their decision making on the same type of analysis as has been used for developing past annual specifications and management measures at the outset of the management cycle. Thus, procedurally it is difficult to assess whether such a change would be easier to make than under Option 1c and 1d. (Under Option 1b it would clearly be more difficult.) It depends on whether the incorporation of targets into regulations presumes a higher level of analysis. Undoubtedly, an EA could not be prepared in such a circumstance. It may be that in future years, unlike 2003 when an EIS was prepared, EAs will suffice as a basis for setting harvest specifications in ordinary circumstances. In that case, a higher level of analysis—an EIS—likely would be required if the new specifications implied a change in the target. However, more public scrutiny might be expected under Options 1c and 1d, especially as part of notice-and-comment rulemaking.

Option 1b: Numerically specify P_{MAX}, T_{MIN}, T_{MAX}, and T_{TARGET}, describe the harvest control rule, and outline the methods used to calculate B_{MSY} in the FMP. This option does not specifically identify any one parameter as the management target. The FMP would need to be amended if the value of any specified parameter changes as a result of a new stock assessment and rebuilding analysis. Since a FMP amendment can take a long time to implement, harvest specifications might sometimes have to be developed before the FMP is amended. In this type of interim, the key strategic parameters of T_{TARGET}, F (as expressed in the harvest control rule) and P_{MAX} would be the likely focus of decision making. It is unclear which parameter the Council would be obligated to manage for. T_{TARGET} is presumed given the legal and policy framework supporting rebuilding. But without guidelines specifying which parameter to choose, it would also be possible for the Council to recommend continuing with the same F (as expressed in the harvest control rule) for the next management cycle. Assuming no estimation errors, this would result in faster rebuilding in comparison to a continued T_{TARGET} strategy. Any policy decisions taken during such an interim between the new assessment and completing the FMP amendment would have to be evaluated in the analysis supporting that amendment. A decision reflecting a major change in policy, such as an implied delay in the target year, would likely require a higher level of analysis. Thus, an amendment that would have otherwise been accompanied by an EA might require an EIS.

Option 1c and 1d: Numerically specify T_{TARGET} and the harvest control rule in federal groundfish regulations, and under Option 1d, incorporate additional descriptive material into the FMP. These two options are similar in that both T_{TARGET} and the harvest control rule are specified in regulations and serve as management targets. Although amendment language makes clear that T_{TARGET} should only be changed in unusual circumstances, specific criteria for when such a change is permissible are not included. Changing T_{TARGET} to an earlier year, by managing according to the same harvest control rule (i.e., a constant F strategy) would accelerate long-term environmental benefits (return to target biomass) with little or no change in economic costs and benefits (change in OY), assuming no estimation errors in past or current stock assessments. If the Council pursued this strategy in setting harvest specifications, it would be easier to justify an EA, depending on other factors. If there is no bias in estimation errors, this strategy also becomes more risk averse over time in comparison to a T_{TARGET} strategy, since stock size should increase faster. As noted in Chapter 2, there are other circumstances in which the target year might be changed. The level of analysis required to make such a change cannot be predicted since it depends on a wide range of factors. Suffice to say, shifting to an earlier year, if short-term economic costs are modest, would demand less scrutiny than delaying the target year. Generally speaking, the closer that actual rebuilding adheres to expectations, recognizing that these expectations are framed stochastically, the less likely that impacts will breach significance thresholds, requiring more extensive analysis. Thus, actually pursuing a constant T_{TARGET} strategy throughout the rebuilding period represents the lowest level of risk for a given set of circumstances (recognizing any reduction in fishing mortality reduces the relative rebuilding risk) because it is consistent with the policy framework of rebuilding within a time period that is "as short as possible." By extension, this would demand less analysis in support of decision making over the course of rebuilding than any deviation from the strategy.

4.2.2 Issue 3 Options

These options are assessed in terms of their consistency with rebuilding by the target year (a constant T_{TARGET} strategy) and how they would prompt changes to the strategy.

Option 3a: Status quo. Since there are no standards under this option, it is not clear what would trigger a change in the rebuilding strategy. Presumptively, the Council would manage to the target year, but would have no decision framework for making a change.

Option 3b: Adjust strategy if P_{MAX} falls below 50%. If the initial P_{MAX} value is high enough, this standard is only likely to come into play if the harvest rate is held constant and stock productivity had been grossly overestimated in previous assessments. If the harvest rate is held constant throughout the rebuilding period, and there are no estimation errors, then P_{MAX} will increase from its initial value instead of decreasing. If the harvest rate is adjusted for a constant T_{TARGET}, it is possible that P_{MAX} could fall below 50%, depending on the initial value that was chosen. Figure 3-9b shows P_{MAX} reaching 50% for several years in the simulation under a constant T_{TARGET} strategy, where the initial value was set at 60%. A higher initial P_{MAX} value would decrease the likelihood of falling below 50%, assuming no estimation errors. Setting the target at T_{MAX} (i.e., P_{MAX} equals 50%) would make it likely that P_{MAX} would fall below 50% after some assessments. To some degree, there would be no additional institutional response, given the range of options chosen under Issue 1. Under Option 1b, the FMP would have to be amended when specified values change; this would likely trigger a reassessment of the rebuilding strategy in any case. Under Options 1c and 1d it is presumed that in most instances the harvest rate (as expressed by the harvest control rule) would be adjusted as necessary during each management cycle. This would result in only slight variations in P_{MAX}, as evidenced by the simulation results in Figure 3-9b, where the dotted line represents the P_{MAX} value under a constant T_{TARGET} strategy. It is likely that this standard would act more as a "safety net" if gross and systematic estimation errors occurred in successive stock assessments. If a new stock assessment and rebuilding analysis accounting for these errors revealed that P_{MAX} had fallen below 50%, this standard would trigger a possible revision of the rebuilding strategy.

Option 3c: Adjust strategy if P_{MAX} falls below its initial value. This standard is a similar but more strict version of Option 3b. The same set of issues would apply, but even without estimation errors P_{MAX} is likely to occasionally fall below its initial value because of recruitment variability. Again, if the management framework presumes frequent changes in the fishing mortality rate (as expressed by the harvest control rule) then this standard would not offer any additional check for reassessing the rebuilding strategy.

Option 3d: The GMT and SSC would jointly evaluate the need to adjust the strategy, based on stock assessments. This alternative does not establish a specific threshold, rather it identifies a process for evaluation. Because it is more flexible, standards could be developed over time that are both based on experience and tailored to the dynamics of the stock in question. For example, if a constant T_{TARGET} strategy is pursued under the framework outlined for Options 1c and 1d, there might be some flexibility to adjust the harvest control rule on a less frequent basis than after every stock assessment, while still maintaining the same target year. As a consequence, P_{MAX} would likely be different from the initially computed value, but this parameter is not specified in regulations under these options. Such an approach could offer some of the benefits of the more stable OYs that result from a constant F strategy with the upward adjustments that are possible under a constant T_{TARGET} strategy. Changing F (as expressed by the harvest control rule) less frequently also would be warranted if there is a lot of uncertainty surrounding stock assessment results. In cases where stock biomass or productivity estimates change substantially, and it is unclear whether this is due to errors in past or current estimates, continuing with the same F could provide more stability until a later stock assessment could be conducted to confirm or dismiss the implied trend. Of course, if the current F appears to high, based on recent, uncertain assessment results, the policy choice would be more complicated. It would be unclear whether past analyses over-estimated F or the most recent analysis is an under-estimate.

Option 3e: Rebuilding plans identify a specific standard (Council-preferred). This option cannot be specifically evaluated, given that it does not identify any one standard. Since standards would be based on the different possibilities encompassed by the preceding options, all of the risks and advantages already discussed would apply to this option.

4.3 Cumulative Effects on Future Management

Cumulative effects are the result of "the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions," including those of other agencies, organizations and individuals (40 CFR 1508.7). They are the total effect, or combination of direct and indirect impacts with external factors affecting components of the human environment. The proposed action will cumulatively affect the environment based on the degree the management regime must devote resources to procedural tasks related to rebuilding plans. Assuming that administrative capacity is fixed, devoting more time and effort to rebuilding plan tasks will take away from other management activities. This can be evaluated in a general way first by describing a range of outcomes, in terms of the different options chosen, that represent different levels of potential work load. These outcomes, or scenarios, can also be characterized with respect to adaptive management and public participation, which could also have management implications cumulatively affecting the environment.

The rebuilding plans that will be implemented pursuant to this amendment are connected actions that in combination will also produce cumulative effects. Instead of developing a separate analysis, this EA incorporates by reference the cumulative effects analysis in the 2003 Groundfish Annual Specifications and Management Measures EIS (PFMC 2003). Management measures for 2003 are largely structured to keep total catch (including bycatch) of overfished species within harvest specifications developed from rebuilding analyses and interim rebuilding plans. Thus, the cumulative effects analysis in the EIS accompanying that action is a good indication of how multiple rebuilding plans, when combined with other, external factors, will affect various resources and human communities.

The status quo (represented by options 1a, 2a, 3a, and 4a) imposes the least additional administrative cost, is moderately adaptive and affords the least public participation.

The most administratively demanding set of choices would likely be:

- Option 1b: Numerically specify P_{MAX}, T_{MIN}, T_{MAX}, and T_{TARGET}, describe the harvest control rule, and outline the methods used to calculate B_{MSY} in the FMP.
- Option 2d: The Council reviews progress toward stock rebuilding (goal 1) only when a new stock assessment has been completed. However, the FMP will describe a stock assessment schedule applying to all overfished species. The remaining FMP-specified goals are reviewed every two years.
- Option 3c: If P_{MAX} falls below the specified value the harvest rate strategy must be adjusted.
- Option 4a: There are no special provisions in the FMP for the listing of overfished species under the Endangered Species Act.

Other sets of choices fall within this range. One that would impose a moderate administrative cost is represented by the following choices:

- Option 1c: Numerically specify T_{TARGET} and the harvest control rule in regulations.
- Option 2b: The Council reviews progress toward stock rebuilding (goal 1) only when a new stock assessment has been completed. The remaining FMP-specified goals are reviewed every two years.
- Option 3d: The Council in consultation with the SSC and GMT will decide on a case-by-case basis whether a significant change in a rebuilding plan parameter requires the plan to be revised/amended.
- Option 4b: If a stock is listed under the ESA, the rebuilding plan defaults to the jeopardy standard or recovery plan developed under the ESA.

The Council-preferred options are similar to the set of choices just described in terms of their effect on the management regime:

- Option 1
- Option 2b: The Council reviews progress toward stock rebuilding (goal 1) only when a new stock assessment has been completed. The remaining FMP-specified goals are reviewed every two years.
- Option 3e: The FMP would require that each rebuilding plan identify a standard based on a predetermined list of possible standards.
- Option 4a: There are no special provisions in the FMP for the listing of overfished species under the Endangered Species Act.

Considering these sets of choices as representative of the range of outcomes, cumulative effects on the environment are considered here. These effects are evaluated in terms of management initiatives the Council has identified as part of Council staff workload prioritization brought before the Council in November 2002 and the Groundfish Strategic Plan (Ad-Hoc Pacific Groundfish Fishery Strategic Plan Development Committee 2000). The management initiatives identified in these sources are evaluated in terms of four resource-related categories: ecosystem and habitat (including protected species), groundfish, other Pacific Council FMPs, and the socioeconomic environment.

4.3.1 Ecosystem and Habitat, Including Protected Species

In April 2001 NMFS published a Notice of Intent to prepare an EIS to evaluate different ways of designating essential fish habitat (EFH) and minimizing adverse effects to EFH due to fishing, to the extent practicable (66 FR 18586; notice of availability of scoping summary at 67 FR 5963).[10/] The draft EIS is scheduled for publication in August of 2003. Preparation of this EIS is being coordinated by NMFS with some work done by outside consultants. However, the Council and Council staff are involved in several respects. Most importantly, the Council is monitoring EIS development and prior to its publication the Council will need to

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10/ This EIS is being prepared pursuant to American Oceans Campaign et al. v Daley et al. (Civil Action No 99-982(GK)).

review the document and select its preferred alternative. Because the draft is slated for publication in 2003, it is unlikely that future rebuilding-plan-related workload would affect activities related to this EIS through the draft stage. At this time it is unclear whether any necessary amendments would be developed as part of the EIS process or be implemented at a later time. If any subsequent amendments were necessary, rebuilding plan monitoring and updates could affect the capability of staff to implement them.

The Strategic Plan identifies two habitat-related goals: adopting marine reserves as a management tool and implementing measures to reduce fishing gear impacts to essential fish habitat. Although the Strategic Plan describes marine reserves in the context of fishery management, a related effect would be to reduce habitat impacts in areas where fishing was restricted or prohibited. Closed areas implemented in 2002 and 2003 to minimize bycatch of overfished species are defacto marine protected areas (MPAs), which will afford some habitat protection since using specified fishing gear types is prohibited in these areas. If the Council were to decide these areas should be developed as a system of semi-permanent or permanent MPAs, considerable staff work would be needed for supporting analyses and likely amendments to Council FMPs. Although these types of changes to the management regime are highly speculative at this time, the EFH EIS discussed above may be the vehicle for implementing habitat-related strategic plan objectives, since tools to identify and assess impacts to EFH could be developed as part of the EIS, and it may contain specific proposals for minimizing fishing gear impacts to EFH.

In summary, although the Council recognizes the need to evaluate and minimize fishing impacts to EFH no specific proposals are pending. Given this context, any added future workload related to the rebuilding plan process is likely to have a moderate effect on future habitat protection efforts.

NMFS NWR is developing strategies in support of the National Plan of Action to Protect Seabirds. The objectives of the national plan are to reduce seabird bycatch in U.S. longline fisheries, to provide national-level policy guidance on reducing seabird bycatch in U.S. longline fisheries, and to call for an assessment of all U.S. longline fisheries to determine whether a seabird bycatch problem exists. The national plan is part of an international plan developed by the U.N. Food and Agriculture Organization's Committee on Fisheries. If data, collected by the observer program for example, reveals a significant seabird bycatch problem in West Coast longline fisheries managed under the groundfish FMP amendments may be needed to require gear modifications or changes in fishing strategies. Implementing these measures could be affected by the need for administrative actions related to rebuilding plan changes.

4.3.2 Groundfish, Including Overfished Stocks

Ongoing management under the groundfish FMP takes up a considerable amount of time within the Council process. The Strategic Plan goal for harvest policies is to establish an allowable level of catch that prevents overfishing while achieving optimum yield based on the best available science. This goal It is also the procedural mechanism related to The Council specifies OYs for groundfish species or species complexes and develops management measures intended to constrain harvests to these levels. Through 2003 this was done annually; with the adoption of Amendment 17 the Council will transition to a biennial process, beginning in 2005-2006. (A new decision-making schedule will be phased in during the 2004 transition year.) The development of specifications and management measures for 2003 was a time consuming process, both for the Council and staff at NMFS NWR. An EIS was prepared in support of decision-making along with analyses for an emergency rule that had to be promulgated for January and February in order to allow public comment on the regulations for the remainder of the year. Five Council staff and three NMFS NWR staff had to devote a substantial part of their time between June and December 2002 to this task. The biennial process will reduce this workload since decision-making, supporting analysis and rulemaking for specifications and management measures will occur every other year. Nonetheless, given that this had become a complex and controversial process, ongoing groundfish management is likely to consume a large proportion of the Council's time. Reviewing and updating rebuilding plans, and amending the FMP and regulations is likely to impinge on the time available to consider specifications and management measures, especially since the same staff would be involved in both issues. There is some possibility, depending on which options are chosen, that rebuilding plan related activities could be combined with the biennial management process. For example, under Option 1d, management targets (e.g., T_{TARGET}, P_{MAX}) would be revised through notice and comment rulemaking. The same rulemaking process used for biennial specifications could be used for these revisions, supported by a single environmental document (EIS or EA). This could reduce the overall administrative burden.

If less time were available to provide supporting analyses and consider decisions related to biennial management there would be greater risk of mis-specification of harvest levels. If harvest levels are set too high, rebuilding could be impeded or stocks not currently overfished could fall below the minimum stock size threshold. Lower harvest levels due to mis-specifications would reduce the environmental risk but would result in socioeconomic impacts due to forgone short-term benefits from harvest.

The Council has been discussing delegating management of nearshore groundfish species occurring in California state waters and adjacent EEZ waters to that state. California has developed a FMP for 19 nearshore species. Sixteen of the 19 species included in the FMP are managed by the Council under the guidance of the Federal Groundfish Plan. Currently, fourteen of the sixteen species are actively managed by the Council (nearshore rockfish and California scorpionfish), while only two are monitored (cabezon and kelp greenling). The FMP cannot be fully implemented until the Council delegates or defers management authority, or removes the relevant species from the groundfish FMP. To date, the Council has decided there is insufficient staff time to devote to the process. As an alternative California proposes developing regulations that would be consistent with federal regulations in order to implement its FMP. Increased workload stemming from rebuilding plan requirements would further frustrate the Council's ability to delegate management authority. For the relevant federally-managed nearshore species, continued delay in implementing the nearshore FMP would only have a negative impact to the degree that state management is more environmentally beneficial than federal management. However, other state-managed species included in the state's FMP would be affected by any delay, assuming more effective management under the state's FMP.

NMFS is preparing a programmatic EIS for the groundfish FMP with a preliminary draft due to the Council by its September 2003 meeting. Thus, any administrative cost stemming from rebuilding plan revisions is unlikely to affect completion of this document, at least through the draft stage. But this EIS includes a range of alternatives, which represent different management programs including one representing elements in the Groundfish Strategic Plan. Over a longer time period, during which rebuilding plan related activity could have an effect on administrative resources, additional FMP amendments may be needed to implement policy recommendations from the programmatic EIS. The Programmatic EIS evaluates management at a strategic level, and implementation of a preferred alternative could make groundfish management more effective and thereby reduce environmental impacts associated with fishing. More time spent on amendments to revise rebuilding plans would make it more difficult to implement measures (through FMP amendments for example) stemming from this analysis.

4.3.3 The Socioeconomic Environment

Economic rationalization of groundfish fleets is the main socioeconomic issue currently facing groundfish fisheries. Rationalization entails matching extractive capacity, or capital and labor, to the available fishery resource. Capacity reduction is ranked as the highest priority in the Groundfish Strategic Plan. Congress recently authorized funding that, along with a loan fund, would establish a vessel buy-back program for groundfish limited entry trawl license-holders. First, however, licence-holders must vote by referendum to approve the program. If approved, program implementation may require a FMP amendment. The Council is also considering several other initiatives for fishery rationalization. Establishing license limitation (limited entry) programs for remaining open access groundfish fisheries is highest priority, although work is at a preliminary stage. The Council has also expressed an interest in implementing share-based management in order to promote economic efficiency, including capacity reduction.

Individual fishing quotas (IFQs), where fishers are assigned a specified harvest share or portion of the OY for a given species or species group, have been implemented in a range of fisheries in the U.S. and other countries (Tietenberg 2002). However, these systems have generated controversy because of concerns over equitable distribution of rights. Partly in response to these concerns, Congress established a moratorium on the use of IFQs, which was allowed to expire in late 2002. (Many expect that any reauthorization of the

Magnuson-Stevens Act will contain guidelines for how IFQ management can be implemented. In the meantime there are no legal constraints on using this class of management measures.) Expiration of the Congressional ban has renewed the Council's interest in this approach. In the early 1990s, the Council planned to implement an IFQ program for groundfish fixed gear fisheries but this effort was stymied by the Congressional ban. Instead, a permit stacking program was implemented, which has many features of a share-based approached. The Council is pursuing two tracks in this regard. First, it is interested in implementing a trawl permit stacking program, similar to the program in place for fixed gear fisheries. In the long term these programs could be supplanted by IFQs.

In addition to promoting economic efficiency, rationalization can make it easier to manage fisheries for sustainability if less complex management measures are needed. For example, trip limits, which indirectly limit fishing effort and ensure year-round harvest, should not be necessary. On the other hand, "quota-busting," or free riding, can be a problem in administering IFQs. Because bycatch, especially of overfished species, is a major concern, it would have to be accounted for as part of a quota system. Addressing these issues would require an effective, comprehensive at-sea monitoring program. The current observer program only covers a small proportion of all groundfish vessels. Although sufficient to estimate total catch through statistical techniques, a higher level of monitoring would likely be needed to administer a quota program.

Although the Council is interested in further rationalization through share-based management, in the short to medium term staff resources are insufficient to allow work to proceed. Programs of this nature would be complex and controversial (especially given the multi-species nature of groundfish fisheries and the problems presented by bycatch). This would require an extended deliberative process with substantial public involvement, and commensurately detailed analyses in support of any proposed actions. If staff resources were available, these efforts could be a major focus in the future. If the framework for rebuilding plans required a large commitment of staff resources it would be much less likely that rationalization measures could be developed and implemented.

4.3.4 Management Issues

During its November 2002 meeting, the Council was briefed on two proposed workshops to (1) evaluate current methods for calculating unfished biomass (B_0) and MSY, and (2) evaluate the current model used to account for bycatch in total catch estimates and consider how observer data might be used to improve model inputs. These issues are directly relevant to managing overfished species since rebuilding strategies are predicated on unfished biomass and MSY estimates (to determine target biomass) and bycatch is the main component of total catch mortality for these species since retention is severely limited or prohibited. On a recommendation from the SSC, the bycatch workshop was held in late January 2003 while the scheduling of the B_0/MSY workshop was deferred for an "off year" under the impending multi-year management regime.

Administrative demands stemming from rebuilding plans would likely have minimal effect on these proposals. The bycatch workshop has already been held; efforts are focusing on the integration of observer data into the estimation model. This work is being carried out by science center staff at NMFS, who are minimally affected by administrative workload issues. Some of the members of the SSC and GMT are science center staff. To the degree that more of these committees' time is taken up with rebuilding plans, staff time would be diverted away from the activities described above. For example, if Option 3d is chosen, the GMT and SSC would review rebuilding progress, requiring an additional commitment. Scheduling of a future B_0/MSY workshop could be affected if off years in the management cycle are mainly taken up with rebuilding plan revisions and amendments. Both of these workshops are related to Strategic Plan goals emphasizing the need for better information to set management reference points (e.g., F_{MSY}) and estimate total fishery removals.

These efforts also have the potential to affect workload related to rebuilding plan revision. As discussed above, new estimates of unfished biomass would result in re-computation of rebuilding parameters. Any parameters specified in the FMP or regulations as ongoing reference points (as opposed to "historical" benchmarks as outlined in Option 1d) would have to be changed by amendment. New bycatch accounting methods, if they revealed that past techniques were under-estimating bycatch, could affect rebuilding probability estimates, with results analogous to the current situation described above for bocaccio.

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5.0 CONSISTENCY WITH FMP OBJECTIVES AND THE MAGNUSON-STEVENS ACT

5.1 FMP Goals and Objectives

The groundfish FMP goals and objectives are listed below. They way in which Amendment 16-1 addresses each objective is briefly described in italics below the relevant statement.

Management Goals.

Goal 1 - Conservation. Prevent overfishing by managing for appropriate harvest levels and prevent any net loss of the habitat of living marine resources.

As part of the changes to the FMP under this amendment, Goal 1 is changed to read "Prevent overfishing and rebuild overfished stocks by managing for appropriate harvest levels and prevent, to the extent practicable, any net loss of the habitat of living marine resources." This makes the goal more consistent with the Magnuson-Stevens Act and the purposes of this amendment.

Goal 2 - Economics. Maximize the value of the groundfish resource as a whole.

Goal 3 - Utilization. Achieve the maximum biological yield of the overall groundfish fishery, promote year-round availability of quality seafood to the consumer, and promote recreational fishing opportunities.

Objectives. To accomplish these management goals, a number of objectives will be considered and followed as closely as practicable:

Conservation.

Objective 1. Maintain an information flow on the status of the fishery and the fishery resource which allows for informed management decisions as the fishery occurs.

Measures in this amendment will not affect this objective. Procedures for periodically reviewing and changing rebuilding plans will depend on reliable information about resource status.

Objective 2. Adopt harvest specifications and management measures consistent with resource stewardship responsibilities for each groundfish species or species group.

Measures in this amendment will not affect this objective. But specified procedures for the adoption and implementation of rebuilding plans will facilitate effective management of overfished species.

Objective 3. For species or species groups which are below the level necessary to produce maximum sustainable yield (MSY), consider rebuilding the stock to the MSY level and, if necessary, develop a plan to rebuild the stock.

As part of the changes to the FMP under this amendment, Objective 3 is changed to read "For species or species groups that are overfished, develop a plan to rebuild the stock as required by the Magnuson-Stevens Act." This change makes the objective more clearly linked to the stock rebuilding requirements of the Act and the intent of this amendment. The standards and procedures in this amendment facilitate the adoption and implementation of rebuilding plans and, therefore, support this objective.

Objective 4. Where conservation problems have been identified for nongroundfish species and the best scientific information shows the groundfish fishery has a direct impact on the ability of that species to maintain its long-term reproductive health, the Council may consider establishing management measures to control the impacts of groundfish fishing on those species. Management measures may be imposed on the groundfish fishery to reduce fishing mortality of a nongroundfish species for documented conservation reasons. The action will be designed to minimize disruption of the groundfish fishery, in so far as consistent with the goal to minimize the bycatch of nongroundfish species, and will not preclude achievement of a quota, harvest guideline, or allocation of groundfish, if any, unless such action is required by other applicable law.

Measures in this amendment do not address this objective.

Objective 5. Describe and identify essential fish habitat (EFH), adverse impacts on EFH, and other actions to conserve and enhance EFH, and adopt management measures that minimize, to the extent practicable, adverse impacts from fishing on EFH.

Measures in this amendment do not address this objective.

Economics.

Objective 6. Attempt to achieve the greatest possible net economic benefit to the nation from the managed fisheries.

This amendment does not address this objective directly. Rebuilding plan implementation should increase net benefits in the long term.

Objective 7. Identify those sectors of the groundfish fishery for which it is beneficial to promote year-round marketing opportunities and establish management policies that extend those sectors fishing and marketing opportunities as long as practicable during the fishing year.

Measures in this amendment do not address this objective.

Objective 8. Gear restrictions to minimize the necessity for other management measures will be used whenever practicable.

Measures in this amendment do not address this objective.

Utilization.

Objective 9. Develop management measures and policies that foster and encourage full utilization (harvesting and processing) of the Pacific coast groundfish resources by domestic fisheries.

Measures in this amendment do not address this objective.

Objective 10. Recognizing the multispecies nature of the fishery and establish a concept of managing by species and gear or by groups of interrelated species.

Measures in this amendment do not address this objective. Rebuilding plans, which will be incorporated and implemented in subsequent amendments, are species- or stock-specific, although associated rebuilding measures will necessarily affect more abundant stocks that co-occur with overfished stocks.

Objective 11. Strive to reduce the economic incentives and regulatory measures that lead to wastage of fish. Also, develop management measures that minimize bycatch to the extent practicable and, to the extent that bycatch cannot be avoided, minimize the mortality of such bycatch. In addition, promote and support monitoring programs to improve estimates of total fishing-related mortality and bycatch, as well as those to improve other information necessary to determine the extent to which it is practicable to reduce bycatch and bycatch mortality.

This amendment does not address this objective directly. The effect of harvest restrictions on bycatch rates could be addressed in rebuilding plans. Rebuilding plans must take into account total fishing mortality and rebuilding measures should also reduce bycatch.

Objective 12. Provide for foreign participation in the fishery, consistent with the other goals to take that portion of the optimum yield (OY) not utilized by domestic fisheries while minimizing conflict with domestic fisheries.

This objective is no longer relevant because the fishery has been declared fully utilized.

Social Factors.

Objective 13. When conservation actions are necessary to protect a stock or stock assemblage, attempt to develop management measures that will affect users equitably.

This amendment does not address this objective directly. Rebuilding plans may discuss allocation among sectors.

Objective 14. Minimize gear conflicts among resource users.

Measures in this amendment do not address this objective.

Objective 15. When considering alternative management measures to resolve an issue, choose the measure that best accomplishes the change with the least disruption of current domestic fishing practices, marketing procedures, and environment.

This amendment does not address this objective directly. The environmental impact analysis of rebuilding plan measures considers disruption of fishing, marketing and the environment. Some disruption is unavoidable.

Objective 16. Avoid unnecessary adverse impacts on small entities.

This amendment does not address this objective directly. Rebuilding plan measures may entail adverse impacts, but these are necessary to rebuild overfished stocks.

Objective 17. Consider the importance of groundfish resources to fishing communities, provide for the sustained participation of fishing communities, and minimize adverse economic impacts on fishing communities to the extent practicable.

This amendment does not address this objective directly. The environmental impact analysis of rebuilding plan measures considers impacts to communities.

Objective 18. Promote the safety of human life at sea.

Measures in this amendment do not address this objective.

Although Amendment 12, the original document specifying rebuilding plan form and content, was remanded in part, the goals and objectives for rebuilding plans enumerated in that document are still relevant. The amendment described five goals, which can be re-cast as objectives falling under the three FMP goals:

Conservation

1. Achieve the population size and structure that will support the maximum sustainable yield within the specified time period.

2. Protect the quantity and quality of habitat necessary to support the stock at healthy levels in the future.

3. Promote widespread public awareness, understanding and support for the rebuilding program.

Economics

4. Minimize, to the extent practicable, the social and economic impacts associated with rebuilding, including adverse impacts on fishing communities.

Utilization

5. Fairly and equitably distribute both the conservation burdens (overfishing restrictions) and recovery benefits among commercial, recreational and charter fishing sectors.

This amendment adheres to these objectives in establishing rebuilding plan elements and plan implementation and review procedures.

5.2 National Standards

A FMP or plan amendment and any pursuant regulations must be consistent with ten national standards contained in the Magnuson-Stevens Act (§301). These are:

National Standard 1 states that conservation and management measures shall prevent overfishing while achieving, on a continuing basis, the optimum yield from each fishery for the United States fishing industry.

This amendment supports National Standard 1 by facilitating the adoption and implementation of rebuilding plans. Rebuilding plans lay out a strategy for stock rebuilding. Management measures implemented to achieve rebuilding must constrain harvests to a level below the overfishing threshold (maximum fishing mortality rate) for a given overfished species. Thus, in addition to establishing a strategy for stock rebuilding they also dictate the implementation of measures to prevent overfishing.

National Standard 2 states that conservation and management measures shall be based on the best scientific information available.

Rebuilding plans are based on rebuilding analyses that use the most recent stock assessment data and incorporate statistical measures of the likelihood that overfished stocks will recover within a mandated time period. These stock assessments and analyses are conducted by state and federal agency staff scientists with expertise in Pacific groundfish biology, ecology, and fishery science. They employ the best available data.

National Standard 3 states that, to the extent practicable, an individual stock of fish shall be managed as a unit throughout its range, and interrelated stocks of fish shall be managed as a unit or in close coordination.

Pacific groundfish are managed on the basis of known stocks when these can be differentiated from the total range of the species. Overfished species are managed individually in that harvest levels are determined for each stock. But managers recognize that many groundfish stocks share common habitats and ecosystems, and fishers may catch them as part of a multi-species complex. This allows unit management of interrelated stocks. Thus management measures are applied to more abundant stocks co-occurring with overfished species that may limit harvests of the healthy stock below optimum yield in order to ensure rebuilding of the associated overfished stocks.

National Standard 4 states that conservation and management measures shall not discriminate between residents of different States. If it becomes necessary to allocate or assign fishing privileges among various United States fishermen, such allocation shall be (A) fair and equitable to all such fishermen; (B) reasonably calculated to promote conservation; and (C) carried out in such manner that no particular individual, corporation, or other entity acquires an excessive share of such privileges. The proposed measures will not discriminate between residents of different States.

This amendment and consequent rebuilding plans, to the degree that they specify allocation between sectors, will do so in a fair and equitable manner. Allocation decisions may be guided by rebuilding plan objectives *and specific policies described in the plans. These decisions are made through the Council process and accordance with its established procedures and policies.*

National Standard 5 states that conservation and management measures shall, where practicable, consider efficiency in the utilization of fishery resources; except that no such measure shall have economic allocation as its sole purpose.

This amendment and resulting rebuilding plans do not address this National Standard directly, except that no measures are intended to allocate groundfish resources solely for the purpose of economic efficiency.

National Standard 6 states that conservation and management measures shall take into account and allow for variations among, and contingencies in, fisheries, fishery resources and catches.

This amendment and resulting rebuilding plans recognize the differences between the various groundfish fishery sectors. Different sectors may have different catch levels for overfished species and capacity to avoid or minimize catch of overfished species. Although the primary purpose of measures described in this amendment is to allow overfished stocks to recover, differential impacts were considered when formulating them.

National Standard 7 states that conservation and management measures shall, where practicable, minimize costs and avoid unnecessary duplication.

Rebuilding plans will be implemented, reviewed and updated in a consistent and specific manner based on the measures in this amendment. Rebuilding plan measures are implemented through the harvest specifications and management measures process developed for the whole groundfish fishery. This approach is intended to minimize cost and duplication.

National Standard 8 states that conservation and management measures shall, consistent with the conservation requirements of this Act (including the prevention of overfishing and rebuilding of overfished stocks), take into account the importance of fishery resources to fishing communities in order to (A) provide for the sustained participation of such communities, and (B) to the extent practicable, minimize adverse economic impacts on such communities.

The analyses supporting this amendment and the individual rebuilding plans (organized around NEPA requirements) consider the socioeconomic impacts or rebuilding to fishing communities. Rebuilding plans generally do not employ a policy that would rebuild stocks in the minimum time period, which would very likely require a complete cessation of many fisheries. This is meant to minimize impacts to communities by allowing some level of fishing mortality on overfished stocks while identifying a trajectory that will lead to their eventual recovery.

National Standard 9 states that conservation and management measures shall, to the extent practicable, (A) minimize bycatch and (B) to the extent bycatch cannot be avoided, minimize the mortality of such bycatch.

Most overfished species are no longer targeted and in many cases only constitute bycatch due to regulatory discards. Because rebuilding plans must account for total fishing mortality, strategies must minimize bycatch. Rebuilding plan environmental impact analyses also evaluate the impact of the alternative management measures on bycatch.

National Standard 10 states that conservation and management measures shall, to the extent practicable, promote the safety of human life at sea.

This amendment does not directly affect safety. Indirect effects of rebuilding plan measures on safety are considered in the environmental analyses.

5.3 Other Applicable Magnuson-Stevens Act Provisions

This amendment and associated rebuilding plans conform to Section 304(e)–Rebuild Overfished Fisheries. The procedural measures described in this EA address the requirement the Council "shall prepare a FMP, plan amendment, or proposed regulations ... to end overfishing in the fishery and to rebuild affected stocks..." (§304(e)(3)). Pursuant rebuilding plans contain the elements required by Section 304(e)(4) and discussed in National Standard guidelines (50 CFR 600.310).

6.0 CROSS-CUTTING MANDATES

In addition to being prepared in accordance with the requirements of the Magnuson-Stevens Act and the National Environmental Policy Act, this document also addresses requirements of other applicable Federal laws and Executive Orders. These laws and orders are described here and their applicability to this action assessed.

6.1 Other Federal Laws

6.1.1 Coastal Zone Management Act

Section 307(c)(1) of the Federal Coastal Zone Management Act (CZMA) of 1972 requires all federal activities that directly affect the coastal zone be consistent with approved state coastal zone management programs to the maximum extent practicable. The preferred alternative would be implemented in a manner that is consistent to the maximum extent practicable with the enforceable policies of the approved coastal zone management programs of Washington, Oregon, and California. This determination has been submitted to the responsible state agencies for review under section 307(c)(1) of the Coastal Zone Management Act (CZMA). The relationship of the groundfish FMP with the CZMA is discussed in Section 11.7.3 of the groundfish FMP. The groundfish FMP has been found to be consistent with the Washington, Oregon, and California coastal zone management programs. The recommended action is consistent and within the scope of the actions contemplated under the framework FMP.

Under the CZMA, each state develops its own coastal zone management program which is then submitted for federal approval. This has resulted in programs which vary widely from one state to the next. Because the intent of Amendment 16-1 is administrative in nature—to establish the process and standards for adoption and review of rebuilding plans for overfished species—none of the alternatives are expected to affect any state's coastal management program.

6.1.2 Endangered Species Act

NMFS issued Biological Opinions under the ESA on August 10, 1990, November 26, 1991, August 28, 1992, September 27, 1993, May 14, 1996, and December 15, 1999 pertaining to the effects of the groundfish fishery on chinook salmon (Puget Sound, Snake River spring/summer, Snake River fall, upper Columbia River spring, lower Columbia River, upper Willamette River, Sacramento River winter, Central Valley spring, California coastal), coho salmon (Central California coastal, southern Oregon/northern California coastal), chum salmon (Hood Canal summer, Columbia River), sockeye salmon (Snake River, Ozette Lake), and steelhead (upper, middle and lower Columbia River, Snake River Basin, upper Willamette River, central California coast, California Central Valley, south-central California, northern California, southern California). During the 2000 Pacific whiting season, the whiting fisheries exceeded the chinook bycatch amount specified in the Pacific whiting fishery Biological Opinion's (December 15, 1999) incidental take statement estimate of 11,000 fish, by approximately 500 fish. In the 2001 whiting season, however, the whiting fishery's chinook bycatch was about 7,000 fish, which approximates the long-term average. After reviewing data from, and management of, the 2000 and 2001 whiting fisheries (including industry bycatch minimization measures), the status of the affected listed chinook, environmental baseline information, and the incidental take statement from the 1999 whiting BO, NMFS determined in a letter dated April 25, 2002 that a re-initiation of the 1999 whiting BO was not required. NMFS has concluded that implementation of the FMP for the Pacific Coast groundfish fishery is not expected to jeopardize the continued existence of any endangered or threatened species under the jurisdiction of NMFS, or result in the destruction or adverse modification of critical habitat. The proposed action is within the scope of these consultations.

6.1.3 Marine Mammal Protection Act

The Marine Mammal Protection Act (MMPA) of 1972 is the principle federal legislation that guides marine mammal species protection and conservation policy in the United States. Under the MMPA, NMFS is responsible for the management and conservation of 153 stocks of whales, dolphins, porpoise, as well as seals, sea lions, and fur seals while the U.S. Fish and Wildlife Service is responsible for walrus, sea otters, and the West Indian manatee.

Off the West Coast, the Steller sea lion (*Eumetopias jubatus*) Eastern stock, Guadalupe fur seal (*Arctocephalus townsendi*), and Southern sea otter (*Enhydra lutris*) California stock are listed as threatened under the ESA and the sperm whale (*Physeter macrocephalus*) Washington, Oregon, and California (WOC) Stock, humpback whale (*Megaptera novaeangliae*) WOC - Mexico Stock, blue whale (*Balaenoptera musculus*) Eastern north Pacific stock, and Fin whale (*Balaenoptera physalus*) WOC Stock are listed as depleted under the MMPA. Any species listed as endangered or threatened under the ESA is automatically considered depleted under the MMPA.

The West Coast groundfish fisheries are considered a Category III fishery, indicating a remote likelihood of or no known serious injuries or mortalities to marine mammals, in the annual list of fisheries published in the *Federal Register*. Based on its Category III status, the incidental take of marine mammals in the West Coast groundfish fisheries does not significantly impact marine mammal stocks. Amendment 16-1 is administrative in nature and would not change the effects of the groundfish fisheries on marine mammals.

6.1.4 Migratory Bird Treaty Act

The Migratory Bird Treaty Act of 1918 was designed to end the commercial trade of migratory birds and their feathers that, by the early years of the 20th century, had diminished populations of many native bird species. The Act states that it is unlawful to take, kill, or possess migratory birds and their parts (including eggs, nests, and feathers) and is a shared agreement between the United States, Canada, Japan, Mexico, and Russia to protect a common migratory bird resource. The Migratory Bird Treaty Act prohibits the directed take of seabirds, but the incidental take of seabirds does occur. The proposed action is administrative in nature and is unlikely to affect the incidental take of seabirds protected by the Migratory Bird Treaty Act.

6.1.5 Paperwork Reduction Act

The proposed action, as implemented by any of the alternatives considered in this EA, does not require collection-of-information subject to the PRA.

6.1.6 Regulatory Flexibility Act

The purpose of the Regulatory Flexibility Act (RFA) is to relieve small businesses, small organizations, and small governmental entities of burdensome regulations and record-keeping requirements. Major goals of the RFA are; (1) to increase agency awareness and understanding of the impact of their regulations on small business, (2) to require agencies communicate and explain their findings to the public, and (3) to encourage agencies to use flexibility and to provide regulatory relief to small entities. The RFA emphasizes predicting impacts on small entities as a group distinct from other entities and the consideration of alternatives that may minimize the impacts while still achieving the stated objective of the action. An initial regulatory flexibility analysis (IRFA) is conducted unless it is determined that an action will not have a "significant economic impact on a substantial number of small entities." The RFA requires that an IRFA include elements that are similar to those required by EO 12866 and NEPA. Therefore, the IRFA has been combined with the RIR and NEPA analyses.

Section 7 (below) summarizes the analytical conclusions specific to the RFA and EO 12866.

6.2 Executive Orders

6.2.1 EO 12866 (Regulatory Impact Review)

EO 12866, Regulatory Planning and Review, was signed on September 30, 1993, and established guidelines for promulgating new regulations and reviewing existing regulations. The EO covers a variety of regulatory policy considerations and establishes procedural requirements for analysis of the benefits and costs of regulatory actions. Section 1 of the Order deals with the regulatory philosophy and principles that are to guide agency development of regulations. It stresses that in deciding whether and how to regulate, agencies should assess all of the costs and benefits across all regulatory alternatives. Based on this analysis, NMFS should choose those approaches that maximize net benefits to society, unless a statute requires another regulatory approach.

The Regulatory Impact Review (RIR) and IRFA determinations are part of the combined summary analysis in Section 7 of this document.

6.2.2 EO 12898 Environmental Justice

EO 12898 obligates federal agencies to identify and address "disproportionately high adverse human health or environmental effects of their programs, policies, and activities on minority and low-income populations in the United States" as part of any overall environmental impact analysis associated with an action. NOAA guidance, NAO 216-6, at §7.02, states that "consideration of EO 12898 should be specifically included in the NEPA documentation for decision making purposes." Agencies should also encourage public participation—especially by affected communities—during scoping as part of a broader strategy to address environmental justice issues.

The environmental justice analysis must first identify minority and low-income groups that live in the project area and may be affected by the action. Typically, census data are used to document the occurrence and distribution of these groups. Agencies should be cognizant of distinct cultural, social, economic or occupational factor that could amplify the adverse effects of the proposed action. (For example, if a particular kind of fish is an important dietary component, fishery management actions affecting the availability or price of that fish could have a disproportionate effect.) In the case of Indian tribes, pertinent treaty or other special rights should be considered. Once communities have been identified and characterized and potential adverse impacts of the alternatives are identified, the analysis must determine whether these impacts are disproportionate. Because of the context in which environmental justice developed, health effects are usually considered and three factors may be used in an evaluation: whether the effects are deemed significant, as the term is employed by NEPA; whether the rate or risk of exposure to the effect appreciably exceeds the rate for the general population or some other comparison group; and whether the group in question may be affected by cumulative or multiple sources of exposure. If disproportionately high adverse effects are identified, mitigation measures should be proposed. Community input into appropriate mitigation is encouraged.

The EIS prepared for 2003 groundfish specifications and management measures (PFMC 2003) describes coastal communities affected by the proposed action and impacts to those communities. Available demographic data show that, coastal counties where these communities are located are variable in terms of social indicators like income, employment and race and ethnic composition. However, equivalent data specific to the groups directly affected by the proposed action are not available. Treaty tribes harvesting West Coast groundfish are part of the Council's decision-making process on groundfish management issues and tribes with treaty rights to salmon, groundfish, or halibut have a seat on the Council.

None of the changes to the FMP under Amendment 16-1 implemented by the proposed action directly affect groundfish allocations or harvest levels that could in turn disproportionately impact low income and minority populations. Actions pursuant to this amendment, most importantly the development of harvest specifications and management measures needed to ensure stock rebuilding could result in changes to coastal communities' income with possible disproportionate effects on low income and minority populations. These actions will be subject to future NEPA analyses in which environmental justice implications can be evaluated.

6.2.3 EO 13132 (Federalism)

Executive Order 13132, which revoked EO 12612, an earlier federalism Executive Order, enumerates eight "fundamental federalism principles." The first of these principles states "Federalism is rooted in the belief that issues that are not national in scope or significance are most appropriately addressed by the level of government closest to the people." In this spirit, the Executive Order directs agencies to consider the implications of policies that may limit the scope of or preempt states' legal authority. Preemptive action having such "federalism implications" is subject to a consultation process with the states; such actions should not create unfunded mandates for the states; and any final rule published must be accompanied by a "federalism summary impact statement."

The Council process offers many opportunities for states (through their agencies, Council appointees, consultations, and meetings) to participate in the formulation of management measures. This process encourages states to institute complementary measures to manage fisheries under their jurisdiction that may affect federally managed stocks.

None of the proposed changes to the groundfish FMP would have federalism implications subject to EO 13132.

6.2.4 EO 13175 (Consultation and Coordination With Indian Tribal Government)

Executive Order 13175 is intended to ensure regular and meaningful consultation and collaboration with tribal officials in the development of federal policies that have tribal implications, to strengthen the United States government-to-government relationships with Indian tribes, and to reduce the imposition of unfunded mandates upon Indian tribes.

The Secretary recognizes the sovereign status and co-manager role of Indian tribes over shared Federal and tribal fishery resources. At Section 302(b)(5), the Magnuson-Stevens Act reserves a seat on the Council for a representative of an Indian tribe with federally-recognized fishing rights from California, Oregon, Washington, or Idaho.

The U.S. government formally recognizes the four Washington Coastal Tribes (Makah, Quileute, Hoh, and Quinault) have treaty rights to fish for groundfish. In general terms, the quantification of those rights is 50% of the harvestable surplus of groundfish available in the tribes' usual and accustomed (U and A) fishing areas (described at 50 CFR 660.324). Each of the treaty tribes has the discretion to administer their fisheries and to establish their own policies to achieve program objectives. Accordingly, tribal allocations and regulations have been developed in consultation with the affected tribe(s) and, insofar as possible, with tribal consensus.

None of the alternatives under consideration for Amendment 16-1 would affect tribal groundfish allocations.

6.2.5 EO 13186 (Responsibilities of Federal Agencies to Protect Migratory Birds)

Executive Order (EO) 13186 supplements the Migratory Bird Treaty Act (above) by requiring federal agencies to work with the U.S. Fish and Wildlife Service to develop memoranda of agreement to conserve migratory birds. NMFS is scheduled to implement its memorandum of understanding by January 2003. The protocols developed by this consultation will guide agency regulatory actions and policy decisions in order to address this conservation goal. The EO also directs agencies to evaluate the effects of their actions on migratory birds in environmental documents prepared pursuant to the National Environmental Policy Act.

As discussed in this EA, the proposed action will not directly affect protected species, including seabirds and were therefore not evaluated.

7.0 REGULATORY IMPACT REVIEW AND REGULATORY FLEXIBILITY ANALYSIS

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APPENDIX A
Amendments to FMP Language

This appendix documents revisions to the language of the FMP which could result from Council action reflected in their choice of preferred options under Issues 1-4 in Chapter 2.

GUIDE TO SECTIONS AFFECTED BY ISSUES CONSIDERED IN THE FMP AMENDMENT

	Issue	Affected Sections
Issue 1	Form & Required Elements of Species Rebuilding Plans	4.5.2 4.5.3 4.5.4
Issue 2	Process for Periodic Review and Rebuilding Plans	4.5.3.5
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	Housekeeping Measures	Section 2.1, Goals and Objectives All Sections of Chapters 4 and 5 Section 6.5.1.2, Observers

KEY TO AFFECTED FMP LANGUAGE

Underline - inserted text
Strikeout - deleted text
[Brackets and **boldface]** - notes on reorganization
Highlight - pending changes from Amendment 17

TABLE OF CONTENTS FOR THE AFFECTED SECTIONS OF THE FMP

Page

2.0 GOALS AND OBJECTIVES

2.1 Goals and Objectives for Managing the Pacific Coast Groundfish Fishery

* * *

Management Goals.

Goal 1 - Conservation. Prevent overfishing and rebuild overfished stocks by managing for appropriate harvest levels and prevent, to the extent practicable, any net loss of the habitat of living marine resources.

* * *

Objective 3. For species or species groups ~~which are below the level necessary to produce maximum sustainable yield (MSY)~~ that are overfished, consider rebuilding the stock to the MSY level and, if necessary, develop a plan to rebuild the stock as required by the Magnuson-Stevens Act.

3.0 AREAS AND STOCKS INVOLVED

* * *

3.1 Species Managed by this Fishery Management Plan

Table 3-1 is the listing of species managed under this FMP.

TABLE 3-1. Common and scientific names of species included in this FMP.

Common Name	Scientific Name
	SHARKS
Leopard shark	*Triakis semifasciata*
Soupfin shark	*Galeorhinus zyopterus*
Spiny dogfish	*Squalus acanthias*
Big skate	*Raja binoculata*
California skate	*R. inornata*
Longnose skate	*R. rhina*
	RATFISH
Ratfish	*Hydrolagus colliei*
	MORIDS
Finescale codling	*Antimora microlepis*
	GRENADIERS
Pacific rattail	*Coryphaenoides acrolepis*
	ROUNDFISH
Lingcod	*Ophiodon elongatus*
Cabezon	*Scorpaenichthys marmoratus*
Kelp greenling	*Hexagrammos decagrammus*
Pacific cod	*Gadus macrocephalus*
Pacific whiting (hake)	*Merluccius productus*
Sablefish	*Anoplopoma fimbria*
	ROCKFISH [a/]
Aurora rockfish	*Sebastes aurora*
Bank rockfish	*S. rufus*
Black rockfish	*S. melanops*
Black and yellow rockfish	*S. chrysomelas*
Blackgill rockfish	*S. melanostomus*
Blue rockfish	*S. mystinus*
Bocaccio	*S. paucispinis*
~~Bronze spotted~~ Bronzespotted rockfish	*S. gilli*
Brown rockfish	*S. auriculatus*
Calico rockfish	*S. dallii*
California scorpionfish	*Scorpaena gutatta*
Canary rockfish	*Sebastes pinniger*
Chameleon rockfish	*S. phillipsi*
Chilipepper	*S. goodei*
China rockfish	*S. nebulosus*
Copper rockfish	*S. caurinus*
Cowcod	*S. levis*
Darkblotched rockfish	*S. crameri*
Dusky rockfish	*S. ciliatus*
Dwarf-red rockfish	S. rufinanus
Flag rockfish	*S. rubrivinctus*
Freckled rockfish	S. lentiginosus
Gopher rockfish	*S. carnatus*
Grass rockfish	*S. rastrelliger*

TABLE 3-1. Common and scientific names of species included in this FMP.

Common Name	Scientific Name
Greenblotched rockfish	*S. rosenblatti*
Greenspotted rockfish	*S. chlorostictus*
Greenstriped rockfish	*S. elongatus*
Halfbanded rockfish	S. semicinctus
Harlequin rockfish	*S. variegatus*
Honeycomb rockfish	*S. umbrosus*
Kelp rockfish	*S. atrovirens*
Longspine thornyhead	*Sebastolobus altivelis*
Mexican rockfish	*Sebastes macdonaldi*
Olive rockfish	*S. serranoides*
Pink rockfish	*S. eos*
Pinkrose rockfish	*S. simulator*
Pygmy rockfish	*S. wilsoni*
Pacific ocean perch	~~*Sebastes*~~ S. *alutus*
Quillback rockfish	*S. maliger*
Redbanded rockfish	*S. babcocki*
Redstripe rockfish	*S. proriger*
Rosethorn rockfish	*S. helvomaculatus*
Rosy rockfish	*S. rosaceus*
Rougheye rockfish	*S. aleutianus*
Sharpchin rockfish	*S. zacentrus*
Shortbelly rockfish	*S. jordani*
Shortraker rockfish	*S. borealis*
Shortspine thornyhead	*Sebastolobus alascanus*
Silvergray rockfish	*Sebastes brevispinis*
Speckled rockfish	*S. ovalis*
Splitnose rockfish	*S. diploproa*
Squarespot rockfish	*S. hopkinsi*
Starry rockfish	*S. constellatus*
Stripetail rockfish	*S. saxicola*
Swordspine rockfish	*S. ensifer*
Tiger rockfish	*S. nigrocinctus*
Treefish	*S. serriceps*
Vermilion rockfish	*S. miniatus*
Widow rockfish	*S. entomelas*
Yelloweye rockfish	*S. ruberrimus*
Yellowmouth rockfish	*S. reedi*
Yellowtail rockfish	*S. flavidus*
	FLATFISH
Arrowtooth flounder (turbot)	*Atheresthes stomias*
Butter sole	*Isopsetta isolepis*
Curlfin sole	*Pleuronichthys decurrens*
Dover sole	*Microstomus pacificus*
English sole	*Parophrys vetulus*

TABLE 3-1. Common and scientific names of species included in this FMP.

Common Name	Scientific Name
	FLATFISH (continued)
Flathead sole	*Hippoglossoides elassodon*
Pacific sanddab	*Citharichthys sordidus*
Petrale sole	*Eopsetta jordani*
Rex sole	*Glyptocephalus zachirus*
Rock sole	*Lepidopsetta bilineata*
Sand sole	*Psettichthys melanostictus*
Starry flounder	*Platichthys stellatus*

a/ The category "rockfish includes all genera and species of the family ~~Scopaenidae~~ Scorpaenidae, even if not listed, that occur in the Washington, Oregon, and California area. The ~~Scopaenidae~~ Scorpaenidae genera are *Sebastes*, ~~*Scorpana*~~ *Scorpaena*, *Sebastolobus*, and ~~*Scorp*~~ *Scorpaenodes*.

* * *

4.0 PREVENTING OVERFISHING AND ACHIEVING OPTIMUM YIELD

National Standard 1 requires that "Conservation and management measures shall prevent overfishing while achieving, on a continuing basis, the OY from each fishery for the U.S. fishing industry." (50 CFR Section 600.310(a))

"The determination of OY is a decisional mecahnism for resolving the MSA's multiple purposes and policies, implementing an FMP's objectives and balancing the various interests that comprise the national welfare. OY is based on MSY, or on MSY as it may be reduced ... [in consideration of social, economic or ecological factors].... The most important limitation on the specification of OY is that the choice of OY and the conservation and management measures proposed to achieve it must prevent overfishing." (50 CFR Section 600.310(b))

This chapter addresses the essential considerations suggested for National Standard 1, as identified in the NMFS guidelines on the standard (600.310):

- Estimating MSY, estimated the MSY biomass and setting the MSY control rule (50 CFR Section 600.310(c)) (Section 4.2 of this Chapter).
- Specifying stock status determination criteria (maximum fishing mortality threshold and minimum stock size threshold, or reasonable proxies thereof) (50 CFR Section 600.310(d)) (Section 4.4 of this Chapter).
- Actions for ending overfishing and rebuilding overfished stocks (including the development and adoption of rebuilding plans) (50 CFR Section 600.310(e)) (Section 4.5 of this Chapter).
- Setting OY and apportionment of harvest levels (50 CFR Section 600.310(f)) (Section 4.6 of this Chapter).

In establishing OYs for West Coast groundfish, this FMP utilizes the interim step of calculating ABCs for major stocks or management units (groups of species). ABC is the MSY harvest level associated with the current stock abundance. Over the long term, if ABCs are fully harvested, the average of the ABCs would be MSY.

OY is set and apportioned under the procedures outlined in Chapter 5.

4.1 Species Categories

[New section title, previously portions of 5.3, as indicated]

~~ABC,~~ B_{msy}, ABC and the overfished/rebuilding stock size threshold cannot be precisely defined for all species, because of the absence of available information for many species managed under the FMP. **[Preceding sentence from section 5.3, para 2, first sentence]**. For the purpose of setting MSY, ABC, MFMT, MSST, OY and rebuilding standards, ~~T~~three categories of species are identified. **[Following was previously section 5.3, para 3]** The first are the relatively few species for which a quantitative stock assessment can be conducted on the basis of catch-at-age or other data. ABCs and overfished/rebuilding thresholds can generally be calculated for these species. The second category includes a large number of species for which some biological indicators are available, but a quantitative analysis cannot be conducted. It is difficult to estimate overfished and overfishing thresholds for the second category of species *a priori*, but indicators of long-term, potential overfishing can be identified. ABCs for species in this category are typically set at a constant level and some monitoring is necessary to determine if this level of catch is causing a slow decline in stock abundance. The third category includes minor species which are caught, but for which there is, at best, only information on landed biomass. For species in this category, it is impossible to determine MSY, ABC, or an overfished threshold.

4.2 Determination of MSY or MSY Proxy and B_{msy}

[Previously 5.2]

Harvest policies are to be specified according to standard reference points such as MSY (MSY, interpreted as ~~an~~ a maximum average achievable catch under prevailing ecological and environmental conditions over a prolonged period), the long-term average biomass associated with fishing at Fmsy is Bmsy. ~~the biomass that produces MSY (B_{msy}) and the fishing rate (F_{msy}) that tends to hold biomass near B_{msy}.~~ In this FMP, MSY generally refers to a constant F control rule that is assumed to produce the maximum average yield over time while protecting the spawning potential of the stock. Thus the constant F control rule is genearlly the proxy for the MSY control rule. . ~~(Pacific whiting is generally based on a variable F control rule.)~~ Fishing rates above F_{msy} eventually result in biomass smaller than B_{msy} and produce less harvestable fish on a sustainable basis. Accordingly, management should avoid fishing rates that hold biomass below B_{msy} for long periods. The biomass level that produces MSY (i.e., B_{msy}) is generally unknown and assumed to be variable over time due to long-term fluctuations in ocean conditions, so that no single value is appropriate. **[Previous sentence moved from below.]** ~~This is especially important during periods of unfavorable environment in which resources may be less productive than usual and the risk of stock depletion is greater.~~ During periods of unfavorable environment it is important to account for reduced sustainable yield levels.

The problem with an F_{msy} control rule is that it is tightly linked to an assumed level of density-dependence in recruitment, and there is insufficient information to determine the level of density-dependence in recruitment for many West Coast groundfish stocks. Therefore, the use of approximations or proxies is necessary. Absent a more accurate determination of F_{msy}, the Council will apply default MSY proxies. The current (~~1998~~ 2001) proxies are: $F_{40\%}$ for flatfish and whiting, $F_{50\%}$ for rockfish (including thornyheads) and $F_{45\%}$ ~~$F_{35\%}$~~ for all species such as sablefish and lingcod ~~except rockfish and $F_{40\%}$ for rockfish[1/]~~. However, ~~these~~ values (~~$F_{35\%}$~~ $F_{40\%}$, $F_{45\%}$ and ~~$F_{40\%}$~~ $F_{50\%}$) are provided here as examples only and are expected to be modified from time to time as scientific knowledge improves. If available information is sufficient, values of F_{msy}, B_{msy}, and more appropriate harvest control rules may be developed for any species or species group. ~~For example, the Council generally has applied a variable F control rule for management of Pacific whiting.~~

At this time, it is generally believed that, for many species, ~~$F_{35\%}$~~ $F_{45\%}$ strikes a balance between obtaining a large fraction of the MSY if recruitment is highly insensitive to reductions in spawning biomass and preventing a rapid depletion in stock abundance if recruitment is found to be extremely sensitive to reductions in spawning biomass. The long-term expected yield under an ~~$F_{35\%}$~~ $F_{45\%}$ policy depends upon the (unknown) level of density-dependence in recruitment. The recommended level of harvest will reduce the average lifetime egg production by each female entering the stock to ~~35%~~ 45% of the lifetime egg production for females that are unfished.

Because the level of recruitment is expected to decline somewhat as a stock is fished at $F_{45\%}$, the expected B_{msy} proxy is less than 45% of the unfished biomass. A biomass level of 40% is a reasonable proxy for B_{msy}. The short-term yield under an ~~$F_{35\%}$~~ $F_{45\%}$ policy will vary as the abundance of the exploitable stock varies. This is true for any fishing policy that is based on a constant exploitation rate. The abundance of the stock will vary, because of the effects of fishing, and because of natural variation in recruitment. When stock abundance is high (i.e., near its average unfished level), short-term annual yields can be approximately two to three times greater than the expected long-term average annual yield. For many of the long-lived groundfish species common on the West Coast, this "fishing down" transition can take decades. Many of the declines in ABC that occurred during the 1980s were the result of this

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~~1/ In the rest of this document use of $F_{35\%}$ will be taken to mean $F_{40\%}$ in the case of rockfish, and the hybrid fishing mortality rate strategy for Pacific whiting.~~

transition from a lightly exploited, high abundance stock level to a fully exploited, moderately abundant stock level. Further declines below the overfished levels in the 1990s were due mostly to much lower than expected recruitment.

~~Recent work (Clark 1993, Mace 1994, and Ianelli 1995) indicates that $F_{35\%}$ may not be the best approximation of F_{msy}, given more realistic information about recruitment than was initially used by Clark in 1991. In his 1993 publication Clark extended his 1991 results by improving the realism of his simulations and analysis. In particular he (1) modeled stochasticity into the recruitment process, (2) introduced serial correlation into recruitment time series, and (3) performed separate analyses for the Ricker and Beverton-Holt spawner-recruit functions. For rockfish, these changes improved the realism of his spawning biomass per recruit (SPR) harvest policy calculations, because these species are known to have stochastic recruitment and they appear to display serial correlation in recruitments (especially on interdecadal time scales), and because the Beverton-Holt spawner-recruit curve may be biologically the most plausible recruitment model. The effect of each of these changes, in isolation and in aggregate, was to decrease F_{msy}. Consequently, the estimated SPR reduction needed to provide an optimal F_{msy} proxy (defined as that level of fishing which produces the largest assured proportion of MSY), must necessarily be increased. Clark concluded that $F_{40\%}$ is the optimal rate for fish stocks exhibiting recruitment variability similar to Alaska groundfish stocks. Likewise, Mace (1994) recommended the use of $F_{40\%}$ as the target mortality rate when the stock-recruitment relationship is unknown. Lastly, Ianelli (1995) determined that $F_{44\%}$ was a good F_{msy} proxy for Gulf of Alaska Pacific ocean perch, although he subsequently indicated that a recent recruitment to that stock was larger than expected and that $F_{44\%}$ may be too conservative in that case.~~

~~Based on this information and advice by its Groundfish Management Team, in 1997 the Council concluded that $F_{40\%}$ should be used as the proxy for F_{msy} for rockfish in the absence of specific knowledge of recruitment or life history characteristics which would allow a more accurate determination of F_{msy}. This and other proxies may be revised on the basis of further information and experience.~~

In spring 2000, the Council's Scientific and Statistical Committee (SSC) sponsored a workshop to review the Council's groundfish exploitation rate policy. The workshop explored the historic use of different fishing mortality (F) rates, and found that the Council's past practices have generally changed in response to new information from the scientific community. Starting in the early 1990s, the Council used a standard harvest rate of $F_{35\%}$. The SSC's workshop participants reported that new scientific studies in 1998 and 1999 had shown that the $F_{35\%}$ and F_{40}% rates used by the Council had been too aggressive for Pacific Coast groundfish stocks, such that some groundfish stocks could not maintain a viable population over time. A 1999 study, *The Meta-Analysis of the Maximum Reproductive Rate for Fish Populations to Estimate Harvest Policy; a Review* (Myers, et al.) showed that Pacific Coast groundfish stocks, particularly rockfish, have very low productivity compared to other, similar species worldwide. One prominent theory about the reason for this low productivity is the large-scale North Pacific climate shifts that are thought to cycle Pacific Coast waters through warm and cool phases of 20-30 years duration. Pacific Coast waters shifted to a warm phase around 1977-78, with ocean conditions less favorable for Pacific Coast groundfish and other fish stocks. Lower harvest rates are necessary to guard against steep declines in abundance during these periods of low productivity (low recruitment). After an intensive review of historic harvest rates, and current scientific literature on harvest rates and stock productivity, the SSC workshop concluded that $F_{40\%}$ is too aggressive for many Pacific coast groundfish stocks, particularly for rockfish. For 2001 and beyond, the Council adopted the SSC's new recommendations for harvest policies of: $F_{40\%}$ for flatfish and whiting, $F_{50\%}$ for rockfish (including thornyheads) and $F_{45\%}$ for other groundfish such as sablefish and lingcod.

In the past, F_{msy} ~~these~~ fishing rates were treated by the Council (as intended) as targets. Under the Magnuson-Stevens Act as amended in 1996, these fishing rates are more appropriately considered to be ~~limits~~ thresholds ~~which~~ that should not be exceeded (see Section 4.4).

The Council will consider any new scientific information relating to calculation of MSY or MSY proxies and may adopt new values based on improved understanding of the population dynamics and harvest of any species or group of species.

~~The biomass level that produces MSY (i.e., B_{msy}) is also generally unknown and assumed to be variable over time due to long-term fluctuations in ocean conditions, so that no single value is appropriate. Current scientific thought is that B_{msy} (and/or the natural range of biomass under F_{msy}) usually falls somewhere between 0.3 to 0.5 of the average unfished abundance (mean $B_{unfished}$), and rarely falls below one quarter of that amount, (i.e., B_{msy} > 0.25 mean $B_{unfished}$). Rebuilding, or at least a reduced harvest rate, may be required if abundance falls below these levels.~~

While B_{msy} may be set based on the averaged unfished abundance ($B_{unfished}$) ~~T~~there are many possible approximations and estimates of mean $B_{unfished}$. If the necessary data exist, the following standard methodology is the preferred approach:

$$\text{mean } B_{unfished} = \text{mean } R * SPR(F=0)$$

Where mean R is the average estimated recruitment expected under unfished conditions ~~over all reliable years~~, and SPR(F=0) is the spawning potential per recruit at zero fishing mortality rate. ~~Alternative reference points based on mean R * SP($F_{35\%}$) or reconstruction of mean $B_{unfished}$ from stock recruitment relationships may also be used.~~ SPR(F=0) is normally available as part of the calculation leading to determination of ~~$F_{35\%}$~~ $F_{45\%}$ and is equilavent to $F_{100\%}$.

4.3 Determination of ABC ~~OY, Precautionary Threshold, and (Overfished/Rebuilding Threshold)~~

[Previously 5.3]

~~The Magnuson-Stevens Act as amended in 1996 defines OY as the amount of fish that is prescribed on the basis of MSY from the fishery as reduced by any relevant economic, social, or ecological factors. By this definition, overfishing occurs if a stock is harvested at a level in excess of F_{msy}. Moreover, overfished stocks (i.e., those that have declined to below a specified (overfished/rebuilding threshold)) are to be rebuilt to a level that is consistent with producing MSY.~~ In establishing OYs for West Coast groundfish, this FMP utilizes the interim step of calculating ABCs for major stocks or management units (groups of species). ABC is the MSY harvest level associated with the current stock abundance. Over the long term, if ABCs are fully harvested, the average of the ABCs would be MSY.

~~ABC, B_{msy}, and overfished/rebuilding stock size threshold cannot be precisely defined for all species, because of the absence of available information for many species managed under the FMP.~~ **[Previous sentence moved to start of 5.1. Remainder of paragraph moved to 4.4.2.]** ~~In this FMP, the term "overfishing" is used to denote situations where catch exceeds or is expected to exceed the established ABC or MSY proxy ($F_{x\%}$). The term "overfished" describes a stock who's abundance is below its overfished/rebuilding threshold). Overfished/rebuilding thresholds in general, are linked to the same productivity assumptions that determine the ABC levels. The default value of this threshold is 25% of the estimated unfished biomass level or 50% of B_{msy}, if known.~~

[Paragraph three of 5.3, on species categories, has been moved to section 4.1. Paragraph four of 5.3, on the precautionary threshold, has been moved to section 4.4.1.]

[Heading 5.3.1 (Determination of ABC) deleted as redundant.]

4.3.1 Stocks with Quantitative Assessments, Category 1

[Previously 5.3.1.1]

The stocks with quantitative assessments are those that have recently been assessed by a catch-at-age analysis. Annual evaluation of the appropriate MSY proxy (e.g., ~~$F_{35\%}$~~ $F_{45\%}$) for species in this category will require some specific information in the SAFE document. Estimated age-specific maturity, growth, and availability to the fishery (with evaluation of changes over time in these characteristics) are sufficient to determine the relationship between fishing mortality and yield-per-recruit and spawning biomass-per-recruit. The estimated time series of recruitment, spawning biomass, and fishing mortality are also required to determine whether recent trends indicate a point of concern. In general, ABC will be calculated by applying ~~$F_{35\%}$~~ $F_{45\%}$ (or $F_{40\%}$ or $F_{50\%}$ or other established MSY proxy) to the best estimate of current biomass. This current biomass estimate may be for a single year or the average of the present and several future years. Thus, ABC may be intended to remain constant over a period of three or more years. ~~All ABCs will remain in effect until revised, and, whether revised or not, will be announced at the beginning of the year along with other specifications.~~ **[Last sentence moved back to chapter 5.]**

4.3.2 Stocks with ABC Set by Nonquantitative Assessment, Category 2

[Previously 5.3.1.2]

These stocks with ABC set by nonquantitative assessments typically do not have a recent, quantitative assessment, but there may be a previous assessment or some indicators of the status of the stock. Detailed biological information is not routinely available for these stocks, and ABC levels have typically been established on the basis of average historical landings. Typically, the spawning biomass, level of recruitment, or the current fishing mortality rate for Category 2 stocks are unknown. The Council places high priority on improving the information for managing these stocks so that they may be moved to Category 1 status.

4.3.3 Stocks Without ABC Values, Category 3

[Previously 5.3.1.3]

Of the 83 groundfish species managed under the FMP, ABC values have been established for only about 25. The remaining species are incidentally landed and usually are not listed separately on fish landing receipts. Information from fishery independent surveys are often lacking for these stocks, because of their low abundance or they are not vulnerable to survey sampling gear. ~~Without an~~ Until sufficient quantities of at-sea observer program data are available or surveys of other fish habitats are conducted, it is unlikely that there ~~a data base~~ will be ~~developed in the future for these stocks to~~ sufficient data to upgrade the assessment ~~capability~~ capabilities or to evaluate their overfishing potential. Interim ABC values may be established for these stocks based on qualitative information, including advice from the Council's advisory entities.

[Section 5.3.2 (Determination of OY moved to section 4.6.]

4.4 Precautionary Thresholds and Overfishing Status Determination Criteria

[New section title]

The National Standard Guidelines define two thresholds that are necessary to maintain a stock at levels capable of producing MSY: the maximum fishing mortality threshold (MFMT) and a minimum stock size threshold (MSST). These two limits are intended for use as benchmarks to decide if a stock or stock complex is being overfished or is in an overfished state. The MFMT and MSST are intrinsically linked through the MSY control rule, which specifies how fishing mortality or catches could vary as a function of stock biomass in order to achieve yields close to MSY.

[Preceding was moved from section 4.2.]

4.4.1 Determination of Precautionary Thresholds

[Previously 5.3.3]

The precautionary threshold is the biomass level at which point the harvest rate will be reduced to help the stock return to the MSY level (see Section 4.5.1 "Default Precautionary and Interim Rebuilding OY Calculation"). The precautionary biomass threshold is in addition to the overfishing and overfished/rebuilding thresholds required under ths Magnuson-Stevens Act (MFMT and MSST). The precautionary biomass threshold is higher than the overfished biomass (MSST). Because B_{msy} is a longterm average, biomass will by definition be below B_{msy} in some years and above B_{msy} in other years. Thus, even in the absence of overfishing, biomass may decline to levels below B_{msy} due to natural fluctuation. By decreasing harvest rates when biomass is below B_{msy} but maintaining MSY control rule (or proxy control rule) harvest rates for biomass levels above MSY, the precautionary threshold and accompanying response effectively constitute a control rule that manages for harvests lower than MSY and an average biomass above MSY.

The precautionary threshold is established only for category 1 species. The precautionary threshold will be the B_{msy} level, if known. The default precautionary threshold will be 40% of the estimated unfished biomass level. The Council may recommend different precautionary thresholds for any species or species group based on the best scientific information about that species or group. It is expected the threshold will be between 25% and 50% of the estimated unfished biomass level.

~~For category 1 species, in addition to the overfished/rebuilding threshold, a precautionary threshold is established. The default value will be 40% of mean $B_{unfished}$. This level of biomass is expected to be near B_{msy}, and if abundance is between the overfished/rebuilding threshold and the precautionary threshold, a precautionary reduction in harvest will implemented to avoid further declines in abundance.~~

[Preceding paragraph moved from section 5.3, then deleted as being redundant with existing/new text.]

4.4.2 Determination of Overfishing Threshold

[New section]

In this FMP, for Category 1 species, the term "overfishing" is used to denote situations where catch exceeds or is expected to exceed the established ABC or MSY proxy ($F_{x\%}$). This can also be expressed as where catch exceeds or is expected to exceed the MFMT. The term "overfished" describes a stock whose abundance is below its overfished/rebuilding threshold). Overfished/rebuilding thresholds, in general, are linked to the same productivity assumptions that determine the ABC levels. The default value of this threshold is 25% of the estimated unfished biomass level or 50% of B_{msy}, if known. **[Preceding was moved from section 5.3]** The MFMT is simply the value(s) of fishing mortality in the MSY control rule. Technically, e~~E~~xceeding F_{msy} ~~now~~ constitutes overfishing. **[Preceding sentence was moved from section 5.2 and revised.]**

[The following paragraphs on category 2 and category 3 species were moved from section 5.3.6.2.]

For Category 2 species, the following may be evaluated as potential indicators of overfishing:

- catch per effort from logbooks
- catch area from logbooks
- index of stock abundance from surveys
- stock distribution from surveys
- mean size of landed fish

If declining trends persist for more than three years, then a focused evaluation of the status of the stock, its ABC, and overfishing threshold will be quantified. If data are available, such an evaluation should be conducted at approximately five year intervals even when negative trends are not apparent. In fact, many stocks are in need of re-evaluation to establish a baseline for monitoring of future trends. Whenever an evaluation indicates the stock may be declining and approaching an overfished state, the Council should:

1. Improve data collection for this species so it can be moved to Category 1.

2. Determine the rebuilding rate that would allow the stock to return to MSY in no longer than ten years.

For Category 3 species, information from fishery independent surveys are often lacking for these species because of their low abundance or they are not vulnerable to survey sampling gear. Without an at-sea observer program, it is unlikely that a data base will be developed in the future for these species to evaluate the risk of overfishing.

4.4.3 Determination of Overfished/Rebuilding Thresholds

[Previously 5.3.4]

The MSST (overfished/rebuilding threshold) is the default value of 25% of the estimated unfished biomass level or 50% of B_{msy}, if known. **[Preceding was moved from section 4.2]** ~~As described in section 5.3,~~ Tthe overfished/rebuilding threshold (also referred to as $B_{rebuild}$ ~~MSST~~), ~~$B_{rebuild}$~~, is generally in the range of 25% to 40% of $B_{unfished}$, and may also be written as

$$B_{rebuild} = x\% * \text{mean } R * SP\underline{R}(F=0)$$

The default overfished/rebuilding threshold for category 1 groundfish is $0.25B_{unfished}$. The Council may establish different thresholds for any species based on information provided in stock assessments, the SAFE document, or other scientific or groundfish management-related report. For example, if B_{msy} is known, the overfished threshold may be set equal to 50% of that amount. The Council may also specify a lower level of abundance where catch or fishing effort is reduced to zero. This minimum abundance threshold (B_{min}) would correspond to an abundance that severely jeopardizes the stock's ability to recover to B_{msy} in a reasonable length of time; ~~likely values fall between five percent and ten percent of the average unfished level.~~

4.5 Ending Overfishing and Rebuilding

[New Section Title]

4.5.1 Default Precautionary and Interim Rebuilding OY Calculation

[Previously 5.3.5]
[Figure omitted here]

The precautionary threshold, defined in Section 4.4.1, is used to trigger a precautionary management approach. If biomass declines to a level that requires rebuilding (below the MSST), the precautionary management approach also provides an interim rebuliding harvest control policy to guide the setting OY until the Council sets a new rebuilding policy specific to the conditions of the stock and fishery. The default OY/rebuilding ~~plan~~ policy can be described as an "ICES-type catch-based approach" that consists of a modification of the catch policy, where catch (C) declines from $C(F_{msy})$ at the precautionary threshold in a straight line to F=0 at the minimum abundance threshold of ten percent of the estimated mean unfished biomass (sometimes called pristine or virgin biomass or reproductive potential). This approach could also be described as an OY based on a variable F_{SPR} that is progressively more conservative at low biomass levels. The abbreviated name for this is the "40-10" default adjustment. In most cases, there is inadequate information to estimate F_{msy}; in such cases, the best proxy for F_{msy} will be used. The default proxy values will be $F_{40\%}$ for flatfish and whiting, $F_{\cancel{40\%}50\%}$ for rockfish in the *Sebastes* complex and $F_{\cancel{35\%}45\%}$ for other species such as sablefish and lingcod. The Council anticipates scientific information about the population dynamics of the various stocks will improve over time and that this information will result in improved estimates of appropriate harvest rates and MSY proxies. Thus, these initial default proxy values will be replaced from time to time. Such changes will not require amendment to the FMP, but the scientific basis for new values must be documented.

The greater amount of catch reduction applied below the precautionary threshold will foster quicker return to the MSY level. If a stock falls below its overfished/rebuilding threshold, this line would be used as the interim rebuilding plan during the year until the Council develops a formal rebuilding plan. The point at which the line intersects the horizontal axis does not necessarily imply zero catch would be allowed, but rather is for determining the slope of the line.

In order to apply this default approach, a minimal amount of information is necessary; only stocks in Category 1 can be managed in this way. For stocks with inadequate information to apply this approach, the Council will consider other methods of ensuring that overfishing will be avoided. The Council will consider the approaches discussed in the National Standard Guidelines in developing such recommendations for stocks in Categories 2 and 3.

4.5.2 Procedures For Calculating Rebuilding Parameters

[New section title]

The Magnuson-Stevens Act and National Standard Guidelines provide a descriptive framework for developing strategies to rebuild overfished stocks. This framework identifies three parameters: a minimum time in which an overfished stock may rebuild to its target biomass (denoted T_{MIN}), a maximum permissible time period for rebuilding the stock to its target biomass (T_{MAX}), and a target year, falling within the time period represented T_{MIN} and T_{MAX} and representing the best of estimate of the year by which the stock will be rebuilt.

[Text below from section 5.3.6.2, but paragraphs reordered.]

T_{MIN}, ~~T~~the lower limit of the specified time period for rebuilding, will be determined by the status and biology of the stock or stock complex and its interactions with other components of the marine ecosystem or environmental conditions and is defined as the amount of time that would be required for rebuilding if fishing mortality were eliminated entirely.

If the lower limit is less than ten years, then the specified time period for rebuilding may be adjusted upward to the extent warranted by the needs of fishing communities and recommendations by international organizations in which the United States participates, except that no such upward adjustment may result in the specified time period exceeding ten years (which would then constitute T_{MAX}), unless management measures under an international agreement in which the United States participates dictate otherwise.

If the lower limit is ten years or greater, then the specified time period for rebuilding may be adjusted upward to the extent warranted by the needs of fishing communities and recommendations by international organizations in which the United States participates, except that no such upward adjustment can exceed the rebuilding period calculated in the absence of fishing mortality, plus one mean generation time or equivalent period based on the species' life-history characteristics. For example, if a stock could be rebuilt within 12 years in the absence of any fishing mortality, and has a mean generation time of eight years, the rebuilding period could be as long as 20 years, which is T_{MAX}.

The Council may consider a number of factors in determining the time period for rebuilding, including:

1. The status and biology of the stock or stock complex.
2. Interactions between the stock or stock complex and other components of the marine ecosystem or environmental conditions.
3. The needs of fishing communities.
4. Recommendations by international organizations in which the United States participates.
5. Management measures under an international agreement in which the United States participates.

Calculating Rebuilding Probabilities

Stock assessment results form the basis of a rebuilding analysis, which in turn is used to develop rebuilding policies and choose the rebuilding parameters identified in each rebuilding plan. The elements of rebuilding analyses are described in the *SSC Terms of Reference for Rebuilding Analyses* (SSC, 2001). This guidance has been incorporated into a computer program. In the analysis the probability that the overfished stock will reach its target biomass is determined with respect to T_{MIN}, T_{MAX} and T_{TARGET}.

The rebuilding analysis program uses “Monte Carlo simulation” to derive a probability estimate for a given rebuilding strategy. This method projects population growth many times in separate simulations. It accounts for possible variability by randomly choosing the value of a key variable—in this case total recruitment or recruits per spawner—from a range of values. These values can be specified empirically, by listing some set of historical values, or by a relationship based on a model. The SSC recommends that the rebuilding analyses use historical values. Because of this variability in a key input value, each simulation will show a different pattern of population growth. As a result, a modeled population may reach the target biomass that defines a rebuilt stock (B_{MSY}) in a different year in each of the simulations.

This technique can be used first to calculate T_{MIN} in probabilistic terms, which is defined as the time needed to reach the target biomass in the absence of fishing with a 50% probability. In other words, in half the simulations the target biomass was reached in some year up to and including the computed T_{MIN}. Given T_{MIN}, T_{MAX} is computed as 10 years or by adding the value of one mean generation time to T_{MIN}, if T_{MIN} is greater than or equal to 10 years.

After determining T_{MAX}, multiple Monte Carlo simulations are conducted, varying the fishing mortality rate. This determines the relationship between F and the probability of the stock being rebuilt by T_{MAX} (denoted P_{MAX}). Since a higher P_{MAX} probability must be achieved by lowering the fishing mortality rate (other things being equal) there is a tradeoff between fishery harvests and rebuilding speed in probabilistic terms. As fishing mortality is reduced, the likelihood that the stock will recover in this maximum time period increases.

A target year, T_{TARGET}, is then computed as the median rebuilding year for each related F and P_{MAX}. The median year is simply the year by which half of all cases have already rebuilt, and is unique for a given F and P_{MAX}.

It is important to recognize that some of the terms introduced and described above represent policy decisions at the national level and the Council ***does not have a choice*** in setting their values. The dates for T_{MIN} and T_{MAX} are determined based on guidelines established at the national level. Mean generation time is a biological characteristic that cannot be chosen by policymakers. Thus, the Council cannot choose these values and then use them as a basis for management. Defined in national guidelines, T_{MIN} is a consequence of the productivity of the fish stock and is calculated by fishery biologists based on information they get from a particular stock. Similarly, T_{MAX}, which is calculated from T_{MIN}, does not represent a Council choice.

Fundamentally, when developing a management strategy the Council **can** choose a fishing mortality rate, and corresponding annual level of fishing. However, when rebuilding overfished species, the choice of F can be based on either the value of T_{TARGET} or P_{MAX}, keeping in mind that these three values cannot be chosen independently of one another. In other words, the Council may choose one of these values and derive the other two from it, but they cannot choose the values for two of these terms independently of the third.

4.5.3 Stock Rebuilding ~~Requirements~~ Plans

[Previously section 5.3.6]

As required by the Magnuson-Stevens Act within one year of being notified by the Secretary that a stock is overfished or approaching a condition of being overfished, the Council will prepare a recommendation to end the overfished condition and rebuild the stock(s) or to prevent the overfished condition from occurring. For a stock that is overfished, the rebuilding plan will specify a time period for ending the overfished condition and rebuilding the stock. Overfishing restrictions and recovery benefits should be fairly and equitably allocated among sectors of the fishery. ~~A new rebuilding plan or revision to an existing plan proposed by the Council will be submitted to the Secretary along with annual management recommendations as part of the regular annual management process. Once approved by the Secretary, a rebuilding plan will remain in effect for the specified duration of the rebuilding program, or until modified. The Council will make all approved rebuilding plans available in the annual SAFE document or by other means. The Council may recommend the Secretary implement interim measures to reduce overfishing until the Council's program has been developed and implemented.~~

Certain elements of a rebuilding plan developed by the Council, as specified in Section 4.5.3.2 (Contents of Rebuilding Plans), will be submitted to the Secretary as **[Option 1c**- a regulatory amendment**] [Option 1d**- an FMP amendment and implementing regulations**]**. Changes to key rebuilding plan elements will be accomplished through full (notice and comment) rulemaking. Once approved by the Secretary, a rebuilding plan will remain in effect for the specified duration of the rebuilding program, or until modified. The Council will make all approved rebuilding plans available in the annual SAFE document or by other means. The Council may recommend that the Secretary implement interim measures to reduce overfishing until the Council's program has been developed and implemented.

The Council intends its stock rebuilding plans to provide targets, checkpoints and guidance for rebuilding overfished stocks to healthy and productive levels. ~~The rebuilding plans themselves will not be regulations but principles and policies.~~ They ~~are intended to~~ should provide a clear vision of the intended results and the means to achieve those results. They will provide the strategies and objectives that regulations are intended to achieve, and proposed regulations and results will be measured against the rebuilding plans. It is likely that rebuilding plans will be revised over time to respond to new information, changing conditions and success or lack of success in achieving the rebuilding schedule and other goals. If, in response to these revisions, the Council recommends changes to the management target for a particular stock, such changes will be published through full (notice and comment) rulemaking as described in Section 6.2 of this

FMP. As with all Council activities, public participation is critical to the development, implementation and success of management programs.

4.5.3.1 Goals and Objectives of Rebuilding Plans

[Previously 5.3.6.1]

The overall goals of rebuilding programs are to (1) achieve the population size and structure that will support the maximum sustainable yield within the specified time period; (2) minimize, to the extent practicable, the social and economic impacts associated with rebuilding, including adverse impacts on fishing communities; (3) fairly and equitably distribute both the conservation burdens (overfishing restrictions) and recovery benefits among commercial, recreational and charter fishing sectors; (4) protect the quantity and quality of habitat necessary to support the stock at healthy levels in the future; and (5) promote widespread public awareness, understanding and support for the rebuilding program. More specific goals and objectives may be developed in the rebuilding plan for each overfished species.

[Following two paragraphs from 5.3.6.2]

To achieve the rebuilding goals, the Council will strive to (1) explain the status of the overfished stock, pointing out where lack of information and uncertainty may require that conservative assumptions be made in order to maintain a risk-averse management approach; (2) identify present and historical harvesters of the stock; (3) where adequate harvest sharing plans are not already in place, develop harvest sharing plans for the rebuilding period and for when rebuilding is completed; (4) set harvest levels that will achieve the specified rebuilding schedule; (5) implement any necessary measures to allocate the resource in accordance with harvest sharing plans; (6) promote innovative methods to reduce bycatch and bycatch mortality of the overfished stock; (7) monitor fishing mortality ~~and the condition of the stock at least every two years to ensure the goals and objectives are being achieved~~ and use available stock assessment information to evaluate the condition of the stock; (8) identify any critical or important habitat areas and implement measures to ensure their protection; and (9) promote public education regarding these goals, objectives and the measures intended to achieve them.

~~The rebuilding plan will specify any individual goals and objectives including a time period for ending the overfished condition and rebuilding the stock and the target biomass to be achieved. The plan will explain how the rebuilding period was determined, including any calculations that demonstrate the scientific validity of the rebuilding period. The plan will identify potential or likely allocations among sectors, identify the types of management measures that will likely be imposed to ensure rebuilding in the specified period, and provide other information that may be useful to achieve the goals and objectives.~~

4.5.3.2 Contents of Rebuilding Plans

[Previously 5.3.6.2 (corrected from 5.6.3.2)]

~~The Council may consider a number of factors in determining the time period for rebuilding, including:~~

~~1. The status and biology of the stock or stock complex.~~

~~2. Interactions between the stock or stock complex and other components of the marine ecosystem or environmental conditions.~~

~~3. The needs of fishing communities.~~

~~4. Recommendations by international organizations in which the United States participates.~~

~~5. Management measures under an international agreement in which the United States participates.~~

~~The lower limit of the specified time period for rebuilding will be determined by the status and biology of the stock or stock complex and its interactions with other components of the marine ecosystem or environmental conditions and is defined as the amount of time that would be required for rebuilding if fishing mortality were eliminated entirely.~~

~~If the lower limit is less than ten years, then the specified time period for rebuilding may be adjusted upward to the extent warranted by the needs of fishing communities and recommendations by international organizations in which the United States participates, except that no such upward adjustment may result in the specified time period exceeding ten years, unless management measures under an international agreement in which the United States participates dictate otherwise.~~

~~If the lower limit is ten years or greater, then the specified time period for rebuilding may be adjusted upward to the extent warranted by the needs of fishing communities and recommendations by international organizations in which the United States participates, except that no such upward adjustment can exceed the rebuilding period calculated in the absence of fishing mortality, plus one mean generation time or equivalent period based on the species' life-history characteristics. For example, if a stock could be rebuilt within 12 years in the absence of any fishing mortality, and has a mean generation time of eight years, the rebuilding period could be as long as 20 years.~~

[Proceeding moved to section 4.5.2.]

Generally, rebuilding plans will contain:

1. A description of the biology and status of the overfished stock and fisheries affected by stock rebuilding measures.

2. A description of how rebuilding parameters for the overfished stock were determined (including any calculations that demonstrate the scientific validity of parameters).

3. Estimates of rebuilding parameters (B_0, B_{MSY}, T_{MIN}, T_{MAX} and the probability of reaching target biomass by this date, and T_{TARGET}) at the time of rebuilding plan adoption.

4. A standard that will be used during periodic review to evaluate progress in rebuilding the stock to the target biomass (see Section 4.5.3.5).

5. Any management measures the Council may wish to specifically describe in the FMP, which facilitate stock rebuilding in the specified period. (These measures would be in addition to any existing measures typically implemented through annual or biennial management. See section 4.5.3.4 for more information.)

6. Any goals and objectives in addition to or different from those listed in the preceding section.

7. Potential or likely allocations among sectors.

8. For fisheries managed under international agreement, a discussion of how the rebuilding plan will reflect traditional participation in the fishery, relative to other nations, by fishermen of the United States.

9 Any other information that may be useful to achieve the rebuilding plan's goals and objectives.

~~In general, the Council will also consider the following questions in developing rebuilding plans.~~ The following questions also serve as a guide in developing rebuilding plans:

1. What is the apparent cause of the current condition (historical fishing patterns, a declining abundance or recruitment trend, a change in assessment methodology, or other factors)?

2. Is there a downward trend in recruitment that may indicate insufficient compensation in the spawner-recruitment relationship?

3. Based on an comparison of historical harvest levels (including discards) relative to recommended ABC levels, has there been chronic over-harvest?

4. Is human-induced environmental degradation implicated in the current stock condition? Have natural environmental changes been observed that may be affecting growth, reproduction, and/or survival?

5. Would reduction in fishing mortality be likely to improve the condition of the stock?

6. Is the particular species caught incidentally with other species? Is it a major or minor component in a mixed-stock complex?

7. What types of management measures are anticipated and/or appropriate to achieve the biological, social, economic and community goals and objectives of the rebuilding plan?

Rebuilding plan documents are distinct from the analytical documents required by the National Environmental Policy Act and other legal mandates, although they will reflect the contents of those analyses in a much briefer form. **[Option 1d-** Rebuilding plan elements incorporated into the FMP (in Section 4.5.4) summarize the contents enumerated in this section.] Rebuilding plans as a whole will be published in the next annual SAFE document after their approval.

Any new rebuilding program will commence as soon as the first measures to rebuild the stock or stock complex are implemented. **[Sentence moved from section 4.6 (formerly 5.3.2).]**

4.5.3.3 Process for Development and Approval of Rebuilding Plans

[Formerly section 5.3.6.3,]

Upon receiving notification that a stock is overfished, the Council will identify one or more individuals to draft the rebuilding plan. ~~If possible, the Council will schedule review and adoption of the proposed rebuilding plan to coincide with the annual management process.~~ A draft of the plan will be reviewed and preliminary action taken (tentative adoption or identification of preferred alternatives), followed by final adoption at a subsequent meeting. The tentative plan or alternatives will be made available to the public and considered by the Council at a minimum of two meetings unless stock conditions suggest more immediate action is warranted. Upon completing its final recommendations, the Council will submit the proposed rebuilding plan or revision to an existing plan to NMFS for concurrence. ~~In most cases, this will be concurrent with its recommendations for annual management measures. In addition, any proposed regulations to implement the~~A rebuilding plan will be developed ~~in accordance with the framework procedures of this FMP. The Council may designate a state or states to take the lead in working with its citizens to develop management proposals to achieve the rebuilding. Allocation proposals require consideration at a minimum of three Council meetings, as specified in the allocation framework. Rebuilding plans will be reviewed periodically, at least every 2 years, and the Council may propose revisions to existing plans at any time, although in general this will be occur only during the annual management process.~~

~~NMFS will review the Council's recommendations and supporting information upon receipt and may approve, disapprove, or partially approve each rebuilding plan. The Council will be notified in writing of the NMFS decision. If NMFS does not concur with the Council's recommendation, reasons for the disapproval will be included in the notification. Once approved, a rebuilding plan will remain in effect for the length of the specified rebuilding period or until revised. Any revisions to a rebuilding plan must also be approved by NMFS.~~following the standard procedures for considering and implementing an FMP amendment under the Magnuson-Stevens Act and other applicable law.

[Option 1d-
The following elements in each rebuilding plan will be incorporated into the FMP in Section 4.5.4:

1. A brief description of the status of the stock and fisheries affected by stock rebuilding measures at the time the rebuilding plan was prepared.

2. The methods used to calculate stock rebuilding parameters, if substantially different from those described in Section 4.5.2.

2. An estimate at the time the rebuilding plan was prepared of:
   - unfished biomass (B_0) and target biomass (B_{MSY}).
   - the year the stock would be rebuilt in the absence of fishing (T_{MIN});
   - the year the stock would be rebuilt if the maximum time period permissible under National Standard Guidelines were applied (T_{MAX}) and the estimated probability that the stock would be rebuilt by this date based on the application of stock rebuilding measures;
   - the year in which the stock would be rebuilt based on the application of stock rebuilding measures (T_{TARGET}).

3. A description of the harvest control rule (e.g., constant catch or harvest rate) and the specification of this parameter. The types of management measures that will be used to constrain harvests to the level implied by the control rule will also be described (see also section 4.5.3.4). These two elements, the harvest control rule and a description of management measures, represents the rebuilding strategy intended to rebuild the stock by the target year.

It is likely that over time the parameters listed above will change. It must be emphasized that the values enumerated in the FMP represent estimates at the time the rebuilding plan is prepared. Therefore, the FMP need not be amended if new estimates of these values are calculated. The values for these parameters found in the FMP are for reference, so that managers and the public may track changes in the strategy used to rebuild an overfished stock. However, any new estimates of the parameters listed above will be published in the SAFE documents as they become available.

In addition to an initial specification in the FMP, the target year (T_{TARGET}) and the harvest control rule (type and numerical value) will also be specified in regulations. If new information indicates a need to change the value of either of these two parameters, such a change will be accomplished through full (notice and comment) rulemaking as described in Section 6.2 of this FMP. Generally, the target year should only be changed in unusual circumstances. Two such circumstances would be if, based on new information, it is determined that the existing target year is later than the recomputed maximum rebuilding time (T_{MAX}) or if a recomputed harvest control rule would result in such a low optimum yield as to cause substantial socioeconomic impacts. Any change to the target year must be supported by commensurate analysis.
-end Option 1d]

[Option 1c- The target year (T_{TARGET}) and the harvest control rule (type and numerical value) will be specified in regulations. If new information indicates a need to change the value of either of these two parameters, such a change will be accomplished through full (notice and comment) rulemaking as described in Section 6.2 of this FMP. Generally, the target year should only be changed in unusual circumstances. Two such circumstances would be if, based on new information, it is determined that the existing target year is later than the recomputed maximum rebuilding time (T_{MAX}) or if a recomputed harvest control rule would result in such a low optimum yield as to cause substantial socioeconomic impacts. Any change to the target year must be supported by commensurate analysis. **-end Option 1c]**

[The following sections on Category 2 and 3 were moved to section 4.4.2.]

~~For Category 2 species, the following may be evaluated as potential indicators of overfishing:~~

- ~~catch per effort from logbooks~~
- ~~catch area from logbooks~~
- ~~index of stock abundance from surveys~~
- ~~stock distribution from surveys~~
- ~~mean size of landed fish~~

~~If declining trends persist for more than three years, then a focused evaluation of the status of the stock, its ABC, and overfishing threshold will be quantified. If data are available, such an evaluation should be conducted at approximately five year intervals even when negative trends are not apparent. In fact, many stocks are in need of re-evaluation to establish a baseline for monitoring of future trends. Whenever an evaluation indicates the stock may be declining and approaching an overfished state, the Council should:~~

~~1. Improve data collection for this species so it can be moved to Category 1.~~

~~2. Determine the rebuilding rate that would allow the stock to return to MSY in no longer than ten years.~~

~~For Category 3 species, information from fishery independent surveys are often lacking for these species because of their low abundance or they are not vulnerable to survey sampling gear. Without an at-sea observer program, it is unlikely that a data base will be developed in the future for these species to evaluate the risk of overfishing.~~

4.5.3.4 Implementation of Actions Required Under the Rebuilding Plan

[New heading, some text from section 5.3.6.3]

Once a rebuilding plan is adopted, certain measures required in the rebuilding plan may need to be implemented through authorities and processes already described in the FMP. Management actions to achieve OY harvest, and objectives related to rebuilding requirements of the Magnuson-Stevems Act and goals and objectives of the FMP (each of which may require a slightly different process) include: automatic actions, notices, abbreviated rulemaking actions, and full rulemaking actions. (These actions are detailed in Section 4.6, Chapter 5 and Section 6.2.) Allocation proposals require consideration as specified in the allocation framework (see Section 6.2.3.1). Any proposed regulations to implement the rebuilding plan will be developed in accordance with the framework procedures of this FMP.

Any rebuilding management measures that are not already authorized under the framework of the existing FMP, or specified in the FMP consequent of rebuilding plan adoption, will be implemented by further FMP amendments. These plan amendments may establish the needed measures or expand the framework to allow the implementation of the needed measures under framework procedures.

The Council may designate a state or states to take the lead in working with its citizens to develop management proposals to achieve stock rebuilding.

4.5.3.5 Periodic Review of Rebuilding Plans

[New heading, text based on section 5.3.6.3]

Rebuilding plans will be reviewed periodically, but at least every two years, although the Council may propose revisions to an adopted rebuilding plan at any time. These reviews will take into account the goals and objectives listed in Section 4.5.3.1, recognizing that progress towards the first goal, to achieve the population size and structure that will support MSY within the specified time period, will only be evaluated on receipt of new information from the most recent stock assessment. In evaluating progress towards achieving target biomass the Council will use the standard identified in the rebuilding plan. When drafting a rebuilding plan one of the following standards, or a standard similar in kind to the following, may be chosen:

- If the probability of achieving the target biomass within the maximum permissible time period (T_{MAX}) falls below 50% (the required minimum value), then progress will be considered inadequate.
- If the probability of achieving the target biomass within the maximum permissible time period (T_{MAX}) falls below the value identified in the rebuilding plan, then progress will be considered inadequate.
- The Council, in consultation with the SSC and GMT, will determine on a case-by-case basis whether there has been a significant change in a parameter such that the chosen management target must be revised.

If, based on this review, the Council decides that the harvest control rule or target year must be changed, the procedures outlined in Section 4.5.3.3 will be followed.

[Option 1d-
4.5.4 Summary of Rebuilding Plan Contents

[New heading]

[Reserved]
-end Option 1d]

4.6 Determination of OY

[Previously 5.3.2.]

[The following five paragraphs comprised the entirety of Chapter 4.]

Optimum yield (OY) is defined in the Magnuson-Stevens Fishery Conservation and Management Act (Magnuson-Stevens Act) as the amount of fish which will provide the greatest overall benefit to the Nation. The Magnuson-Stevens Act also specifies that OY is based on maximum sustainable yield (MSY), and may be equal to or less than MSY. The fishery management plan (FMP) authorizes establishment of a numerical or non-numerical OY for any groundfish species or species group and lays out the procedures the Council will follow in determining appropriate numerical OY values. An OY may be specified for the fishery management area as a whole or for specific subareas. Numerical OYs will be specified annually, based on acceptable biological catches (ABCs) for major species or species groups, which are in turn based on quantitative or qualitative stock assessments. "Control rules" for determining the numerical values of OYs ensure they will not exceed the ABCs except under tightly limited conditions.

Most of the 83 species managed by the FMP have never been assessed in either a quantitative or qualitative manner. In some cases even basic catch statistics are unavailable, because many species (rockfish, for example) are not sorted unless specifically required by regulation. Species of this type have generally not been subject to numerical harvest limits, but rather harvest is limited by gear restrictions and market demand. Other management measures which determine the total amount of harvest each year include trip landing and frequency limits. Those species without a specified OY and not included in a multi-species OY will be included in a non-numerical OY, which is defined as all the fish that can be taken under the regulations, specifications, and management measures authorized by the FMP and promulgated by the U.S. Secretary of Commerce. This non-numerical OY is not a predetermined numerical value, but rather the harvest that results from regulations, specifications, and management measures as they are changed in response to changes in the resource and the fishery. In many cases, the absence of a numerical specification reflects the absence of basic management information, such as abundance estimates and catch statistics. The non-numerical OY concept allows for a variable amount of groundfish to be harvested annually, limited by such constraints as gear restrictions, management measures for other species, and/or absence of consumer acceptance or demand.

The close spatial relationship of many groundfish species throughout the management area results in commercial and recreational catches often consisting of mixtures of several species. This is especially the case in the trawl fishery where fishermen may target on one species, but unavoidable harvest several other species. In such cases, the optimum harvest strategy often is to target on a group (complex or assemblage) of groundfish species. ~~The grouping of groundfish species into multispecies numerical and non-numerical OYs provides the flexibility to manage to obtain the optimum public benefit from the groundfish fishery as a whole rather than the maximum yield from each species. In other cases, single species management may be necessary to provide adequate resource protection, bycatch controls, or equitable allocation. In such cases, the Council may determine it more appropriate to use individual species management by means of quotas, harvest guidelines, allocations by gear type, and other management measures.~~

~~Managing multiple species complexes for OY from the complex as a whole necessarily may result in some degree of overfishing or failure to allow recovery to the MSY level for some individual stocks.~~ The Council will ~~strive, to the extent practicable, to~~ avoid <u>allowing</u> overfishing individual stocks <u>and control harvest mortality to allow overfished stocks to rebuild</u> ~~or preventing a stock from recovering~~ to the MSY level. In the event the Council determines that greater long-term benefits will be gained from the groundfish fishery by overfishing individual stocks or by preventing a stock from recovering to its MSY level, it will justify the action in writing in accordance with the procedures <u>and standards identified in this section and Section 600.310 of the National Standard Guidelines.</u> ~~in Section 5.3.6 (Stock Rebuilding) or in Section 5.5 (Annual Implementation Procedures for Specifications and Apportionments).~~ Conversely, the Council may determine that greater benefits will accrue from protecting an individual stock by constraining the multiple species complex or specific components of that complex.

Prior to implementation of the FMP in 1982, the states of Washington, Oregon, and California managed the groundfish fishery without the use of quotas. State regulations since the mid-1940s took the form of area closures (such as San Francisco Bay), legal gear definitions, minimum codend mesh regulations, size limits, bag limits, and other nonquota management measures. Implementation of the FMP built upon those historical management practices by increasing the level of catch monitoring, improving the assessment of stock conditions, and establishing other mechanisms for responding to management needs. It provides for continuation of the historical fishery on traditionally harvested groundfish species while allowing for the development of new fisheries for underutilized species. The FMP, as amended, provides for the establishment of resource conservation measures such as harvest guidelines or quotas through the annual specification procedure and annual and inseason management measures through the "points of concern" and socioeconomic framework mechanisms.

[The remainder of this section previously comprised the entirety of section 5.3.2, except as noted.]

Reduction in catches or fishing rates for either precautionary or rebuilding purposes is an important component of converting values of ABC to values of OY. This relationship is specified by the harvest control rule. All OYs will remain in effect until revised, and, whether revised or not, will be announced at the beginning of the ~~year~~ fishing period along with other specifications (see Chapter 5).

Groundfish stock assessments generally provide the following information to aid in determination of ABC and OY.

1. Current biomass (~~or~~ and reproductive potential) estimate.

2. F_{msy} or proxy, translated into exploitation rate.

3. Estimate of MSY biomass (B_{msy}), or proxy, unfished biomass (based on average recruitment), precautionary threshold, and/or overfished/rebuilding threshold.

4. Precision estimate (e.g., confidence interval) for current biomass estimate.

Determination of Numerical OYs If Stock Assessment Information Is Available (Category 1)

The Council will follow these steps in determining numerical OYs. The recommended numerical OY values will include any necessary adjustments to harvest mortality needed ~~actions~~ to rebuild any stock determined to be below its overfished/rebuilding threshold and may include adjustments to address uncertainty in the status of the stock.

1. ABC: Multiply the current fishable biomass estimate times the F_{msy} exploitation rate or its proxy to get ABC.

2. Precautionary adjustment: If the abundance is above the specified precautionary threshold, OY may be equal to or less than ABC. If current biomass estimate is less than the precautionary threshold (Section 4.4.1), the harvest rate will be reduced according to the harvest control rule specified in Section ~~5.3.5~~ 4.5.1 in order to accelerate a return of abundance to optimal levels. If the abundance falls below the overfished/rebuilding threshold (Section 4.4.2), the harvest control rule will generally specify a greater reduction in exploitation as an interim management response toward rebuilding the stock while a formal rebuilding plan is being developed. The rebuilding plan will include a specific harvest control rule designed to rebuild the stock, and that control rule will be used in this stage of the determination of OY.

3. Uncertainty adjustments: In cases where there is a high degree of uncertainty about the biomass estimate and other parameters, OY may be further reduced accordingly.

4. Other adjustments to OY: Adjustments to OY for ~~O~~other social, economic, or ecological considerations may be made. There will be, ~~including~~ reductions for anticipated bycatch mortality (i.e. mortality of discarded fish)~~, may be made~~. Amounts of fish harvested as compensation for private vessels participating in NMFS resource survey activities will also be deducted from ABC prior to setting OY.

5. OY recommendations will be consistent with established rebuilding plans and achievement of their goals and objectives unless otherwise adjusted in accordance with section 6 below.
   (a) In cases where overfishing is occurring, Council action will be sufficient to end overfishing.
   (b) In cases where a stock or stock complex is overfished, Council action will specify OY in a manner that complies with rebuilding plans developed in accordance with Section 4.5.2. **[The following is eliminated because it duplicates provisions of section 4.5.3.]** ~~a time period for rebuilding the stock or stock complex that satisfies the requirements of section 304(e)(4)(A) of the Magnuson-Stevens Act.~~

~~(i) The Council will consider a number of factors in determining the time period for rebuilding:~~

~~(1) The status and biology of the stock or stock complex.~~

~~(2) Interactions between the stock or stock complex and other components of the marine ecosystem (also referred to as "other environmental conditions").~~

~~(3) The needs of fishing communities.~~

~~(4) Recommendations by international organizations in which the United States participates.~~

~~(5) Management measures under an international agreement in which the United States participates.~~

~~(ii) These factors enter into the specification of the time period for rebuilding as follows:~~

~~(1) The lower limit of the specified time period for rebuilding is determined by the status and biology of the stock or stock complex and its interactions with other components of the marine ecosystem and is defined as the amount of time that would be required for rebuilding if fishing mortality were eliminated entirely.~~

~~(2) If the lower limit is less than ten years, then the specified time period for rebuilding may be adjusted upward to the extent warranted by the needs of fishing communities and recommendations by international organizations in which the United States participates, except that no such upward adjustment can result in the specified time period exceeding ten years, unless management measures under an international agreement in which the United States participates dictate otherwise.~~

~~(3) If the lower limit is ten years or greater, then the specified time period for rebuilding may be adjusted upward to the extent warranted by the needs of fishing communities and recommendations by international organizations in which the United States participates, except that no such upward adjustment can exceed the rebuilding period calculated in the absence of fishing mortality, plus one mean generation time or equivalent period based on the species' life-history characteristics. For example, suppose a stock could be rebuilt within twelve years in the absence of any fishing mortality, and has a mean generation time of eight years. The rebuilding period, in this case, could be as long as 20 years.~~

[Paragraph (iii) was moved to section 4.5.3.2.]

~~(iii) Any new rebuilding program will commence as soon as the first measures to rebuild the stock or stock complex are implemented.~~

[Paragraph (iv) is eliminated because there are no pre-existing rebuilding plans.]

~~(iv) Any pre-existing rebuilding plans will be reviewed to determine whether they are in compliance with all requirements of the Magnuson-Stevens Act. (Note: Only Pacific ocean perch falls into this category.)~~

(c) For fisheries managed under an international agreement, Council action must reflect traditional participation in the fishery, relative to other nations, by fishermen of the United States.

(d) For any stock that has been declared overfished, the open access/limited entry allocation shares may be temporarily revised for the duration of the rebuilding period by amendment to the regulations in accordance with the normal allocation process described in this FMP. However, the Council may at any time recommend the shares specified in chapter 12 of this FMP be reinstated without requiring further analysis. Once reinstated, any change may be made only through the allocation process.

(e) For any stock that has been declared overfished, any vessel with a limited entry permit may be prohibited from operating in the open access fishery when the limited entry fishery has been closed.

6. Adjustments to OY could include increasing OY above the default value up to the overfishing level as long as the management still allows achievement of established rebuilding goals and objectives. In limited circumstances, these adjustments could include increasing OY above the overfishing level as long as the harvest meets the standards of the mixed stock exception in the National Standard Guidelines:
   (a) The Council demonstrates by analysis that such action will result in long-term net benefits to the Nation.
   (b) The Council demonstrates by analysis that mitigating measures have been considered and that a similar level of long-term net benefits cannot be achieved by modifying fleet behavior, gear selection/ configuration, or other technical characteristic in a manner such that no overfishing would occur.
   (c) The resulting rate or level of fishing mortality will not cause any species or evolutionarily significant unit thereof to require protection under the Endangered Species Act.

7. For species complexes (such as Sebastes complex), the OY will generally be set equal to the sum of the individual component ABCs, HGs, and/or OYs, as appropriate.

Determination of a Numerical OY If ABC Is Based on Nonquantitative Assessment (Category 2)

1. ABC may be based on average of past landings, previous nonquantitative assessment, or other qualitative information.

2. Precautionary adjustments, if any, would be based on relevant information. In general, the Council will follow a risk-averse approach and may recommend an OY below ABC if there is a perception the stock is below its MSY biomass level. If a declining trend persists for more than three years, then a focused evaluation of the status of the stock, its ABC, and the overfishing parameters will be quantified. If data are available, such an evaluation should be conducted at approximately five-year intervals even when negative trends are not apparent. In fact, many stocks are in need of re-evaluation to establish a baseline for monitoring of future trends. Whenever an evaluation indicates the stock may be declining and approaching an overfished state, then the Council should:
   a. Recommend improved data collection for this species.
   b. Determine the rebuilding rate that would increase the multispecies value of the fishery.

3. Uncertainty adjustment: In cases where there is a high degree of uncertainty about the condition of the stock or stocks, OY may be reduced accordingly.

4. Amounts of fish harvested as compensation for industry research activities will also be deducted.

5. These adjustments could include increasing OY above the default value as indicated for Category 1 stocks, items 5 and 6 above.

Non-numerical OY for Stocks with No ABC Values (Category 3)

Fish of these species are incidentally landed and usually are not listed separately in fish landing receipts. Information from fishery-independent surveys are often lacking for these stocks, because of their low abundance or they are not vulnerable to survey sampling gear. Until sufficient quantities of ~~Without an~~ at-sea observer program data are available or surveys of other fish habitats are conducted and/or requirements that landings of all species be recorded separately, it is unlikely that there ~~a data base~~ will be ~~developed in the future for these stocks to~~ sufficient data to upgrade the assessment ~~capability~~ capabilities or to evaluate their overfishing potential.

These species typically may be included in a non-numerical OY that is defined as all the fish that can be taken under the regulations, specifications, and management measures authorized by the FMP and promulgated by the Secretary. Such an OY may not be a predetermined numerical value, but rather that harvest that results from regulations, specifications, and management measures as they are changed in response to changes in the resource and the fishery. Nothing in this FMP prevents inclusion of these species in a numerical OY if the Council believes that is more appropriate.

5.0 PERIODIC SPECIFICATION AND APPORTIONMENT OF HARVEST LEVELS

The ability to establish and adjust harvest levels is the first major tool at the Council's disposal to exercise its resource stewardship responsibilities. Each biennial fishing period, the Council will assess the biological, social, and economic condition of the Pacific coast groundfish fishery and update maximum sustainable yield (MSY) estimates or proxies for specific stocks (management units) where new information on the population dynamics is available. The Council will make this information available to the public in the form of the *Stock Assessment and Fishery Evaluation (SAFE)* document described in Section 5.1. Based upon the best scientific information available, the Council will evaluate the current level of fishing relative to the MSY level for stocks where sufficient data are available. Estimates of the acceptable biological catch (ABC) for major stocks will be developed, and the Council will identify those species or species groups which it proposes to be managed by the establishment of numerical harvest levels (optimum yields [OYs], harvest guidelines [HGs], or quotas). For those stocks judged to be below their overfished/rebuilding threshold, the Council will develop a stock rebuilding management strategy.

The process for specification of numerical harvest levels includes the estimation of ABC, the establishment of OYs for various stocks, calculation of specified allocations between harvest sectors, and the apportionment of numerical specifications to domestic annual processing (DAP), joint venture processing (JVP), total allowable level of foreign fishing (TALFF), and the reserve. The specification of numerical harvest levels described in this chapter is the process of designating and adjusting overall numerical limits for a stock either throughout the entire fishery management area or throughout specified subareas. **The process normally occurs annually between November and June, but can occur, under specified circumstances, at other times of the fishing year.** The Council will identify those OYs which should be designated for allocation between limited entry and open access sectors of the commercial industry. Other numerical limits which allocate the resource or which apply to one segment of the fishery and not another are imposed through the socioeconomic framework process described in Chapter 6 rather than the specification process.

The National Marine Fisheries Service (NMFS) Regional Administrator will review the Council's recommendations, supporting rationale, public comments, and other relevant information; and, if it is approved, will undertake the appropriate method of implementation. Rejection of a recommendation will be explained in writing.

The procedures specified in this chapter do not affect the authority of the U.S. Secretary of Commerce (Secretary) to take emergency regulatory action as provided for in Section 305(c) of the Magnuson-Stevens Fishery Conservation and Management Act (Magnuson-Stevens Act) if an emergency exists involving any groundfish resource or to take such other regulatory action as may be necessary to discharge the Secretary's responsibilities under Section 305(d) of the Magnuson-Stevens Act.

This chapter describes the steps in this process. **[Moved from the end of this section.]**

5.1 General Overview of Annual Specifications Process

[New heading, text moved from introduction to Chapter 5]

The specifications and management process, in general terms, occurs as follows:

1. The Council will determine the MSY or MSY proxy and ABC for each major stock. Typically, the MSY proxy will be in terms of a fishing mortality rate ($F_{x\%}$,) and ABC will be the $F_{x\%}$ applied to the current biomass estimate. The MSY is the maximum long-term average yield expected from annual application of the MSY (or proxy) harvest policy under prevailing ecological and environmental conditions.

2. Every species will either have its own designated OY or be included in a multispecies OY. Species which are included in a multispecies OY may also have individual OYs, have individual HGs, or be included in a HG for a subgroup of the multispecies OY. Stocks without quantitative or qualitative assessment information may be included in a numerical or non-numerical OY.

3. To determine the OY for each stock, the Council will determine the best estimate of current abundance and its relation to its precautionary and overfished thresholds. If the abundance is above the precautionary threshold, OY will be equal to or less than ABC. If abundance falls below the precautionary threshold, OY will be reduced according to the harvest control rule for that stock. If abundance falls below the overfished/rebuilding threshold, OY will be set according to the interim rebuilding rule until the Council develops a formal rebuilding plan for that species.

4. For any stock or stock complex where the Secretary identifies that overfishing is occuring the Council will take remedial action to end overfishing. For any stock or stock complex the Secretary has identified as approaching the overfished condition the Council will take remedial action to prevent the stock or stock complex from falling below the minimum stock size threshold. For any stock the Secretary has declared overfished or approaching the overfished condition, or for any stock the Council determines is in need of rebuilding, the Council will implement such periodic management measures as are necessary to rebuild the stock by controlling harvest mortality, habitat impacts or other effects of fishing activities that are subject to regulation under this biennial process. ~~the Council will develop a rebuilding plan and submit it in the same manner as recommendations of the annual management process. Once approved, a rebuilding plan will remain in effect for the specified duration or until the Council recommends and the Secretary approves revision.~~

5. The Council may reserve and deduct a portion of the ABC of any stock to provide for compensation for vessels conducting scientific research authorized by NMFS. Prior to the research activities, the Council will authorize amounts to be made available to a research reserve. However, the deduction from the ABC will be made in the year after the "compensation fishing"; the amounts deducted from the ABC will reflect the actual catch during compensation fishing activities.

6. The Council will identify stocks which are likely to be fully harvested (i.e., the ABC, OY, or HG achieved) in the absence of specific management measures and for which allocation between limited entry and open access sectors of the fishery is appropriate.

7. The groundfish resource is fully utilized by U.S. fishing vessels and seafood processors. The Council may entertain applications for foreign or joint venture fishing or processing at any time, but fishing opportunities may be established only through amendment to this FMP. This section supercedes other provisions of this FMP relating to foreign and joint venture fishing.

~~This chapter describes the steps in this process.~~ **[Moved above new heading 5.1.]**

5.2 SAFE Document

[Previously 5.1]

For the purpose of providing the best available scientific information to the Council for evaluating the status of the fisheries relative to the MSY and overfishing definition, developing ABCs, determining the need for individual species or species group management, setting and adjusting numerical harvest levels, assessing social and economic conditions in the fishery, and updating the appendices of this fishery management plan (FMP); a SAFE document is prepared annually. Not all species and species groups can be reevaluated every year due to limited state and federal resources. However, the SAFE document will in general contain the following information:

1. A report on the current status of Washington, Oregon, and California groundfish resources by major species or species group.

2. Specify and update estimates of harvest control rule parameters for those species or species groups for which information is available. (The Council anticipates scientific information about the population dynamics of the various stocks will improve over time and that this information will result in improved estimates of appropriate harvest rates and MSY proxies. Thus, initial default proxy values will be replaced from time to time. Such changes will not require amendment to the FMP, but the scientific basis for new values must be documented.) **[Copied from 4.5.]**

3. Estimates of MSY and ABC for major species or species groups.

4. Catch statistics (landings and value) for commercial, recreational, and charter sectors.

5. Recommendations of species or species groups for individual management by OYs.

6. A brief history of the harvesting sector of the fishery, including recreational sectors.

7. A brief history of regional groundfish management.

8. A summary of the most recent economic information available, including number of vessels and economic characteristics by gear type.

9. Other relevant biological, social, economic, ecological, and essential fish habitat information which may be useful to the Council.

10. A description of the maximum fishing mortality threshold (MFMT) and the minimum stock size threshold (MSST) for each stock or stock complex, along with other information the Council may use to determine whether overfishing is occurring or a stock or stock complex is overfished. (The default overfished/rebuilding threshold for category 1 groundfish is $0.25B_{unfished}$. The Council may establish different thresholds for any species based on information provided in stock assessments, the SAFE document, or other scientific or groundfish management-related report.) **[The previous two sentences were copied from 4.4.2.]**

~~10.~~ 11. A description of any rebuilding plans currently in effect, a summary of the information relevant to the rebuilding plans, and any management measures proposed or currently in effect to achieve the rebuilding plan goals and objectives.

~~11.~~ 12. A list of annual specifications and management measures that have been designated as routine under processes described in the FMP at Section 6.2.

Under a biennial specifications and management measures process, elements 2, 5, 6, 7, and 11 would not need to be included in a SAFE document in years when the Council is not setting specifications and management measures for an upcoming biennial fishing period. The ~~preliminary~~ stock assessment section of the SAFE document is normally completed ~~late in the year, generally late October,~~ when the most current stock assessment and fisheries performance information is available and prior to the meeting at which the Council approves its final management recommendations for the upcoming biennial fishing period. The Council will make the ~~preliminary~~ stock assessment ~~and fishery evaluation section~~ of the SAFE document available to the public by such means as mailing lists or newsletters and will provide copies upon request. ~~A final~~ The fishery evaluation section of the SAFE may be prepared after the Council has made its final recommendations for the upcoming biennial fishing period and will include the final recommendations, an estimate of the previous year's catch, and ~~including~~ summaries of ~~proposed and pre-existing~~ rebuilding plans. ~~The final SAFE document, if prepared, will also~~ It will be made available upon request.

5.3 Authorization and Accounting for Fish Taken as Compensation for Authorized Scientific Research Activities.

[Previously 5.4, sections 5.2 and 5.3 moved to chapter 4.]

At a Council meeting, NMFS will advise the Council of upcoming resource surveys that would be conducted using private vessels with groundfish as whole or partial compensation. For each proposal, NMFS will identify the maximum number of vessels expected or needed to conduct the survey, an estimate of the species and amounts of compensation fish likely to be needed to compensate vessels for conducting the survey, when the fish would be taken, and when the fish would be deducted from the ABC in determining the OY/harvest guideline. NMFS will initiate a competitive solicitation to select vessels to conduct resource surveys. NMFS will consult with the Council regarding the amounts and types of groundfish species to be used to support the surveys. If the Council approves NMFS' proposal, NMFS may proceed with awarding the contracts, taking into account any modifications requested by the Council. If the Council does not approve the proposal to use fish as compensation to pay for resource surveys, NMFS will not use fish as compensation.

Because the species and amounts of fish used as compensation will not be determined until the contract is awarded, it may not be possible to deduct the amount of compensation fish from the ABC or harvest guideline in the year that the fish are caught. Therefore, the compensation fish will be deducted from the ABC the biennial fishing period after the fish are harvested. During the annual specification process, NMFS will announce the total amount of fish caught during the biennial fishing period as compensation for conducting a resource survey, which then will be deducted from the following year's ABCs in setting the OYs.

[Section 5.5, Determination of DAH, DAV, JVP and TALFF deleted.]

5.4 Biennial Implementation Procedures for Specifications and Management Measures

[Previously 5.6]

Biennially, the Council will develop recommendations for the specification of ABCs, OYs, any HGs or quotas, ~~and apportionments to DAH, DAP, JVP, and TALFF and the reserve~~ over the span of three Council meetings. In addition during this process, the Council may recommend establishment of HGs and quotas for species or species groups within an OY.

The Council will develop preliminary recommendations at the first of three meetings (usually in November) based upon the best stock assessment information available to the Council at the time and consideration of public comment. After the first meeting, the Council will provide a summary of its preliminary recommendations and their basis to the public through its mailing list as well as providing copies of the information at the Council office and to the public upon request. The Council will notify the public of its intent to develop final recommendations at its third meeting (usually in June) and solicit public comment both before and at its second meeting.

At its second meeting, the Council will again consider the best available stock assessment information which should be contained in the recently completed SAFE report and consider public testimony before adopting final recommendations to the Secretary. Following the second/third meeting, the Council will submit its recommendations along with the rationale and supporting information to the Secretary for review and implementation.

Upon receipt of the Council's recommendations supporting rationale and information, the Secretary will review the submission, and, if approved, publish a notice in the *Federal Register* making the Council's recommendations avaialable for public comment and agency review. Following the public comment period on the proposed rule, the Secretary will review the proposed rule, taking into account any comments or additional information received, and will publish a final rule in the Federal Register, possibly modified from the proposed rule in accordance with the Secretary's consideration of the proposed rule. All ABCs, OYs, and any HGs or quotas will remain in effect until revised, and, whether revised or not, will be announced at the beginning of the year along with other specifications. **[Previous sentence moved from 5.3.1.1.]**

In the event that the Secretary disapproves one or more of the Council's recommendations, he may implement those portions approved and notify the Council in writing of the disapproved portions along with the reasons for disapproval. The Council may either provide additional rationale or information to support its original recommendation, if required, or may submit alternative recommendations with supporting rationale. In the absence of an approved recommendation at the beginning of the biennial fishing period, the current specifications in effect at the end of the previous biennial fishing period will remain in effect until modified, superseded, or rescinded.

5.5 Inseason Procedures for Establishing or Adjusting Specifications and Management Measures

[Previously 5.7]

5.5.1 Inseason Adjustments to ABCs

[Previously 5.7.1]

Occasionally, new stock assessment information may become available inseason that supports a determination that an ABC no longer accurately describes the status of a particular species or species group. However, adjustments will only be made during the biennial specifications process and a revised ABC announced at the beginning of the next biennial fishing period. The only exception is in the case where the ABC announced at the beginning of the biennial fishing period is found to have resulted from incorrect data or from computational errors. If the Council finds that such an error has occurred, it may recommend the Secretary publish a notice in the *Federal Register* revising the ABC at the earliest possible date.

5.5.2 Inseason Establishment and Adjustment of OYs, HGs, and Quotas

[Previously 5.7.2]

OYs and HGs may be established and adjusted inseason (1) for resource conservation through the "points of concern" framework described in Chapter 6; (2) in response to a technical correction to ABC described above; or, (3) under the socioeconomic framework described in Chapter 6.

Quotas~~, except for apportionments to DAH, DAP, JVP, TALFF,~~ and reserve, may be established and adjusted inseason only for resource conservation or in response to a technical correction to ABC.

[Section 5.7.3 (Inseason Apportionment and Adjustments to DAH, DAP, JVP, TALFF, and Reserve) deleted.]

* * *

6.0 MANAGEMENT MEASURES

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6.5.1.2 Observers

* * *

The Regional Administrator ~~may~~ will implement an observer program through a Council-approved federal regulatory framework. Details of how observer coverage will be distributed across the West Coast groundfish fleet will be described in an observer coverage plan. NMFS will publish an announcement of the authorization of the observer program and description of the observer coverage plan in the *Federal Register*.

* * *

13.0 REFERENCES

* * *

Myers, R.A., N.J. Barrowman, and R. Hilborn. 2000. The Meta-analysis of the maximum reproductive rate for fish populations to estimate harvest policy; a review. Unpublished report distributed at the March 20-23, 2000, West Coast Groundfish Harvest Rate Policy Workshop sponsored by the Scientific and Statistical Committee of the Pacific Fishery Management Council.

* * *

SSC (Science and Statistical Committee). 2001. SSC terms of reference for groundfish rebuilding analyses. Pacific Fishery Management Council, Portland, April 2001, Briefing Book Exhibit F.7.

DRAFT

AMENDMENT 16-2

TO THE PACIFIC COAST GROUNDFISH FISHERY MANAGEMENT PLAN

REBUILDING PLANS FOR DARKBLOTCHED ROCKFISH, PACIFIC OCEAN PERCH, CANARY ROCKFISH, AND LINGCOD

INCLUDING

PRELIMINARY

DRAFT ENVIRONMENTAL IMPACT STATEMENT AND REGULATORY ANALYSES

Prepared by
The Pacific Fishery Management Council
7700 NE Ambassador Place, Suite 200
Portland, OR 97220
(503) 820-2280
www.pcouncil.org

In Cooperation With
National Marine Fisheries Service

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COVER SHEET
AMENDMENT 16-2 ENVIRONMENTAL IMPACT STATEMENT

Proposed Action:	Implement legally-compliant rebuilding plans, consistent with the framework established in Amendment 16-1, that will set strategic rebuilding parameters to guide stock rebuilding for canary rockfish (*Sebastes pinniger*), darkblotched rockfish (*S. crameri*), lingcod (*Ophiodon elongatus*), and Pacific ocean perch (*S. alutus*) These rebuilding parameters stem from the Magnuson-Stevens Fishery Conservation and Management Act (Magnuson-Stevens Act) and National Standard 1 guidelines (50 CFR 600.310). The most important strategic rebuilding parameters are the stock's size, or target biomass, capable of supporting maximum sustainable yield (MSY) and a time period within which the stock must be rebuilt to this size. Although draft fishery management plan (FMP) language states that new management measures intended to achieve these targets may be added to the FMP as part of rebuilding plans, only existing management measures are considered under the proposed action.
Type of Statement:	Preliminary review draft of Draft Environmental Impact Statement
For Further Information:	
Technical issues, biological:	Mr. John DeVore Pacific Fishery Management Council 7700 NE Ambassador Pl. Suite 200 Portland, OR 97220 (503) 820-2280 John.Devore@noaa.gov
Technical issues, socioeconomic:	Mr. Jim Seger Pacific Fishery Management Council 7700 NE Ambassador Pl. Suite 200 Portland, OR 97220 (503) 820-2280 Jim.Seger@noaa.gov
National Marine Fisheries Service Northwest Region National Environmental Policy Act Coordinator:	Mr. Matthew Harrington NMFS F/NWR3 7600 Sand Point Way Seattle, WA 98115 (206) 526-4742 Matthew.Harrington@noaa.gov

Abstract:

The U.S. Secretary of Commerce (Secretary) has declared nine fish species managed under the Pacific Coast Groundfish Fishery Management Plan (FMP) to be overfished, based on criteria and procedures described in the Magnuson-Stevens Act (§304(e)), and overfishing criteria adopted by the Pacific Fishery Management Council (Council) under Amendment 11 to the FMP. The Magnuson-Stevens Act (§304(e)(3)) also requires councils to "prepare a fishery management plan, plan amendment, or proposed regulations" in order to prevent overfishing and implement a plan to rebuild the overfished stocks. The Council has chosen to adopt legally-compliant rebuilding plans for overfished groundfish through a series of FMP and/or regulatory amendments. Amendment 16-2 adopts rebuilding plans for four of the nine overfished species in order to rebuild these stocks to a size capable of supporting MSY, or to a stock size less than this if such stock size results in long-term net benefit to the nation, and according to the requirements of the Magnuson Stevens Act. The Act requires rebuilding plans to identify a time period, which "shall be as short as possible," while

accounting for various mitigating factors, such as the biology of the stock, ecological considerations, and the needs of fishing communities. This EIS evaluates alternatives with different strategic rebuilding parameters. These parameters include the harvest rate, the probability that the stock will rebuild in the maximum statutorily-permitted time period, and the median, or most likely, year in which the stock would be rebuilt to its target biomass for the given harvest rate. The use of the Mixed Stock Exception, identified in National Standard 1 guidelines (50 CFR 600.310(d)(6)), is also considered for some overfished stocks. Under this exception overfishing could continue in cases where the overfished species co-occurs with other species that are the target of the fishery. However, it must be demonstrated that such an approach results in a long-term net benefit to the nation that could not be achieved through the implementation of other mitigating measures. In addition, the stock cannot be reduced to a level that would result in its listing under the Endangered Species Act. A range of management measures, implemented through the annual/biennial harvest specification process, will be used to constrain total fishing mortality within levels identified by these parameters. The range of measures implemented in this fashion is not expected to differ in kind among the alternatives. New measures, different from the types of measures implemented through the specification process, are not considered at this time as part of the four rebuilding plans evaluated here. However, new management measures, consistent with stock rebuilding, could be part of some separate, future action.

EXECUTIVE SUMMARY

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ACRONYMS AND GLOSSARY

ABC	Allowable Biological Catch
BO	Biological Opinion
BRD	bycatch reduction device
CalCOFI	California Cooperative Oceanic Fisheries Investigations
CDFG	California Department of Fish and Game
CEQ	Council on Environmental Quality
CFR	Code of Federal Regulations
CMC	Center for Marine Conservation
Council	Pacific Fishery Management Council
CPFV	commercial passenger fishing vessel
CPS	Coastal Pelagic Species
CPUE	catch per unit of effort
CZMA	Coastal Zone Management Area
DBCA	Darkblotched Conservation Area
DEIS	draft environmental impact statement
DTS	Dover sole/thornyhead/sablefish
EA	Environmental Assessment
EDCP	Enhanced Data Collection Project
EEZ	exclusive economic zone
EFH	Essential Fish Habitat
EFP	exempted fishing permit
EIS	Environmental Impact Statement
ENSO	El Niño southern oscillation
EO	Executive Order
ESA	Endangered Species Act
FEAM	fishery economic assessment model
FEIS	final environmental impact statement
FMP	Fishery Management Plan
FONSI	Finding of No Significant Impact
GAP	Groundfish Advisory Subpanel

GMT	Groundfish Management Team
INPFC	International North Pacific Fishery Commission
IPHC	International Pacific Halibut Commission
IRFA	initial regulatory flexibility analysis
ITQ	individual transferable quota
kg	kilogram
m	meter
Magnuson- Stevens Act	Magnuson-Stevens Fishery Conservation and Management Act
MBTA	Migratory Bird Treaty Act
MFMT	maximum fishing mortality threshold
MHHW	mean high high water
MMPA	Marine Mammal Protection Act
MPA	marine protected area
MRFSS	Marine Recreational Fisheries Statistics Survey
MSA	Magnuson-Stevens Fishery Conservation and Management Act
MSE	*Mixed Stock Exception* (alternative)
MSST	Minimum Stock Size Threshold
MSY	Maximum Sustainable Yield
mt	metric ton
NAO	NOAA Administrative Order
NEPA	National Environmental Policy Act
NMFS	National Marine Fisheries Service
NOAA	National Oceanographic and Atmospheric Administration
NOI	Notice of Intent
NRDC	Natural Resources Defense Council
NSG	National Standards Guidelines
NWR	Northwest Region
ODFW	Oregon Department of Fish and Wildlife
OY	optimum yield
PacFIN	Pacific Coast Fisheries Information Network

PDO	Pacific decadal oscillation
PMCC	Pacific Marine Conservation Council
POP	Pacific ocean perch
PSMFC	Pacific States Marine Fisheries Commission
QSM	quota species monitoring
RCA	Rockfish Conservation Area
RecFIN	Recreational Fishery Information Network
RFA	Regulatory Flexibility Act (or Analysis)
RIR	Regulatory Impact Review
ROD	record of decision
SAFE	Stock Assessment Fishery Evaluation
Secretary	U.S. Secretary of Commerce
SEIS	supplemental environmental impact statement
SFA	Sustainable Fisheries Act
SL	standard length
SSC	Scientific and Statistical Committee
STAR	Stock Assessment Review Panel
STAT	Stock Assessment Team
SWFSC	Southwest Fisheries Science Center (NMFS)
TAC	total allowable catch
U & A	usual and accustomed
USFWS	U.S. Fish and Wildlife Service
VMS	Vessel Monitoring System
WDFW	Washington Department of Fish and Wildlife
WOC	Washington-Oregon-California
YRCA	Yelloweye Rockfish Conservation Area

1.0 INTRODUCTION

1.1 How This Amendment is Organized

This document provides background information about and analysis of changes to the Pacific Coast Groundfish Fishery Management Plan incorporated as Amendment 16-2. The actual changes, or amended parts of the plan, appear in Appendix E. The Pacific Fishery Management Council (Council) prepared this document. The Council is one of eight regional Fishery Management Councils providing management recommendations to the National Marine Fisheries Service (NMFS), which then implements these regulations through federal regulations as appropriate. The Pacific Fishery Management Council is responsible for fisheries occurring in federal waters off the U.S. West Coast (Figure 1.1-1). Each Council draws its membership from constituent states; in addition to Washington, Oregon, and California, Idaho is also a member of the Pacific Council, because salmon, managed by the Council under a different fishery management plan, return to rivers in Idaho to spawn.

This document is the second in a series of amendments numbered Amendments 16-1, 16-2, 16-3, and so forth. Amendment 16-1 establishes a framework for the adoption of rebuilding plans for overfished species. This amendment, Amendment 16-2, adopts four rebuilding plans: darkblotched rockfish, Pacific ocean perch, lingcod, and canary rockfish. Adopted plans are implemented through the framework contained in Amendment 16-1. Subsequent amendments will adopt rebuilding plans for all of the remaining five overfished species. (Additional amendments to adopt rebuilding plans will continue this numbering system.)

Fishery management plans (FMPs), and any amendments to them, must conform to the Magnuson-Stevens Fishery Conservation and Management Act (Magnuson-Stevens Act, or MSA), the principal legislation governing fishery management within the Exclusive Economic Zone (EEZ), which extends from the outer boundary of the territorial sea to a distance of 200 miles from shore. In addition to addressing Magnuson-Stevens Act mandates, this document is an environmental impact statement (EIS), pursuant to the National Environmental Policy Act (NEPA) of 1969, as amended. According to the Act (Sec. 102(2)(C)), any "major federal action significantly affecting the quality of the human environment" must be evaluated in an EIS. Based on a preliminary determination by Pacific Fishery Management Council (Council) and National Marine Fisheries Service (NMFS) staff, adopting these four rebuilding plans is likely to have significant impacts. Therefore, rather than preparing an environmental assessment, which provides "sufficient evidence and analysis for determining whether to prepare an environmental impact statement," NMFS and the Council have decided to proceed directly to preparation of an EIS. The document also contains information and analyses relevant to the Regulatory Flexibility Act (RFA) and Executive Order (EO) 12866 (Regulatory Impact Review or RIR). These mandates require agencies to evaluate the economic impact of regulatory actions, especially on small entities.

Federal regulations (40 CFR 1502.9) require agencies to prepare and circulate a draft EIS (DEIS), which "must fulfill and satisfy to the fullest extent possible the requirements established for final statements in section 102(2)(C) of the Act" (i.e., NEPA). Agency guidelines (NOAA Administrative Order [NAO] 216-6. 5.01.b.1(i)) stipulate a minimum 45-day public comment period on the DEIS. At the end of this period a final EIS (FEIS) is prepared, responding to comments and revising the document accordingly. After the EIS is completed, a 30-day "cooling off" period ensues—with another opportunity for public comment—before the responsible official may sign a record of decision (ROD) and implement the proposed action. In addition to these two statutorily-defined opportunities for public comment, "preliminary drafts" of this document are circulated as part of the Council process and in advance of completing the DEIS. A preliminary draft was made available in advance of the Council's April 2003 meeting. A complete preliminary draft was made available in advance of the Council's June 2003 meeting. At this meeting the Council selects its preferred alternative among those identified in Chapter 2 of this document. The 45-day public comment period on the DEIS will occur after this meeting.

The information and analysis in this document are organized in 11 chapters:

- The rest of this chapter, Chapter 1, discusses the reasons for changing the FMP. This description of purpose and need defines the scope of the subsequent analysis.

- Chapter 2 outlines different alternatives that have been considered to address the purpose and need. One of these alternatives is the Council's preferred alternative, which is recommended to NMFS for adoption as a plan amendment.

- Chapter 3 describes the affected environment. This description of current conditions, or the environmental baseline, provides the basis for the analysis contained in Chapter 4.

- Chapter 4 assesses the direct impacts to the human environment of each alternative described in Chapter 2.

- Chapter 5 evaluates the cumulative impacts of the proposed action. Cumulative effects are the result of "the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions," including those of other agencies, organizations and individuals (40 CFR 1508.7). They are the total effect, or combination of direct and indirect impacts with external, factors affecting components of the human environment.

- Chapter 6 addresses additional requirements of NEPA and implementing regulations, including the identification of any measures that will be implemented to mitigate significant impacts of the proposed action.

- Chapter 7 details how this amendment meets 10 National Standards set forth in the Magnuson-Stevens Act (§301(a)) and Groundfish FMP goals and objectives.

- Chapter 8 provides information on those laws and Executive Orders, in addition to the Magnuson-Stevens Act and NEPA, that an amendment must be consistent with, and how this amendment has satisfied those mandates.

- Chapters 9, 10, and 11 include required supporting information: the list of preparers, who received copies of the document, and the bibliography.

Rebuilding analyses, which provide background information used to structure the alternatives, and the amendatory language are appended to the document.

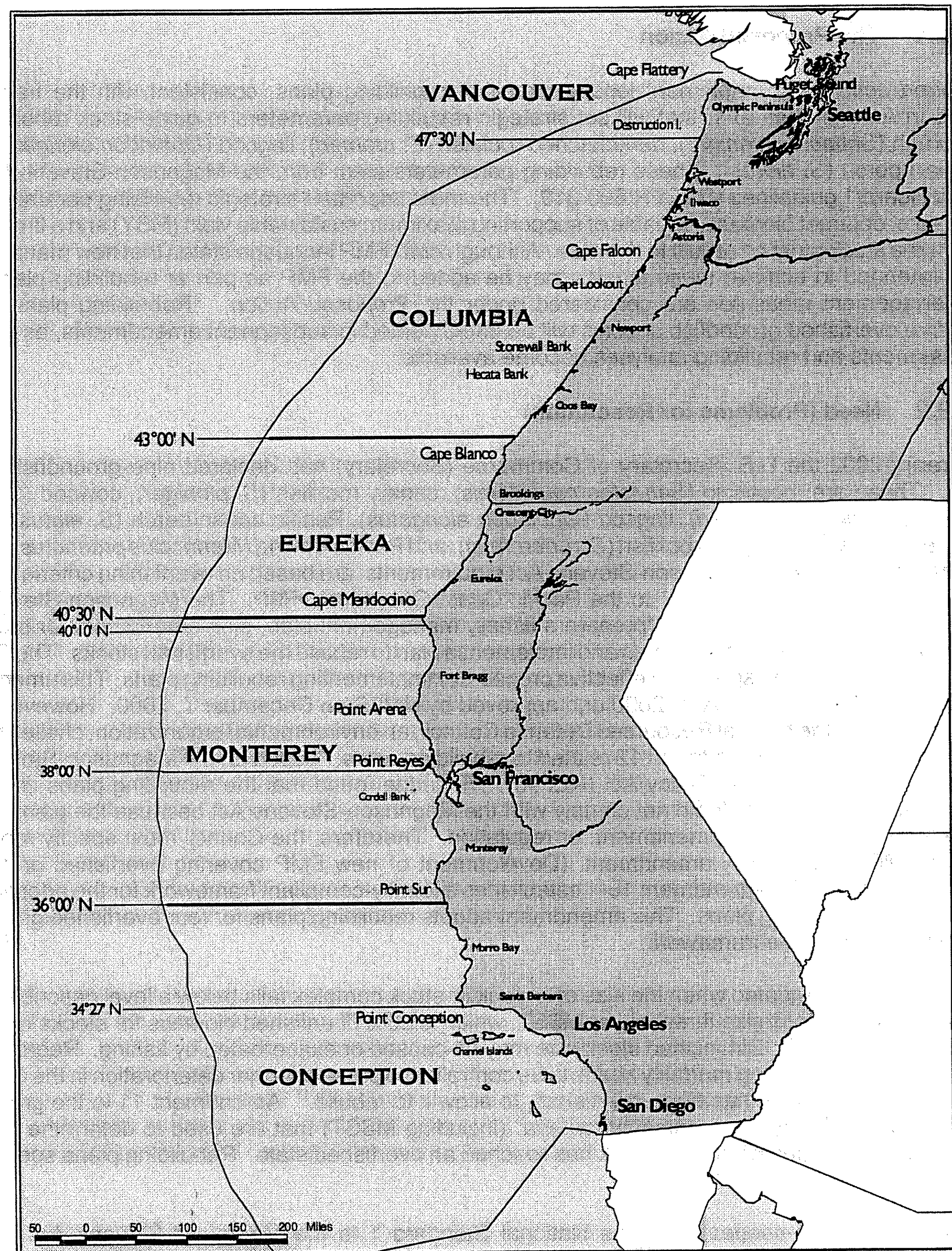

FIGURE 1.1-1. The Pacific Fishery Management Council management area (EEZ of the West Coast of the United States) and INPFC management areas.

1.2 Purpose of and Need for the Proposed Action

1.2.1 The Proposed Action

The proposed action is to implement legally-compliant rebuilding plans, consistent with the framework established in Amendment 16-1, that will set strategic rebuilding parameters to guide stock rebuilding for canary rockfish (*Sebastes pinniger*), darkblotched rockfish (*S. crameri*), lingcod (*Ophiodon elongatus*), and Pacific ocean perch (*S. alutus*). These rebuilding parameters stem from the Magnuson-Stevens Act and National Standard 1 guidelines (50 CFR 600.310). The most important strategic rebuilding parameters are the stock's size, or target biomass, capable of supporting maximum sustainable yield (MSY) and a time period within which the stock must be rebuilt to this size. Although draft FMP language states that new management measures intended to achieve these targets may be added to the FMP as part of rebuilding plans, only existing management measures are considered under the *Proposed Action*. Rebuilding plans for the remaining five overfished groundfish species will be implemented in subsequent amendments, as updated stock assessments and rebuilding analyses become available.

1.2.2 Need (Problems for Resolution)

As of February 2002 the U.S. Secretary of Commerce (Secretary) had declared nine groundfish stocks overfished. These are: bocaccio (*Sebastes paucispinis*), canary rockfish (*S. pinniger*), cowcod (*S. levis*), darkblotched rockfish (*S. crameri*), lingcod (*Ophiodon elongatus*), Pacific ocean perch (*S. alutus*), widow rockfish (*S. entomelas*), yelloweye rockfish (*S. ruberrimus*), and Pacific whiting (*Merluccius productus*). These declarations, stemming from Magnuson-Stevens Act requirements, are based on overfishing criteria adopted by the Council under Amendment 11 to the Pacific Coast Groundfish FMP. The Magnuson-Stevens Act (§304(e)(3)) also requires councils to "prepare a fishery management plan, plan amendment, or proposed regulations" in order to prevent overfishing and implement a plan to rebuild the overfished stocks. The Council developed Amendment 12 to specify an effective process for implementing rebuilding plans. This amendment was approved by the Council in April 2000 and approved by NMFS on December 7, 2000. However, in Federal District Court the Natural Resources Defense Council, an environmental organization, challenged the legality of the provisions in Amendment 12 related to rebuilding plans,[1/] based on the Magnuson-Stevens Act and the National Environmental Policy Act (NEPA). The judge found that the rebuilding plans created in accordance with Amendment 12 did not comply with the Magnuson-Stevens Act because the plans did not take the form of an FMP, FMP amendment, or regulation. Therefore, the Council must specify rebuilding plans as an FMP or regulatory amendment. (Development of new FMP covering overfished groundfish species is not considered.) Amendment 16-1 establishes a legally-compliant framework for the adoption and implementation of rebuilding plans. This amendment adopts rebuilding plans for four overfished groundfish species, consistent with the framework.

Rebuilding plans are mandated when the size of a stock or stock complex falls below a level described in the FMP as the minimum stock size threshold or MSST, which is 25% of unfished biomass for stocks managed under the groundfish FMP. Diminished stock size may be caused or exacerbated by fishing. Regardless of the cause of the decline, fishing mortality needs to be controlled to prevent further deterioration in the condition of the stock, and if the stock has been overfished, to allow it to rebuild.[2/] Amendment 11 to the groundfish FMP established the "status determination criteria" (including MSST) that are used to determine whether overfishing is occurring and whether a stock has reached an overfished state. Rebuilding plans specify how an overfished stock will be rebuilt.

The proposed action is needed, because National Standard 1 in the Magnuson-Stevens Act requires conservation and management measures that prevent overfishing. Preventing overfishing also means returning stocks to a size capable of achieving maximum sustainable yield (MSY), or to a stock size less than

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1/ The amendment also removed FMP provisions that allowed foreign fishing on groundfish stocks. This part of the amendment was not challenged, and these changes to the FMP stand.

2/ But when environmental changes affect the long-term productive capacity of the stock, one or more components of the status determination criteria may be respecified and the need for a reduction in fishing mortality reevaluated (50 CFR Section 600.310).

this if such stock size results in long-term net benefit to the nation. In order to satisfy this mandate, legally compliant rebuilding plans must be adopted for stocks that have been declared overfished by the Secretary of Commerce.

1.2.2 Purpose of the Proposed Action

The purpose of the *Proposed Action* is to rebuild canary rockfish, darkblotched rockfish, lingcod, and Pacific ocean perch stocks managed under the Pacific Coast Groundfish FMP to a size capable of supporting MSY, or to a stock size less than this if such stock size results in long-term net benefit to the nation, and according to the requirements of the Magnuson Stevens Act. The Act states that "For a fishery that is overfished, any fishery management plan, amendment, or proposed regulations... for such fishery shall... specify a time period for ending overfishing and rebuilding the fishery..." (Sec. 304(e)(4)). The Act also states that this time period "shall be as short as possible," and usually may not exceed 10 years. However, in setting a time period for rebuilding the stock, fishery managers may take into account various mitigating factors, such as the biology of the stock and the needs of fishing communities, such that the time period may exceed 10 years. Rebuilding plans must also take into account variations and contingencies in ecological and environmental conditions that cause MSY biomass to vary over time, which affects the practicable time period for rebuilding the stock. (Further details on stock rebuilding requirements may be found in section 1.3.1.)

1.3 Background

1.3.1 Requirements for Rebuilding Plans

National Standards Guidelines specify how rebuilding should occur and, in particular, establish constraints on Council action (50 CFR600.310(e)). Rebuilding should bring stocks back to a population size that can support MSY (B_{MSY}). A rebuilding plan must specify a target year (T_{TARGET}) based on the time required for the stock to reach B_{MSY}. This target is bounded by a lower limit (T_{MIN}) defined as the time needed for rebuilding in the absence of fishing (i.e., fishing mortality rate [F] = 0). Rebuilding plans for stocks with a T_{MIN} less than 10 years must have a target less than or equal to 10 years. If, as is the case with most of the groundfish stocks considered in this amendment, the biology of a particular species dictates a T_{MIN} of 10 years or greater, then the maximum allowable rebuilding time, T_{MAX}, is the rebuilding time in the absence of fishing (T_{MIN}) plus "one mean generation time." Mean generation time is a measure of the time required for a female to produce a reproductively-active female offspring (Pielou 1977; and especially Restrepo *et al.* 1998) calculated as the mean age of the net maternity function (product of survivorship and fecundity at age). The Magnuson-Stevens Act states that the rebuilding time should be as short as possible, taking into account the status and biology of the overfished stocks and the needs of fishing communities (Sec. 304(e)(A)(i)). In most cases, because of the biology of the stocks and the needs of fishing communities, the rebuilding time, or the target year, will be greater than the minimum rebuilding time (T_{MIN}).

Because of the uncertainty surrounding stock assessments and future population trends (due, for example, to variable recruitment), these limits and the target need to be expressed probabilistically. At the outset of the rebuilding period T_{TARGET} should be set, so there is at least a 50% probability of achieving B_{MSY} within the T_{MAX}.[3/] (The nature of probabilities associated with T_{MIN}, T_{TARGET}, and T_{MAX} are discussed in Amendment 16-1, Section 3.1.2.2.)

National Standards Guidelines identify a "mixed-stock complex" exception to the definition of overfishing (50 CFR 600.310(d)(6)), which is applicable to some overfished groundfish species. Different fish assemblages—some with healthy stocks and some with overfished stocks—can co-occur in a mixed-stock complex, and thus both can be caught simultaneously. An optimum yield (OY) harvest for the healthy stock can result in overfishing the depleted stock. The guidelines allow councils to authorize this type of overfishing if three conditions are met (50 CFR 600.315(d)(6)). First, an FMP (or plan amendment) must assess the overall benefits of such a policy in comparison to other measures, such as reducing the OY for the healthy stock. Second, councils must consider mitigating measures that reduce overfishing by, for example, modifying fishing strategy or gear configuration. The benefits of mitigation must be compared to those

3/ The use of a low bound 50% probability is not specified in regulations; it is the result of litigation (*Natural Resources Defense Council v. Daley, April 25, 2000, U.S. Court of Appeals for the District of Columbia Circuit*).

determined in the preceding assessment; the measures would only be implemented if they will result in greater benefits. Finally, permitted overfishing cannot result in eventual listing of the species (or evolutionarily significant unit thereof) under the Endangered Species Act (ESA). This mixed-stock exception may be considered in formulating rebuilding plans and could allow some modification in the recovery trajectory of overfished stocks.

National standard guidelines also distinguish the activity of "overfishing" from the status of a stock characterized as "overfished." Overfishing is defined by the maximum fishing mortality threshold (MFMT); harvest mortality above this limit constitutes overfishing. A stock is considered overfished when its biomass falls below the MSST, which is defined as 25% of the unfished biomass for stocks managed under the groundfish FMP. Although sometimes causing confusion, this distinction is an important one. It can be seen that any combination of these two features may apply to a stock. For example a stock above the MSST may experience overfishing (because the MFMT is being exceeded). Conversely, an overfished stock (biomass below the MSST) may not be experiencing overfishing. In fact, stock rebuilding characterizes this second condition where historical overfishing has caused the stock to become overfished. Although overfishing is no longer occurring, and the stock is rebuilding, the stock is considered overfished until it returns to the target biomass.

1.3.2 Stock Status of the Four Species Considered in this Amendment

Table 1.3-1 lists current rebuilding parameter estimates for the four species considered in this amendment.

The West Coast canary rockfish stock was declared overfished in January 2000 after stock assessments found that both the northern and southern portions of the stock were overfished (Crone *et al.* 1999, for Columbia and U.S./Vancouver International North Pacific Fishery Commission (INPFC) areas; Williams *et al.* 1999, for Conception, Monterey, and Eureka INPFC areas). The darkblotched rockfish stock was declared overfished in January 2001, after the 1999 biomass was estimated at 22% of unfished biomass (Rogers *et al.* 2000). This is below the MSST of 25% of unfished biomass. The lingcod stock was declared overfished in March 1999. The northern lingcod stock (Columbia and U.S./Vancouver INPFC areas) was estimated to be at 8.8% of its unfished spawning potential in 1997 (Jagielo *et al.* 1997), and the coastwide biomass was estimated to be at 15% of its unfished biomass in 2000 (Jagielo *et al.* 2000).

The Pacific ocean perch (POP) and darkblotched rockfish stocks in the northeast Pacific were the target of intense fishing pressure between 1965 and 1977, mostly by Soviet and Japanese trawlers. In 1981 the Council adopted a 20-year rebuilding plan for POP in response to significant declines in catch and abundance. Rebuilding under the original plan was largely influenced by a cohort analysis of 1966-1976 catch and age composition data (Gunderson 1979), updated with 1977-1980 data (Gunderson 1981), and an evaluation of trip limits as a management tool (Tagart *et al.* 1980). Management under the original rebuilding strategy served to halt further declines in stock biomass. However, the stock has not recovered to an abundance that supports MSY. Ianelli and Zimmerman (1998) estimated the 1998 abundance of the POP stock in U.S. waters to be at 13% of its unfished biomass. Under new guidelines in the Magnuson-Stevens Act, as amended by the Sustainable Fisheries Act of 1996 (P.L. 104-297), the Secretary declared the stock overfished in March 1999.

1.3.3 Summary of the Current Management Regime

Draft rebuilding plans and rebuilding analyses have been used since 2000 to guide the Council in deciding annual management measures for overfished groundfish stocks. Provisions in Amendments 11 and 12 of the FMP established a framework for their development and implementation, in a way thought to be consistent with the Sustainable Fisheries Act (or SFA, which re-authorized the Magnuson-Stevens Act and added new provisions). As specified in these draft rebuilding plans, rebuilding management measures would be adopted through the Council's annual process of setting harvest specifications for the groundfish fishery. In addition to the draft rebuilding plans, rebuilding analyses (which are written by the stock assessment authors) and the EA or EIS for each year's harvest specifications (used in the Council/NMFS decision making process) take into account the scientific and legal constraints on harvests imposed by the need to rebuild overfished groundfish fisheries. Although the Council has respected these constraints in its decisions to date, NMFS has the authority to reject these decisions because, in the regulatory context, they only represent recommendations to the Secretary of Commerce.

The Council has typically chosen a risk-averse strategy when deciding on harvest levels for overfished stocks based on recommendations contained in rebuilding analyses and given by the Council's advisory bodies (Table 1.3-1). Total mortality has been controlled by reducing trip and landing limits for co-occurring species in select target fisheries, gear restrictions (e.g., the small footrope specification for landing shelf rockfish), seasonal closures (e.g., the recreational groundfish fishery seasons adopted in California), and area closures (e.g., Rockfish Conservation Areas).

The actual discard rate (or bycatch) of fish species that are overfished, which may differ among the various groundfish fishery sectors, is a critical uncertainty that must be addressed if effective measures to control total mortality, and thus achieve rebuilding objectives, are to be adopted. Limited data have been available on which to base these estimates. Therefore, bycatch and discard rate assumptions have been contentious and the focus of some recent legal challenges. However, NMFS implemented an Observer Program in August 2001, which allows direct observation of commercial bycatch and discard. Data from this program will promote more informed management decisions and allow managers to more effectively control total mortality of overfished groundfish stocks.

1.3.4 Summary of Litigation over Amendment 12

In January 2000, the Natural Resources Defense Council (NRDC), along with other conservation organizations, challenged the adequacy of Amendment 12 (*Natural Resources Defense Council v. Evans*) in Federal District Court. They claimed that rebuilding plans submitted pursuant to Amendment 12 were inadequate for two reasons. First, they did not take the form of fishery management plans, plan amendments, or regulations as required by the Magnuson-Stevens Act. Second, rebuilding plans could allow overfishing under the "mixed-stock exception." The NRDC argued that the overfished species provisions in the SFA demonstrate Congress's intent to eliminate this exception so rebuilding plans should not entertain this exception. The Plaintiffs also argued that the environmental assessment (EA) accompanying Amendment 12 failed to consider a reasonable range of alternatives as required by NEPA. The Court found for the Plaintiffs on the claim that rebuilding measures must conform to the Magnuson-Stevens Act-mandated format of a plan, amendment, or regulation and the NEPA-related claim of an inadequate range of alternatives. The Court decided that the second Magnuson-Stevens Act-related claim, on the validity of the mixed-stock exception, was not ripe for judicial review, because the exception had not yet been applied to Pacific groundfish management. In response to its findings, the Court ordered NMFS to revise Amendment 12, so rebuilding plans accord with Magnuson-Stevens Act and NEPA requirements.

1.3.5 Development of Rebuilding Plan Adoption Strategy

Because of the litigation described above, in late 2001 work began on a new FMP amendment for the rebuilding plan adoption process that would be consistent with the Court's findings. The Council and NMFS published a Notice of Intent (NOI) to prepare an EIS on April 16, 2002 (67 FR 18576). According to this NOI, the EIS would evaluate two sets of alternatives: one set addressing the framework for rebuilding plan adoption (or the "process and standards") and a second set evaluating different rebuilding strategies that could be adopted as rebuilding plans for overfished species. (These strategies are described in terms of targets and limits, such as T_{TARGET}, T_{MIN}, T_{MAX}, harvest control rules satisfying a given target, and potential management measures to constrain fishing mortality to levels determined by the harvest control rule.) Based on internal discussion, Council staff decided in late 2002 that the process and standards alternatives should be analyzed in a separate environmental document and adopted as Amendment 16-1. Evaluated in an environmental assessment, Amendment 16-1 will probably be submitted to NMFS for approval in advance of the Amendment 16-2 DEIS. This will ensure adopted rebuilding plans can be prepared in a manner that conforms to the already-adopted framework. Because of this change of strategy, NMFS and the Council published a second NOI on March 18, 2003 (68 FR 12888), and identified an additional public scoping opportunity. Public comments raised during this scoping meeting are summarized in the next section.

1.3.6 Relationship Between the Contents of Rebuilding Plans and the Contents of This EIS

Draft FMP language, proposed as part of Amendment 16-1, specifies the contents of rebuilding plans. Although these components are part of this EIS, they are not presented as separate, concise documents. Rebuilding plans as such will appear in the first annual Stock Assessment and Fishery Evaluation (SAFE) document published after rebuilding plan adoption and approval by the Secretary. The components identified in the draft FMP language, and corresponding sections in this EIS, are summarize below.

1. A description of the biology and status of the overfished stock and fisheries affected by stock rebuilding measures.

   Section 3.2.1 describes the biology and status of the stocks. Section 3.4.2 describes the fisheries affected by stock rebuilding measures.

2. A description of how rebuilding parameters for the overfished stock were determined (including any calculations that demonstrate the scientific validity of parameters).

   Appendices A through D contain the rebuilding analyses for the four overfished species. These analyses describe the derivation of rebuilding parameters.

3. Estimates of rebuilding parameters (B_0, B_{MSY}, T_{MIN}, T_{MAX} and the probability of reaching target biomass by this date, and T_{TARGET}) at the time of rebuilding plan adoption.

   All these parameters are listed in Table 1.3-1 for the Council interim rebuilding measures. The values of the probability of reaching target biomass by this date (P_{MAX}), T_{TARGET} and the harvest control rule (F) under the different alternatives are given in Table 2.0-1. (T_{MIN}, T_{MAX}, B_0, and B_{MSY} do not vary among the alternatives.)

4. A standard that will be used during periodic review to evaluate progress in rebuilding the stock to the target biomass.

   FMP Section 4.5.3.5 lists three types of review standards. For the four rebuilding plans considered here the following review standard will be adopted as part of each rebuilding plan: "The Council, in consultation with the Scientific and Statistical Committee (SSC) and Groundfish Management Team (GMT), will determine on a case-by-case basis whether there has been a significant change in a parameter such that the chosen management target must be revised."

5. Any management measures the Council may wish to specifically describe in the FMP, which facilitate stock rebuilding in the specified period. (These measures would be in addition to any existing measures typically implemented through annual or biennial management.)

   As discussed in the introduction to Chapter 2, no new management measures will be adopted as part of these four rebuilding plans.

6. Any goals and objectives in addition to or different from those listed in the FMP.

   No additional goals are included in these rebuilding plans.

7. Potential or likely allocations among sectors.

   Section 4.4.2 discusses potential allocation among sectors.

8. For fisheries managed under international agreement, a discussion of how the rebuilding plan will reflect traditional participation in the fishery, relative to other nations, by fishermen of the United States.

   None of these stocks are managed under international agreement.

9 Any other information that may be useful to achieve the rebuilding plan's goals and objectives.

   Chapter 3 describes baseline conditions. This information may be used, as appropriate, when drafting rebuilding plans.

TABLE 1.3-1. Current parameter/target estimates specified for rebuilding darkblotched rockfish, Pacific ocean perch, canary rockfish, and lingcod. (Page 1 of 1)

Rebuilding Parameter/Target	Estimate or Proxy			
	Darkblotched	**Pacific Ocean Perch**	**Canary**	**Lingcod**
T_0 (year declared overfished)	2000	1999	2000	1999
T_{MIN} (minimum time to achieve B_{MSY} = mean time to rebuild at F = 0)	2014	2012	2057	2007
Mean generation time	33 years	30 years	19 years	NA
T_{MAX} (maximum time to achieve $B_{MSY} = T_{MIN}$ + 1 mean generation time)	2047	2042	2076	2009
P_{MAX} (P to achieve B_{MSY} by T_{MAX})[a/]	80%	70%	60%	60%
Most recent stock assessment	Rogers *et al.* 2000	Ianelli *et al.* 2000	Methot and Piner 2002	Jagielo *et al.* 2000
Most recent rebuilding analysis	Methot and Rogers 2001	Punt and Ianelli 2001	Methot and Piner 2002	Jagielo and Hastie 2001
B_0 (estimated unfished biomass)	29,044 mt	60,212 units of spawning output	31,550 mt	22,882 mt N; 20,971 mt S
$B_{CURRENT}$ (current estimated biomass)	4,067 mt in 2002	13,066 units of spawning output in 1998	2,524 mt in 2002	3,527 mt N; 3,220 mt S in 2000
% Unfished Biomass	14% in 2002	21.7% in 1998	8% in 2002	15% N & S in 2000
MSST (minimum stock size threshold = 25% of B_0)	7,261 mt	15,053 units of spawning output	7,888 mt	5,720 mt N; 5,243 mt S
B_{MSY} (rebuilding biomass target = 40% of B_0)	11,618 mt	24,084 units of spawning output	12,620 mt	9,153 mt N; 8,389 mt S
MFMT (maximum fishing mortality threshold = F_{MSY})	$F_{50\%}$	$F_{50\%}$	$F_{73\%}$	$F_{45\%}$; F = 0.12 N; F = 0.14 S
Harvest Control[a/]	F = 0.027	F = 0.0082	F = 0.022	F = 0.0531 N; F = 0.061 S
T_{TARGET}[a/]	2030	2027	2074	2009

a/ Under *Council Interim* rebuilding measures.

1.4 Scoping Summary

1.4.1 Background to Scoping

The National Environmental Policy Act requires that the public and other agencies be involved in the decision-making process. "Scoping" is an important part of this process. Scoping is designed to provide interested citizens, government officials, and tribes an opportunity to help define the range of issues and alternatives that should be evaluated in the EIS. NEPA regulations stress that agencies should provide public notice of NEPA-related proceedings and hold public hearings whenever appropriate during EIS development (40 CFR 1506.6).

The scoping process is designed to ensure all significant issues are properly identified and fully addressed during the course of the EIS process. The main objectives of the scoping process are to provide stakeholders with a basic understanding of the proposed action, explain where to find additional information about the project, provide a framework for the public to ask questions, raise concerns, identify issues, recommend options other than those being considered by the agency conducting the scoping, and ensure those concerns are included within the scope of the EIS review process.

On April 16, 2002, NMFS and the Council published a Notice of Intent (NOI) in the *Federal Register* announcing their intent to prepare an environmental impact statement (EIS) in accordance with the National Environmental Policy Act of 1969 (NEPA) for Amendment 16 to the Pacific Coast Groundfish Fishery Management Plan (Groundfish FMP). The FMP would be amended to establish procedures for periodic review and revision of rebuilding plans and incorporate rebuilding plans for overfished groundfish species.

As discussed above, NMFS and the Council subsequently decided to prepare two (or more) separate analyses for these actions. These are Amendment 16-1, establishing the rebuilding plan adoption and review process, and subsequent amendments (including this one) adopting rebuilding plans. Therefore, on March 18, 2003, NMFS and the Council published a second NOI (68 FR 12888). This NOI :

- presented a schedule for a renewed scoping process, based on the change in approach;
- described a scoping meeting to be held on April 6, 2003;
- identified where additional information about the proposed project could be obtained;
- explained the roles of NMFS and the Council in the EIS and authorization processes;
- described the EIS process after scoping and presented a tentative EIS schedule;
- presented a brief summary of the history of rebuilding plans; and,
- described the alternatives being considered to date by NMFS and the Council for inclusion in the EIS.

Publication of the NOI announced the public and agency scoping comment period that ended on May 30, 2003.

1.4.2 Council Scoping and Agency NEPA Scoping

The Council process, which is based on stakeholder involvement, allows a lot of public participation and public comment on fishery management proposals during Council, subcommittee, and advisory body meetings. The advisory bodies involved in groundfish management include the GMT, with representation from state, federal, and tribal fishery scientists; and the Groundfish Advisory Subpanel (GAP), whose members are drawn from the commercial and recreational fishery, processing, and conservation sectors. The Ad Hoc Allocation Committee, a subpanel of the whole Council, provides advice on allocating harvest opportunity among the various fishery sectors. These opportunities all constitute the broadly defined Council scoping process, not all of which focuses on the scope and content of NEPA analysis. The Council and its advisory bodies considered rebuilding plans, and took public comment on them, at six different meetings held in March, April, June, September, and November 2002, and April 2003.

In addition, NMFS and the Council hosted a public scoping meeting on April 6, 2003 at the Red Lion Hotel in Vancouver, Washington specifically for the purpose of getting comments on the scope of the NEPA analyses for rebuilding plan related actions. Approximately 28 people attended. The meeting served two purposes: to listen to and record the public's comments about the proposed action and to respond to requests for background information. NMFS and Council staff were available to answer questions and offer explanations. All comments were documented as part of the administrative record.

1.4.3 Summary of Scoping Comments Received by the Council

Written and oral comments were received from 18 different sources during both Council scoping during and the public scoping meeting held on April 6. Comments were categorized in themes (such as communities, the mixed stock exception, science, and data) and were recorded in a spreadsheet. Comments were reworded for clarity. A scoping summary report listing each comment is available from the Council office or the NMFS Northwest Region NEPA coordinator. A summary of commenters is provided below.

Comment Source	Number
Agency	1
Commercial fishing sector	9
Conservation organizations	4
Municipal government	1
Processing sector	2
Tribes	1
TOTAL	18

The number of times an issue is raised during the scoping process provides an indication of the issues that commenters are most concerned about. Scoping also helps agencies eliminate from detailed study issues that are not significant (40 CFR 1501.4(g)).

1.4.3.1 Identification of Issues

Analysis of the comments received during the scoping process is an important step in identifying key concerns about the proposed project. The comments received during the scoping process were individually analyzed and can be separated loosely into four groups.

- Observations and opinions. These comments were not recommendations, but general observations and opinions about the management process, scientific validity, and other topics related to rebuilding plans.
- Issues outside the scope of these analyses in the EA and EIS.
- Recommendations relevant to the Amendment 16-1 EA.
- Recommendations relevant the Amendments 16-2 EIS.

Using these categories comments were screened to determine which recommendations were relevant to the analysis. They were brought forward and used to determine what types of environmental impacts would be evaluated.

1.4.3.2 Recommendations Brought Forward As Part of the Analysis

This section lists the recommendations used in structuring the environmental impact analysis and notes how they have been incorporated into this document. Although the comments summarized below are enclosed in quotes to set them off from the rest of the text, they are not taken verbatim from the written and oral comments received by the Council. Most have been reworded for clarity or brevity. Original written comments, and transcripts of oral comments, are available from the Council upon request.

Bycatch

- "Use all reasonably available technologies to avoid non-target species and age classes."

  Bycatch reduction is not considered directly since the range of alternatives focuses on management targets. Current bycatch assessment methods and implications for rebuilding will be considered in Sections 3.3 and 4.3. In addition, NMFS is preparing a separate EIS that considers different bycatch reduction measures.

Communities/Social and Economic Impacts

- Consider effects of decisions on fishing community infrastructure (cumulative from all rebuilding plans)."
- "Consider socioeconomic impacts on coastal (not just fishing) communities."

- "Create and distribute a document describing individual and cumulative effects on communities."

The Magnuson-Stevens Act requires the Council and NMFS to determine how the proposed action will affect fishing communities. Sections 3.4.8 and 4.4.8 evaluates the effects of the alternatives on fishing communities. Chapter 5 analyzes cumulative effects.

Range of Alternatives

- "Include full, species-specific analysis of bycatch and evaluate as alternatives and consider for adoption all potentially practicable bycatch reduction measures."
- "Evaluate a range of alternatives for rebuilding Pacific groundfish stocks, and use an ecologically conservative approach due to the overexploitation of many harvested species."
- "Make a commitment to ensure OYs are not exceeded."

Alternatives considered in the EIS are based on different rebuilding strategies, which determine the level of fishing mortality that will be allowed to rebuild an overfished stock within a specified time period and with a given probability. The framework for rebuilding plans proposed in Amendment 16-1 allows plans to contain rebuilding-specific management measures, although they are not required. However, additional, rebuilding-plan-specific management measures have not been included in the alternatives. Instead, fishing mortality is constrained through management measures that are already part of the FMP framework. These management measures are implemented through the harvest specification process, which has occurred annually, but will shift to a biennial cycle for 2005-2006 and thereafter. This approach is considered more adaptive, because it allows management measures to be adjusted on an ongoing basis in response to new information about the status of the stock.

Habitat and Marine Reserves

- "Avoid impairing the habitats of target and non-target species."
- "Evaluate and consider the advantages of avoiding impacts to marine habitats as a component of rebuilding, including the possible inclusion of marine reserves into alternatives."
- "Fully analyze habitat needs and existing impacts on habitat for each overfished species; consider the full range of alternatives for protecting and enhancing habitat for each species being rebuilt."
- "In the rebuilding plans, note the conformity to the bycatch and habitat provisions in the analysis, even though they are part of the FMP."
- "Specifically address options for, and effectiveness of, habitat protection as an integral component of the rebuilding plan."
- Explore value of big, old, fat female spawners and their contribution to recruitment; see whether they are protected, where they are, etc. Have the SSC look into recent data on this."
- "Good that participants in the Pacific groundfish fleet have volunteered to change fishing methods to avoid habitat destruction; address how these efforts might be furthered through the rebuilding plan."

The effect of different rebuilding strategies on habitat are considered in Chapter 5, the cumulative effects analysis. As discussed above, the alternatives are based on strategic rebuilding parameters that define a rebuilding strategy, and no additional management measures will be considered outside of those that are already part of the FMP framework. However, NMFS is preparing a separate EIS to identify essential fish habitat (EFH), the effects fo fishing on EFH, and evaluate different management measures to protect habitat.

Protected Species

- "Consider the effect of marine mammals on fish populations."

Mortality (death) of overfished species from sources other than fishing is called natural mortality by fishery biologists. Natural mortality can have many different causes, including predation by marine mammals, but as long as natural mortality is accurately estimated in a stock assessment, accounting for all the different components (such as natural mortality due to old age or toxic chemicals in the water) is not important. Given this information, fishery managers can estimate the amount of fishing mortality that can occur and still allow the population to sustain itself at a healthy level. Although reducing the number of marine mammals may reduce natural mortality, these species are federally protected, so such measures *would conflict with the protective measures of the Endangered Species Act and the Marine Mammal Protection Act. Because of their protected status, the EIS does consider the effects of the proposed action on marine mammals, since groundfish are a food source for these animals. Chapter 5, the cumulative effects analysis, will evaluate these impacts.*

Mixed Stock Exception

- "Many conditions need to be satisfied in order to use the mixed stock exception; consider them."
- "Clarify the difference between the mixed stock exception and the sustainability analysis for bocaccio (regarding biomass size and rebuilding trajectories)."
- "Do not use the *Mixed Stock Exception* for any of the species."
- "If the *Mixed Stock Exception* is going to be considered, study the socioeconomic impacts."

The EIS includes a Mixed Stock Exception alternative in Chapter 2. The Mixed Stock Exception is identified in the guidelines for rebuilding (National Standard Guidelines) and may be used in limited circumstances. Because it is identified in the guidelines, the Mixed Stock Exception falls within the range of reasonable alternatives and should be evaluated for its impacts on the human environment. However, the guidelines require more careful analysis to determine if the Mixed Stock Exception is warranted, and this EIS includes the mandated level of analysis in Chapter 4 and 5.

Other Impacts

- "It is impossible to rebuild all the stocks at the same time because some are predators, some are prey, and they are in competition and fluctuate normally."
- "Analyze all issues relevant to species' current overfished condition and rebuilding strategies."

The Mixed Stock Exception would be one way to address the concern that not all stocks can be rebuilt simultaneously, and such an alternative will be considered. Even without invoking the Mixed Stock Exception, it may be possible to rebuild stocks above the overfished threshold (the minimum stock size threshold or MSST) even if not all stocks are simultaneously at a biomass level capable of supporting maximum sustainable yield. With regard to the second point, the EIS will analyze a wide range of issues as identified through scoping.

Overfishing, Exceeding OYs

- "Analyze the extent to which current management systems and strategies have contributed to the overfished status of each species; consider all alternative management systems and strategies that might help rebuild each species faster or more effectively."

Chapter 3 and 4 evaluates past and current management measures and their effects on the status of overfished stocks.

Process

- "Be sure to clearly define terms (like F, harvest control rule, harvest rule)."

The EIS contains a glossary and list of acronyms. In addition, Chapter 3 provides information on the management process.

Science and Data

- "The more you restrict fishermen, the less data you have to assess fish stocks."
- "There's not enough information available to create effective rebuilding plans."

Managers recognize that fishery-dependant data (e.g., logbooks and landings receipts) are a valuable source of information about stock status and the effectiveness of management measures. Chapter 3 and 4 discusses issues related to stock assessment. Uncertainty, in part due to the lack of information, is also considered in the development of rebuilding strategies, which include an estimate of the likely *success of rebuilding based on variability in stock productivity. Chapters 3 and 4 discusses the implications of uncertainty for rebuilding stocks.*

Tribal Issues

- "Address the Quileute Tribe's treaty fishing rights whenever management activities occur in the tribe's usual and accustomed fishing areas."
- "Ensure the Quileute Tribe's treaty fishing rights are not adversely affected by rebuilding parameters of non-treaty fisheries."
- "Ensure that the effects of fishing mortality management strategies aimed at non-treaty fisheries do not impact the Quileute Tribe's fisheries."

Tribal interests are represented in Council decision making through the tribal seat on the Council. The EIS will consider the effect of the alternatives on tribal fisheries in Chapter 4.

1.4.4 Criteria Used to Evaluate the Impacts of the Amendment 16-2 Proposed Action

Implementation of the rebuilding plans for four overfished species will be evaluated based on projected impacts to the components of the human environment listed below. For each of these components the criteria used for measuring impacts are described.

Habitat and Protected Species

The combined and cumulative effects of implementing multiple rebuilding plans are considered. Impacts to habitat and protected species would correlate with the level and type of fishing activity. Increased fishing activity, particularly bottom trawling, would result in greater impacts to habitat in comparison to a decrease in fishing. Different protected species are affected by a variety of gear types. For example, ESA-listed salmon stocks are caught in midwater trawl fisheries targeting Pacific whiting. Although there are no data for West Coast fisheries, elsewhere longline fisheries hook seabirds during gear deployment. As with habitat, alternatives that allow more fishing effort would result in greater impacts to protected species in comparison to alternatives that result in less fishing effort.

Overfished Species Stocks

Rebuilding analyses provide three metrics that can be used to compare the effect of the alternatives on the four overfished species stocks considered in this EIS. The analyses identify the probability of rebuilding in the maximum permissible time period and the median rebuilding year (or target year) for different harvest levels. The harvest level represents the direct impact. The associated probability of rebuilding in the maximum time period is a measure of the long-term risk that a particular harvest level will not achieve rebuilding. The median rebuilding year is the most likely year by which the stock will be rebuilt and is an indication of the tradeoff between harvests and how quickly the stock will rebuild. Harvest levels are inversely correlated with the rebuilding time and probability. The alternatives will be evaluated based on these metrics. Alternatives that restrict harvests more have less environmental impacts than alternatives that allow a higher harvest rate.

Co-occurring Species

Co-occurring species include other overfished groundfish stocks whose rebuilding plans are not implemented through this amendment and stocks that are not overfished. Certain overfished species act as constraining stocks in that the level of harvest needed to rebuild them is so low that harvest limits for co-occurring species cannot be reached. Direct and indirect impacts of the alternatives can be compared by considering each of the four overfished species' rebuilding plans separately. Alternatives that require lower harvest limits for the species in question would also limit harvest of co-occurring species, thereby resulting in less environmental impact while higher harvest limits would result in greater environmental impacts. Because of the constraining effect of rebuilding measures for a given overfished species, combined and cumulative effects also have to be considered. An evaluation of these effects considers the interaction between rebuilding measures for different overfished species. However, the same metric—fishing mortality to co-occurring species—can be used.

The Management Regime

Although not part of the proposed action, management measures will be implemented to ensure total fishing mortality remains at levels necessary to achieve targets incorporated into rebuilding plans. Generally, the range of management measures implemented through the annual/biennial harvest specification process will be used, although new management measures could be identified in the FMP and implemented through future actions. The impacts of the alternatives are evaluated in terms of the types of management measures that may be used. More complicated, controversial and difficult to enforce management measures would impose greater costs in comparison to less complex measures. Impacts to the management regime can also be evaluated in terms of the data needed to both support and evaluate potential management measures. Management measures that are more dependent on precise total catch monitoring will require a higher level of direct observation than is currently in place. Increasing observer coverage would entail more costs.

Commercial Fisheries

Commercial fishery impacts are compared in terms of changes in exvessel revenue. This is evaluated both in terms of the present value of exvessel revenue derived from catches of each overfished species, and in the short term, changes in exvessel revenue from landings of all co-occurring species. These socioeconomic impacts are inversely related to biological impacts. Alternatives that limit harvest more, and thereby reduce landings, also reduce exvessel revenue; while alternatives that allow higher harvest levels result in comparatively higher exvessel revenue.

Recreational Fisheries

Recreational fishery impacts are evaluated qualitatively based on the change in fishing opportunity as measured by the number of fishing trips that might occur under each alternative. These effects are compared for each overfished species in terms of the impact of rebuilding measures on recreational fishing. Because some species are not caught in recreational fisheries, rebuilding measures would have little effect. Other species, such as canary rockfish, are frequently caught, and rebuilding measures would have a greater impact.

Tribal Fisheries

Tribal fishery impacts are qualitatively evaluated based on the degree of change in groundfish landings compared to historical landings. Some treaty fisheries have specific allocations reserved to them and rebuilding measures could affect the allocations. As with all socioeconomic impacts, alternatives with a lower harvest limit are more likely to affect tribal allocations than those that allow a higher harvest limit.

Buyers, Processors, and Markets

Impacts on buyers and processors correlate closely with changes in landings and associated exvessel revenue. (Exvessel revenue is derived from purchases by this sector.) Alternatives can, thereby, be qualitatively evaluated in a similar fashion. Lower harvest limits would reduce the amount of fish that could be purchased in relation to higher harvest limits. Impacts of the alternatives on markets, such as retail outlets and restaurants, can be qualitatively evaluated in terms of the substitutability of other fish products for those that might become unavailable (or become too expensive) as a result of harvest limits. Some groundfish products might be easily substituted, while others—such as live fish sales—may not be.

Fishing Communities

Fishing community impacts represent the aggregate of the socioeconomic impacts described above. Alternatives can be qualitatively evaluated by comparing the alternatives in terms of changes in personal income resulting from changes in groundfish landings. Given the range of these species and how vessels targeting them are distributed by port, there will be geographic differences in community impacts. This evaluation compares these differences, based on the different harvest limits set for different overfished groundfish species under alternative rebuilding plans.

2.0 REBUILDING PLAN ALTERNATIVES

Rebuilding alternatives for darkblotched rockfish, Pacific ocean perch, canary rockfish, and lingcod within MSA, FMP, and other legal constraints are analyzed in this EIS. The most risk-averse alternative (*Maximum Conservation*), most risk-prone alternatives (*Maximum Harvest* and *Mixed Stock Exception*), and an alternative with intermediate risk (*Council Interim*) are compared with a *No Action* alternative. All rebuilding alternatives consider the best available science for determining risk-neutral bycatch and discard rates[4/]. The best available science for determining discard mortality rates is anticipated to be direct observations of bycatch and discard in West Coast groundfish fisheries. However, until these data are available to account for all sources of fishing-related mortality, the best available science for estimating trawl bycatch is considered to be a bycatch/discard model developed by the Northwest Fisheries Science Center of the National Marine Fisheries Service (Hastie 2001). Assumed bycatch rates of the overfished groundfish species addressed in this EIS in trawl fisheries targeting other species are estimated from logbooks and Enhanced Data Collection Program (EDCP) data (Hastie 2001). Rebuilding parameter estimates and probabilities for all alternatives (Table 2.0-1) are derived in the most recent stock assessments and rebuilding analyses, which are appended attachments to this EIS. The median year when spawning biomass is projected to reach B_{MSY} (T_{TARGET}) under each alternative is noted in Table 2.0-1. The choice of T_{TARGET} is constrained to fall between T_{MIN} and T_{MAX}. The probability of the stock attaining B_{MSY} in the maximum allowable time (T_{MAX}) is denoted as P_{MAX}. These estimated rebuilding parameters under each alternative are summarized in Table 2.0-1. Relative risk and probability of rebuilding alternatives meeting rebuilding objectives is sensitive to our current state of knowledge and the harvest control rule (i.e., harvest rate) adopted as a rebuilding target and strategy. The harvest control rule varies between rebuilding alternatives analyzed in this rebuilding plan, the best available science in forming decisions and our current state of knowledge does not.

Incorporating habitat-protective measures such as marine protected areas or marine reserves in the alternatives analyzed in this EIS was recommended by some during scoping for this EIS. Although protecting critical habitats from the potential negative impacts of fishing may be an effective means to rebuild these species, such measures were considered beyond the scope of this EIS which seeks to analyze the effects of alternative harvest levels on the affected West Coast physical, biological, and socioeconomic environments. However, area closures are considered in this EIS. Currently depth-based closures are in place to move the fishery off areas where these species primarily reside to reduce the total mortality of adult fish. Additionally, the Council and NMFS are developing a policy for habitat-based management that may result in modification to existing closures or other management measures intended to protect habitat deemed important to groundfish production. At issue in the development of this policy is the integration of habitat-based management with the harvest control management strategies that have historically been the foundation for Council actions. Alternative policies are being analyzed in a Programmatic EIS (contact Mr. Jim Glock, NMFS, 503-231-2178). The policies adopted through the Programmatic EIS will be implemented through subsequent decisions, such as implementation of the essential fish habitat (EFH) provisions of the Magnuson-Stevens Act or the annual/biennial management process, and may be utilized to achieve the mortality goals for these species established in the rebuilding plans analyzed in this EIS. Implementation of the EFH provisions is underway through another EIS that tiers off the Programmatic EIS. Publication of the draft action-specific EFH EIS is anticipated for August 2003 (contact Mr. Steve Copps, NMFS, 206-526-6187).

Other management measures are also addressed in Chapters 3 and 4 of this EIS, but are not structured in the alternatives analyzed. Such measures include trip, landing, and bag limits, seasonal fishery closures, gear restrictions, and capacity reduction mechanisms. While all of these strategies may aid the rebuilding of overfished groundfish species, they are ancillary to the analysis of the effect of managing the total mortality of these species to alternative levels. Catch monitoring in West Coast groundfish fisheries has been uncertain at best (see Section 3.3), but is improving with the advent of the NMFS Groundfish Observer Program and the overhauling of the Marine Recreational Fisheries Statistical Survey. These nascent monitoring systems have not been in place long enough to use as a "litmus test" of the efficacy of management measures to control total mortality of groundfish species. Therefore, it is anticipated that effective management measures

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4/ In this rebuilding plan bycatch rate is defined as the rate of co-occurrence of non-targeted species during fishing, while discard rate refers to the rate of those non-targeted species caught and thrown overboard prior to landing. The discard mortality rate of rockfish species subject to rebuilding plans analyzed in this EIS is assumed to be 100%. Differentiation of bycatch and discard in this rebuilding plan is noted, since the MSA defines bycatch as discard in marine fisheries.

will be adopted in annual or biennial notice and comment rulemaking. Such measures will be analyzed using the best available science. This EIS simply analyzes the alternative harvest levels consistently with the frameworking provisions analyzed in FMP Amendment 16 (see the Environmental Assessment of Amendment 16-1, Process and Standards For Rebuilding Plans). Once rebuilding plans are adopted for overfished groundfish species, it is expected that management measures adopted in subsequent rulemaking will effectively limit harvest to the total mortality levels specified in the rebuilding plans.

TABLE 2.0-1. Strategic rebuilding parameters associated with darkblotched rockfish, Pacific ocean perch, canary rockfish, and lingcod rebuilding alternatives. (Page 1 of 1)

Strategic Rebuilding Parameters	Rebuilding Alternatives						
	No Action	***Maximum Conservation***	***Maximum Harvest***	***Council Interim***	***Mixed Stock Exception***	***Other Intermediate Alternatives Considered***	
				Darkblotched Rockfish			
P_{MAX}	74%	approaches 100%	50%	80%	NA	60%	70%
T_{TARGET}	2029	2014	2047	2030	NA	2040	2034
F rate	Variable	0.000	0.033	0.027	NA	0.031	0.029
				Pacific Ocean Perch			
P_{MAX}	< 1%	100%	50%	70%	NA	60%	80%
T_{TARGET}	2XXX [a/]	2012	2042	2027	NA	2034	2022
F rate	Variable	0.0000	0.0109	0.0082	NA	0.0096	0.0068
				Canary Rockfish			
P_{MAX}	19%	approaches 100%	50%	60%	0%	70%	80%
T_{TARGET}	2094	2057	2076	2074	NA	2071	2068
F rate	Variable	0.0000	0.0242	0.0220	0.1178	0.0193	0.0161
				Lingcod			
P_{MAX}	55% N, 68% S	100%	50%	60%	NA	70%	80%
T_{TARGET}	2009	2007	2009	2009	NA	2009	2008
F rate	Variable	0.0000 N & S	0.0607 N 0.0667 S	0.0531 N 0.0610 S	NA	0.0510 N 0.0533 S	0.0474 N 0.0472 S

a/ Doesn't rebuild with at least a 50% probability within the 125 year simulation period.

2.1 The *No Action* Alternative

The choice of the *No Action* alternative for the four overfished groundfish species subject to rebuilding plans analyzed in this EIS was considered in terms of providing the most informative analysis of the consequences and tradeoffs of rebuilding these stocks and what rebuilding strategies are formalized in the FMP. Absent rebuilding plans in the FMP, the precautionary management strategy to rebuild stocks to B_{MSY} (for the stocks analyzed in this EIS, the B_{MSY} proxy is 40% of initial, unfished biomass or $B_{40\%}$) in the FMP is to decrease the optimum yield (OY or target harvest level) from the ABC (acceptable biological catch) using the "40-10" adjustment. The "40-10" adjustment is a scaled decrease in the OY from the ABC as the spawning stock biomass varies downward from $B_{40\%}$, until at $B_{10\%}$, the OY is set to 0 (Figure 2.1-1). Conversely, when the stock is rebuilt, or at $B_{40\%}$, the OY would be set equal to the ABC. The harvest control rule is, therefore, a variable harvest rate based on the stock's biomass relative to its initial, unfished biomass. Since this is the only rebuilding strategy currently in the FMP, and Amendment 16 to the FMP is intended to incorporate a rebuilding framework and individual species' rebuilding plans into the FMP, the *No Action* alternative is structured using the "40-10" adjustment.

However, the *No Action* alternative could be construed as the actions the Council has taken in the absence of an approved rebuilding plan (or *status quo*) when setting annual harvest specifications and management measures. Under this construction of the *No Action* alternative, continued application of the rebuilding targets included in the *Council Interim* alternative, but without adoption of an approved rebuilding plan, could be considered to represent *status quo*. However, under this *status quo* there would be no obligation to continue managing to these targets, so rebuilding measures could differ in unknown ways in the future. But for the purposes of analysis it is assumed that in the short-term the effects of this *status quo* and the *Council Interim* alternative would not differ. Since the impacts of the *Council Interim* alternative are analyzed in this EIS, both interpretations of *No Action* are analyzed and compared to other possible rebuilding alternatives, even though a *status quo* alternative is not separately identified.

2.1.1 Darkblotched Rockfish

Under the *No Action* alternative, darkblotched rockfish would be managed using a harvest level based on the "40-10" adjustment of the ABC to calculate a total catch OY. The probability of achieving B_{MSY} for darkblotched by T_{MAX} is 74%. The median year of reaching B_{MSY} is projected to be 2029.

2.1.2 Pacific Ocean Perch

Under the *No Action* alternative POP would be managed using the "40-10" adjustment of the ABC to calculate a total catch OY. The probability of the POP stock achieving B_{MSY} by T_{MAX} is <1% (about 0.3%). Pacific ocean perch rebuilding simulations under the "40-10" harvest control rule predict the stock will not reach B_{MSY} with at least a 50% probability within the 125 year simulation period. This is well beyond the predicted T_{MAX} of 2042 for POP.

2.1.3 Canary Rockfish

Under the *No Action* alternative canary rockfish would be managed using the "40-10" harvest control rule to calculate a total catch OY. The probability of achieving B_{MSY} by T_{MAX} is 19%. The median year of the coastwide canary stock reaching B_{MSY} is projected to be 2094 under the *No Action* alternative, which is beyond the predicted T_{MAX} for the stock.

2.1.4 Lingcod

Under the *No Action* alternative lingcod would be managed using the "40-10" adjustment of the ABC to calculate a total catch OY. The probability of the lingcod stock attaining B_{MSY} by T_{MAX} is 55% for the northern portion of the stock in the Columbia and U.S./Vancouver INPFC areas and 68% for the southern portion of the stock in the Conception, Monterey, and Eureka INPFC areas. The median year predicted for lingcod attaining B_{MSY} under the *No Action* alternative is 2009.

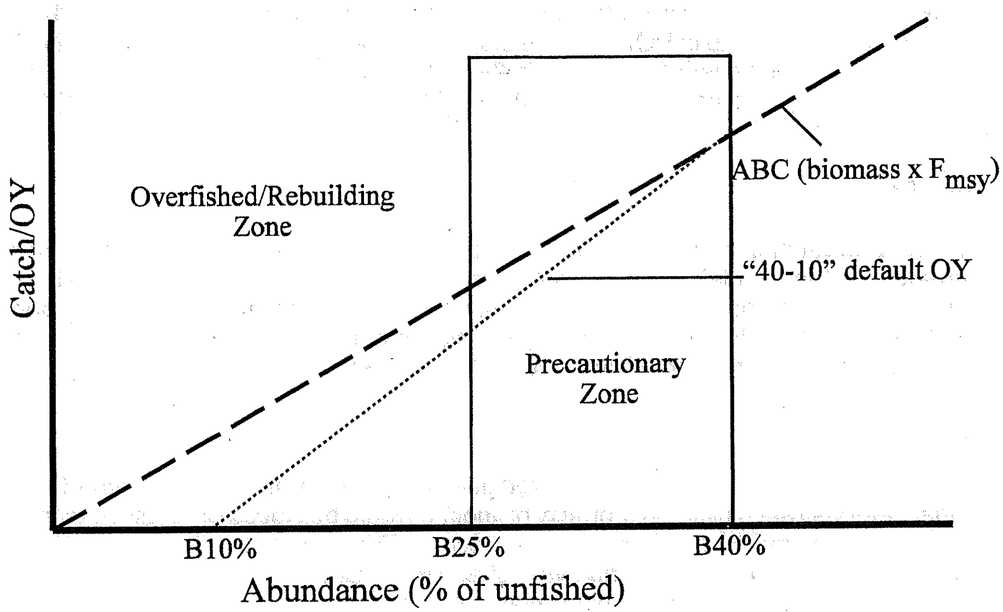

FIGURE 2.1-1. Relationship of the ABC (acceptable biological catch) of groundfish and the biomass-based reduction of the OY (optimum yield) for groundfish species managed under the Pacific Coast Groundfish Fishery Management Plan.

2.2 The *Maximum Conservation* Alternative

Under the *Maximum Conservation* alternative rebuilding would occur in the shortest time possible by setting the fishing mortality rate to zero (F = 0) for all fisheries in the EEZ that take these four species. The tradeoff is the greatest adverse socioeconomic impact occurs to fisheries and fishing-dependent communities on the West Coast during the course of rebuilding. The target rebuilding period (T_{TARGET}) would be the minimum rebuilding time to achieve B_{MSY} (T_{MIN}). Potential habitat impacts would be minimized by eliminating fishing effort. A subsequent decision-making process to implement the EFH provisions of the MSA would be utilized to determine if additional habitat-based management measures were necessary to enhance productivity of the stock. The *Maximum Conservation* alternative has a probability of rebuilding within T_{MAX} approaching 100%. This is considered the environmentally-preferred alternative in this EIS since it rebuilds the stock the fastest and has the least potential impact on habitat of all the alternatives analyzed.

2.2.1 Darkblotched Rockfish

Bottom trawl fisheries (and any other fisheries that demonstrate a bycatch of darkblotched rockfish) operating on the shelf and slope would be closed or modified to the point where targeted and incidental catch of darkblotched rockfish did not occur under the *Maximum Conservation* alternative. While darkblotched rockfish is a slope species, juveniles are found in shallower depths on the shelf. Therefore, the *Maximum Conservation* alternative would analyze restrictions on fisheries with a potential take of juvenile darkblotched. The analysis of this alternative assumes restrictions on trawl and fixed gear line fisheries operating in the West Coast EEZ in depths 50 fm to 250 fm. T_{TARGET} is estimated to be 2014. There would be no bycatch of darkblotched rockfish since there is no fishing-related mortality.

2.2.2 Pacific Ocean Perch

Bottom trawl fisheries (and any other fisheries that demonstrate a bycatch of POP) operating on the shelf and slope would be closed or modified to the point where targeted and incidental catch of POP did not occur. While POP is primarily a slope species, adults are found on the edge of the shelf in the summer, and juveniles are found in shallower depths on the shelf. Therefore, the *Maximum Conservation* alternative would analyze restrictions on fisheries with a potential take of POP at all life stages. The analysis of this alternative assumes restrictions on trawl and fixed gear line fisheries operating in the West Coast EEZ in depths 50 fm to 250 fm. The target rebuilding period (T_{TARGET}) is estimated to be 2012. There would be no bycatch of POP since there is no fishing-related mortality.

2.2.3 Canary Rockfish

Fisheries that demonstrate a bycatch of canary rockfish operating on the shelf would be closed or modified to the point where targeted and incidental catch of canary rockfish did not occur. The analysis of this alternative assumes restrictions on commercial trawl, fixed gear, tribal, and recreational fisheries operating in the West Coast EEZ in depths 50 fm to 150 fm. The target rebuilding period (T_{TARGET}) is estimated to be 2057. There would be no bycatch of canary rockfish since there is no fishing-related mortality.

2.2.4 Lingcod

All fisheries operating on the shelf (bottom trawl fisheries, fixed gear, recreational fisheries, and tribal fisheries) under Council control that demonstrate a bycatch mortality of lingcod would be closed or modified to the point where targeted and incidental catch mortality of lingcod did not occur. The target rebuilding period (T_{TARGET}) would be the minimum rebuilding time with the median year of achieving B_{MSY} estimated to be 2007. There would be no bycatch of lingcod since there is no fishing-related mortality.

2.3 The *Maximum Harvest* Alternative

Under the *Maximum Harvest* alternative rebuilding would occur in the maximum allowable time (T_{MAX}), thereby allowing the maximum allowable harvest under rebuilding. A minimal impact would be expected on existing fisheries and dependent fishing communities, but at a cost of the slowest legal rebuilding schedule allowed by the FMP, MSA, and the National Standards Guidelines (NSGs). The target rebuilding period (T_{TARGET}) would be T_{MAX}. The *Maximum Harvest* alternative has a 50% probability of rebuilding by T_{MAX}.

2.3.1 Darkblotched Rockfish

T_{TARGET} for darkblotched rockfish under the *Maximum Harvest* alternative is projected to be 2047. The total catch OY would be calculated using a fishing mortality rate of 0.033. There is a 50% probability of the stock rebuilding within T_{MAX} under this alternative.

2.3.2 Pacific Ocean Perch

T_{TARGET} for POP under the *Maximum Harvest* alternative is projected to be 2042. The total catch OY would be calculated using a fishing mortality rate of 0.0109. There is a 50% probability of the stock rebuilding within T_{MAX} under this alternative.

2.3.3 Canary Rockfish

T_{TARGET} for canary rockfish under the *Maximum Harvest* alternative is projected to be 2076. The total catch OY would be calculated using a fishing mortality rate of 0.022. There is a 50% probability of the stock rebuilding within T_{MAX} under this alternative.

2.3.4 Lingcod

T_{TARGET} for lingcod under the *Maximum Harvest* alternative is projected to be 2009. The total catch OY would be calculated using a fishing mortality rate of 0.0607 in the north (Columbia and U.S./Vancouver INPFC areas) and 0.0667 in the south (Conception and Monterey INPFC areas). There is a 50% probability of the stock rebuilding within T_{MAX} under this alternative.

2.4 The *Council Interim* Alternative

The *Council Interim* alternative specifies the rebuilding measures for these four species in accordance with the most recent management measures and specifications adopted by the Council. While these interim rebuilding measures do not represent a Council-preferred alternative at this point, they do comport with Council decisions based on rebuilding analyses, advice from Council advisory bodies and the public, and other considerations for managing the total mortality of overfished groundfish species. The *Council Interim* alternative for the four stocks subject to rebuilding plans analyzed in this EIS have a range of probabilities of rebuilding by T_{MAX} of 60% to 80%. This is considered an intermediate alternative in the context of this EIS.

2.4.1 Darkblotched Rockfish

Under the *Council Interim* alternative there would be an 80% probability of rebuilding darkblotched within T_{MAX}. This alternative was the one the Council selected in September 2002 when setting the 2003 groundfish annual harvest specifications and management measures as its preferred alternative for rebuilding darkblotched rockfish. The target rebuilding year (T_{TARGET}) would be 2030 under this alternative. The total catch OY would be calculated using a fishing mortality rate of 0.027. Depth-based restrictions, such as adopted for 2003 management, are measures anticipated to be needed to manage darkblotched rockfish under harvest levels associated with the *Council Interim* alternative.

2.4.2 Pacific Ocean Perch

Under the *Council Interim Rebuilding* alternative there would be a 70% probability of rebuilding POP within T_{MAX}. This alternative was the one the Council selected in 2001 as its preferred alternative for rebuilding POP. The target rebuilding time (T_{TARGET}) would be 27 years with the median year of reaching B_{MSY} projected to be 2027. The total catch OY would be calculated using a fishing mortality rate of 0.0082. Depth-based restrictions, such as adopted for 2003 management, are measures anticipated to be needed to manage POP under harvest levels associated with the *Council Interim* alternative.

2.4.3 Canary Rockfish

Under the *Council Interim* alternative there would be a 60% probability of rebuilding canary rockfish within T_{MAX}. The target rebuilding year (T_{TARGET}) would be 2074 under this alternative. The total catch OY would be calculated using a fishing mortality rate of 0.022. Depth-based restrictions and mandatory use of small footropes in bottom trawls operating in primary canary rockfish habitats, such as adopted for 2003 management, are measures anticipated to be needed to manage canary rockfish under harvest levels associated with the *Council Interim* alternative. Analysis of this alternative assumes a 50:50 commercial and recreational catch sharing, although there is no formal allocation of canary rockfish.

2.4.4 Lingcod

Under the *Council Interim* alternative there would be a 60% probability of rebuilding lingcod within T_{MAX}. This alternative was the one the Council selected in 1999 as its preferred alternative for rebuilding lingcod. Under this alternative $T_{TARGET} = T_{MAX}$ which is 2009. The total catch OY would be calculated using a fishing mortality rate of 0.0531 in the north and 0.061 in the south. Depth-based restrictions and a winter season fishery closure to protect nest-guarding males, such as adopted for 2003 management, are measures anticipated to be needed to manage lingcod under harvest levels associated with the *Council Interim* alternative.

2.5 The *Mixed Stock Exception* Alternative

The Mixed Stock Exception is a provision in NSG 1 allowing an increased OY above the overfishing level as long as the harvest meets certain standards. Harvesting one species of a mixed-stock complex at its optimum level may result in the overfishing of another stock component in the complex. The Council may decide to permit this type of overfishing only if all of the following conditions are satisfied:

(a) The Council demonstrates by analysis that such action will result in long-term net benefits to the Nation.
(b) The Council demonstrates by analysis that mitigating measures have been considered and that a similar level of long-term net benefits cannot be achieved by modifying fleet behavior, gear selection/ configuration, or other technical characteristic in a manner such that no overfishing would occur.
(c) The resulting rate or level of fishing mortality will not cause any species or evolutionarily significant unit thereof to require protection under the Endangered Species Act.

The *Mixed Stock Exception* would only be contemplated for stocks that constrain fisheries across a wide geographic range. Although all overfished groundfish species require management measures designed to control mortality sufficiently to rebuild the stock within the NSGs, not all act as constraining stocks. Management measures for a constraining stock can limit fisheries that would otherwise catch healthy stocks at higher levels in order to limit the total fishing-related mortality of the constraining stock; thus, constraining stocks constrain fisheries before rebuilding measures for other overfished species would do so. Of the four stocks analyzed in this EIS, only darkblotched and canary rockfish are constraining stocks in one or more fishery sectors. Constraints imposed by the need to rebuild POP are overshadowed by the more conservative rebuilding measures considered for darkblotched rockfish while lingcod rebuilding is eclipsed by the more constraining rebuilding measures considered for the overfished shelf rockfish species such as canary rockfish.

The *Mixed Stock Exception* alternative described in this preliminary draft EIS is the level of harvest predicted to keep the spawning stock biomass at its current equilibrium for the next 100 years. If, at its June 2003 meeting, the Council chooses the *Mixed Stock Exception* alternative for any of these overfished groundfish species, they may also elect to specify a different harvest level than modeled in this preliminary draft EIS. A different harvest level could constitute a new alternative that would have to be described and analyzed in the draft DEIS that is released for the statutorily required 45-day public comment period (see Section 1.1). Any substantial change in the proposed action that occurs after the release of the DEIS that could raise environmental concerns requires recirculation of a supplemented statement (40 CFR 1509(c)). Thus, any required analyses would need to be completed before the DEIS could be released. However, the *Mixed Stock Exception* alternative evaluated in this preliminary draft EIS allows the highest harvest level allowed by the MSA, as interpreted in NSG 1.[5/] Thus, any other alternative chosen by the Council that would employ the *Mixed Stock Exception* would result in impacts within the range that are already analyzed in this preliminary draft.

2.5.1 Darkblotched Rockfish

A *Mixed Stock Exception* alternative was initially considered for darkblotched rockfish. Since the West Coast darkblotched rockfish stock is the most binding constraint to slope trawl fisheries north of Pt. Reyes, California at 38° N latitude, darkblotched may be considered to meet the standards of the Mixed Stock Exception provision. However, at its June 2002 meeting, the Council explicitly rejected a *Mixed Stock Exception* alternative for final analysis in this rebuilding plan.

2.5.2 Pacific Ocean Perch

Since the West Coast POP stock does not constrain fisheries to the extent that darkblotched rockfish constrain slope fisheries and canary and yelloweye rockfish constrain fisheries on the edge of the shelf, POP are not considered to meet the standards of the Mixed Stock Exception provision.

2.5.3 Canary Rockfish

Since the West Coast canary rockfish stock is the most binding constraint to most shelf fisheries north of Cape Mendocino, California at 40°10' N latitude, canary rockfish may be considered to meet the standards of the Mixed Stock Exception provision. While the Council has the authority to recommend a harvest level under a Mixed Stock Exception, this DEIS assumes a level of harvest estimated to maintain the current spawning stock biomass at equilibrium for the next 100 years. In this case, spawning stock biomass is not

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5/ In addition, even under the *Mixed Stock Exception* harvest levels that would allow the stock to decline to a size that would require an ESA listing are impermissible.

projected to decline or increase in that time. Canary rockfish would be managed with a fixed 0.1178 harvest rate for an annual OY of 217.3 mt under this alternative.

2.5.4 Lingcod

Since the West Coast lingcod stock is not the most binding constraint to shelf fisheries in the north or the south, lingcod are not considered to meet the standards of the Mixed Stock Exception provision.

2.6 Other Alternatives That May Be Considered

While the above alternatives indicate various probabilities of rebuilding within T_{MAX}, the Council is free to choose any alternative with a rebuilding probability of at least 50%. The 50% P_{MAX} alternative is formally structured in the *Maximum Harvest* alternative. Likewise, the most aggressive rebuilding strategy with the highest possible P_{MAX} (100% or approaching 100%) is formally structured in the *Maximum Conservation* alternative. The *Council Interim* alternative for the four species analyzed in this EIS represent rebuilding probabilities intermediate to *Maximum Harvest* and *Maximum Conservation*. Given that rebuilding analyses provide results for a range of rebuilding probabilities with $P_{MAX} \geq 50\%$, intermediate alternatives other than *Council Interim* are analyzed to provide decision-makers the ability to better understand the tradeoffs in determining rebuilding strategies for overfished groundfish. Therefore, this section specifies the intermediate rebuilding alternatives for these four species other than specified in the *Council Interim* alternative. All intermediate alternatives, including *Council Interim*, considered in this EIS have rebuilding probabilities of 60%, 70%, or 80%. Most of the summary tables in Chapters 2 and 4 of this EIS display results under these intermediate alternatives. However, the suite of intermediate alternatives under this section will not be analyzed for their expected socioeconomic consequences. Such consequences can be inferred from results of the socioeconomic analyses of the *Maximum Conservation*, *Maximum Harvest*, and *Council Interim* alternatives.

2.6.1 Darkblotched Rockfish

Given that the *Council Interim* alternative for darkblotched rockfish specifies a rebuilding probability of 80%, the other considered intermediate alternatives have rebuilding probabilities of 60% and 70%.

2.6.2 Pacific Ocean Perch

Given that the *Council Interim* alternative for POP specifies a rebuilding probability of 70%, the other considered intermediate alternatives have rebuilding probabilities of 60% and 80%.

2.6.3 Canary Rockfish

Given that the *Council Interim* alternative for canary rockfish specifies a rebuilding probability of 60%, the other considered intermediate alternatives have rebuilding probabilities of 70% and 80%.

2.6.4 Lingcod

Given that the *Council Interim* alternative for lingcod specifies a rebuilding probability of 60%, the other considered intermediate alternatives have rebuilding probabilities of 70% and 80%.

2.7 Alternatives Considered, But Rejected

Any alternatives with less than a 50% probability of rebuilding to B_{MSY} within T_{MAX} are not compliant with the MSA as interpreted in a 2000 federal court ruling (*Natural Resources Defense Council v. Daley, April 25, 2000, U.S. Court of Appeals for the District of Columbia Circuit*). Such alternatives are not analyzed in this rebuilding plan.

The *Mixed Stock Exception* alternative for darkblotched rockfish was considered, but rejected (see Section 2.5.1). The *Mixed Stock Exception* alternative was not considered for POP and lingcod since they are not the binding constraint in fisheries that target or incidentally catch these stocks (see Sections 2.5.2 and 2.5.4).

3.0 AFFECTED ENVIRONMENT

3.1 Habitat and Ecosystem

3.1.1 Essential Fish Habitat

The 1996 Sustainable Fisheries Act re-authorizing and amending the Magnuson-Stevens Act obligates the Councils and NMFS to identify and characterize essential fish habitat (EFH), which for West Coast groundfish is defined as the aquatic habitat necessary to allow for groundfish production to support long-term sustainable fisheries for groundfish and for groundfish contributions to a healthy ecosystem. To satisfy this description EFH must be described for all life history stages of managed species. EFH descriptions have been incorporated into the Groundfish FMP in both section 11.10 and in a detailed appendix (available online at: http://www.nwr.noaa.gov/1sustfsh/efhappendix/page1.html). West Coast groundfish species managed by the Groundfish FMP (see section 3.2.1) occur throughout the EEZ and occupy diverse habitats at all stages in their life histories. EFH may be large, because a species' pelagic eggs and larvae are widely dispersed for example, or comparatively small as is the case with the adults of many nearshore rockfishes which show strong affinities to a particular location or type of substrate.

This section summarizes the more than 400 EFH areas identified in the Groundfish FMP for all the different life history stages of West Coast groundfish species. This EFH collectively includes all waters from the mean high water line and the upriver extent of saltwater intrusion in river mouths, along the coasts of Washington, Oregon, and California seaward to the boundary of the U.S. EEZ.

The Groundfish FMP groups the various EFH descriptions into seven major habitat types called "composite" EFHs. This approach focuses on ecological relationships among species and between the species and their habitat, reflecting an ecosystem approach in defining EFH. The seven composite EFH identifications are as follows:

1. Estuarine - Those waters, substrates, and associated biological communities within bays and estuaries of the EEZ, from mean higher high water level (MHHW, which is the high tide line) or extent of upriver saltwater intrusion to the respective outer boundaries for each bay or estuary as defined in 33 CFR 80.1 (Coast Guard lines of demarcation).

2. Rocky Shelf - Those waters, substrates, and associated biological communities living on or within ten meters (5.5 fm) overlying rocky areas, including reefs, pinnacles, boulders, and cobble, along the continental shelf, excluding canyons, from the high tide line MHHW to the shelf break (~200 meters or 109 fm).

3. Nonrocky Shelf - Those waters, substrates, and associated biological communities living on or within ten meters (5.5 fm) overlying the substrates of the continental shelf, excluding the rocky shelf and canyon composites, from the high tide line MHHW to the shelf break (~200 meters or 109 fm).

4. Canyon - Those waters, substrates, and associated biological communities living within submarine canyons, including the walls, beds, sea floor, and any outcrops or landslide morphology, such as slump scarps and debris fields.

5. Continental Slope/Basin - Those waters, substrates, and biological communities living on or within 20 meters (11 fm) overlying the substrates of the continental slope and basin below the shelf break (~200 meters or 109 fm) and extending to the westward boundary of the EEZ.

6. Neritic Zone - Those waters and biological communities living in the water column more than ten meters (5.5 fm) above the continental shelf.

7. Oceanic Zone - Those waters and biological communities living in the water column more than 20 meters (11 fm) above the continental slope and abyssal plain, extending to the westward boundary of the EEZ.

Rebuilding alternatives can be evaluated based on their effect on habitat. As discussed in Section 11.10.3.1 of the Groundfish FMP, fishing gear can damage benthic habitat, which may contribute to the kinds of ecological effects described in the previous section. Altered habitat may favor some species, contributing to a change in community structure, and more broadly, to the population productivity of fish populations caught in fisheries.

3.1.1.1 Darkblotched Rockfish EFH

The distribution of darkblotched rockfish extends from the Bering Sea to Santa Catalina Island, California (Allen and Smith 1988). Based on the location of commercial landings and NMFS triennial survey data, darkblotched rockfish are frequently encountered along the central Pacific Coast (Oregon and Northern California). They can be found at depths ranging from 29-549 m (Rogers *et al.* 2000), usually deeper than 76 m, and are classified as a middle shelf-mesobenthal species.

Darkblotched rockfish move into deeper water as they increase in size and age. Older larvae and pelagic juveniles are found closer to the surface than many other rockfish species (Love *et al.* 2002). Off Oregon, benthic juveniles are taken at depths of 55 m to 200 m. Adults have been found in water as shallow as 29 m, but are most abundant in the deeper portion of their range. In 1999, NMFS triennial survey data indicated 91% of the estimated darkblotched rockfish biomass was found at depths between 180 m and 360 m, with the remaining 9% found between 360 m and 540 m (Rogers *et al.* 2000).

Darkblotched rockfish are associated with mud and rock habitats throughout their range (Eschmeyer *et al.* 1983). However, Rogers *et al.* (2000) disputes a darkblotched association with soft slope substrates and cited submersible observations (W. Wakefield, NMFS, pers. comm.). The greatest numbers of darkblotched larvae and pelagic juveniles are found 83 km to 93 km offshore; juvenile darkblotched can be taken as far offshore as 194 km. Off Central California, young darkblotched rockfish recruit to soft substrate and low relief habitats. Demersal juveniles are often found perched on the highest structure in the benthic habitat (Love *et al.* 2002). Adults are typically observed resting on mud, near cobble and boulders, and do not often rise above the bottom (Love *et al.* 2002). In Soquel Canyon, California, adults were most frequently associated with mud boulder, mud rock, rock mud, and mud cobble habitats (Yoklavich *et al.* 1999). Darkblotched rockfish make limited migrations once they recruit to the adult stock.

3.1.1.2 Pacific Ocean Perch EFH

Pacific ocean perch are distributed from Japan and the Bering Sea to La Jolla, California, although they are uncommon south of Oregon (Eschmeyer *et al.* 1983). The species is most abundant on the northern end of their range in northern British Columbia, Gulf of Alaska, and the Aleutian Islands (NMFS (National Marine Fisheries Service) *et al.* 1998). They are abundant offshore in depths of 55 m to 825 m with adults primarily found along the upper continental slope and shelf edge in depths of 100 m to 450 m. They are classified as an outer shelf-mesobenthal species (Allen and Smith 1988).

Larvae and juveniles are pelagic. Larvae are released at dusk, 20-30 m off the bottom in depths of 360 m to 400 m, and rise to midwater depths of 215 m to 275 m. Early POP studies suggest that after release, larvae immediately move to surface waters. However, recent research off British Columbia indicates that larvae remain at depth for extended periods and gradually move to shallower waters over several months (Leaman 2002). Juvenile POP are found in the shallow and intermediate portion of their bathymetric range until age ten. They tend to aggregate over rough or rocky bottoms.

Subadults and adults are benthopelagic (reside near the bottom and up in the water column). Adults are generally associated with gravel, rocky, or boulder substrates found in and along gullies, canyons, and submarine depressions; they may also occur on smooth substrates. Adults primarily inhabit waters 180 m to 220 m in depth during summer months, but migrate to deeper waters (>275 m) in the fall and winter months to spawn and give birth. Research off British Columbia suggests that POP prefer a temperature range of 4° C to 7°C (Scott 1995).

3.1.1.3 Canary Rockfish EFH

Canary rockfish are found between Cape Colnett, Baja, California, and southeastern Alaska (Boehlert 1980; Boehlert and Kappenman 1980; Hart 1988; Love 1991; Miller and Lea 1972; Richardson and Laroche 1979).

They are considered a middle shelf-mesobenthal species. There is a major population concentration of between latitude 44°30' N latitude and 45° N latitude off Oregon (Richardson and Laroche 1979). Canary rockfish have a depth range from the surface to 274 m, but primarily inhabit waters 91 m to 183 m (50 fm to 100 fm) deep (Boehlert and Kappenman 1980) (Table 3.1-1). Canary rockfish are densely aggregating, and are most abundant above hard bottoms. They are often seen hovering above sand or small rock piles.

In general, canary rockfish inhabit shallow water when they are young, and deep water as adults (Mason 1995). Adult canary rockfish are associated with pinnacles and sharp drop-offs (Love 1991) and are most abundant above hard bottoms (Boehlert 1980). Canary rockfish appear to be a reef-associated species in the southern part of its range (Boehlert and Kappenman 1980). In Central California, newly settled canary rockfish are first observed at the seaward sand-rock interface and farther seaward in deeper water (18 m to 24 m). Larvae can be captured over a wide area, from 13 km to 306 km offshore in neritic and oceanic habitats. Pelagic juveniles occur mostly beyond the continental shelf. Young-of-the-year can also be found in tide pools. Juveniles descend into deeper water as they mature. Adults continue to move deeper with age and also are capable of major latitudinal movements.

No information is available on habitat needs during the mating stage. Parturition occurs from November through March, probably within adult habitat.

3.1.1.4 Lingcod EFH

Lingcod occur from Kodiak Island, Gulf of Alaska to Baja, California with the highest densities from Point Conception, California to Cape Spenser, Alaska. They are classified as an estuarine-mesobenthal species (Allen and Smith 1988).

Young lingcod larvae are demersal. Older larvae and young juveniles are epipelagic and primarily found in the upper 3 m of the water column. Off California, young juveniles are pelagic and occur in the upper 35 m of the water column. Juveniles move to deeper water as they grow, but are still most common in waters less than 150 m. Adults are demersal along the continental shelf and most abundant in waters less than 200 m in depth. The catch of lingcod is generally highest in 70 m to 150 m of water from Vancouver Island, British Columbia to the Columbia River estuary. Survey data indicates that male lingcod tend to be more abundant in shallower waters than females (Jagielo *et al.* 2000).

In general, lingcod are patchily distributed among areas of hard bottom and rocky relief. Larvae are typically found in nearshore waters. Small juveniles can be found on sandy substrate in estuaries and subtidal zones all along the coast, but are more common in the northern extent of their range. Large juveniles settle to the ocean floor on sand, often near eelgrass or kelp beds. Adults prefer slopes of submerged banks with seaweed, kelp, and eelgrass beds 10 m to 70 m below the surface and channels with swift currents flowing around rocky reefs. Adults are strongly residential, tending to remain near the reefs and rocky areas where they live (Adams and Starr 2001).

Spawning lingcod are generally associated with nearshore, rocky reef habitat. During spawning, male and female lingcod gather along rocky reefs affected by strong wave action or tidal currents (Vincent-Lang 1994). Egg masses are usually found in rock crevices or under over hanging boulders and have been found to depths of 97 m (Karpov *et al.* 1995). As current flow is necessary for gas exchange, eggs are usually laid in areas with currents 3.5 km/h or greater. Male lingcod guard egg masses from predators during incubation, removal of the male results in a high incidence of egg loss (Karpov *et al.* 1995). Spawning adults and eggs are common in Puget Sound, Hood Canal, and Skagit Bay, Washington and in Humboldt Bay, California.

3.1.2 West Coast Marine Ecosystems

Ecosystem and habitat, discussed below, are closely related concepts. Ecosystems embody both the relationships between species, represented by the flow of material and energy through a network of relationships, and the sum total of the species comprising the system within a given physical setting. This overlaps with habitat as the physical and biological attributes to the space occupied by a particular species. The ecosystem concept is reflected in groundfish management through the use of biogeographic zones and species complexes to distinguish the application of management measures. These ecological divisions have both a north south component, with Cape Mendocino representing an important break in the distribution of many groundfish species (particularly rockfish), hence the use of the 40°10' N latitude (or alternatively, 40°30'

N latitude). Point Conception represents another important biogeographic boundary considered when crafting management measures. A second, and perhaps more influential, ecological demarcation depends on distance from shore, or depth. Groundfish are managed based on distinction between nearshore, continental shelf, and continental slope species. Distinct species assemblages characterize these zones; in addition, there are differences between the zones based on possible vertical distribution of species. Finally, particular species may exhibit seasonal migrations, producing some annual variation in the characteristics of these different ecological zones. The nearshore, shelf, and slope ecosystems can be characterized by combinations of the habitat composites described below, the species assemblages particular to these ecosystems, and the trophic relationships between these species. More specific information on trophic relationships may be found in the managed species descriptions in Section 3.2.

Bathymetry and physical topography helps determine habitat, by influencing its physical structure, and also the co-occurrence of species. The U.S. West Coast is characterized by a relatively narrow continental shelf. The 200 m depth contour shows a shelf break closest to the shoreline off Cape Mendocino, Point Sur, and in the Southern California Bight; and widest from Central Oregon north to the Canadian border, as well as off Monterey Bay. Deep submarine canyons pocket the Exclusive Economic Zone (EEZ), with depths greater than 4,000 m south of Cape Mendocino (see Figure 1.1-1).

As on land, climate is another important ecological determinant. However, in the ocean's fluid medium, currents are the predominant expression of this broad environmental influence. Not only do currents influence water temperature, vertical mixing and movement can bring nutrient-rich, deep-bottom water into the photic zone, strongly influencing biological productivity. In the North Pacific Ocean, the large, clockwise-moving North Pacific Gyre circulates cold, subarctic surface water eastward across the North Pacific, splitting at the North American continent into the northward-moving Alaska Current and the southward-moving California Current (Figure 3.1-1). Along the U.S. West Coast, the surface California Current flows southward through the U.S. West Coast EEZ. The California Current is known as an eastern boundary current, meaning it draws ocean water along the eastern edge of an oceanic current gyre. The northward-moving California Undercurrent flows along the continental margin and beneath the California Current. Influenced by the California Current system and coastal winds, waters off the U.S. West Coast are subject to major nutrient upwelling, particularly off Cape Mendocino (Bakun 1996). Shoreline topographic features such as Cape Blanco and Point Conception, and bathymetric features such as banks, canyons, and other submerged features, often create large-scale current patterns such as eddies, jets, and squirts. For example, a current jet off Cape Blanco drives surface water offshore, which is replaced by upwelling sub-surface water (Barth *et al.* 2000). One of the better known current eddies off the West Coast occurs in the Southern California Bight between Point Conception and Baja, California (Longhurst 1998), wherein the current circles back on itself by moving in a northward and counterclockwise motion just within the Bight.

While the seasonal environmental effects of the California Current and related lesser current patterns are easily observable (Lynn and Simpson 1987), the influence of longer period cycles has only been appreciated recently. The effect of El Niño-Southern Oscillation (ENSO) events on climate and ocean productivity in the northeast Pacific is relatively well-known. In the past decade a still longer period cycle, termed the Pacific Decadal Oscillation or PDO, has been identified. Although similar in effect, instead of the 1 year to 2 year periodicity of ENSO, PDO events affect ocean conditions for 15 years to 25 years (Mantua in press). The PDO shifts between warm and cool phases. The warm phase is characterized by warmer temperatures in the northeast Pacific (including the West Coast) and cooler-than-average sea surface temperatures and lower-than-average sea level air pressure in the central North Pacific; opposite conditions prevail during cool phases. Because the effects are similar, "in-phase" ENSO events (e.g., an El Niño during a PDO warm phase) can be intensified. However, aside from these phase effects, PDO conditions, although of much longer duration than ENSO events, are milder. It is also important to note that—while the fundamental causes of PDO are not fully understood—they are known to be different from those driving ENSO events; and while ENSO has its primary effect on the tropical Pacific, with secondary effects in colder regions, the opposite is true of PDO; its primary effects occur in the northeast Pacific. The ecosystem effects of PDO conditions are pervasive. Climate conditions directly affect primary production (phytoplankton abundance), but ecosystem linkages ensure these changes influence the abundance of higher trophic level organisms, including fish populations targeted by fishers (Francis *et al.* 1998). Scientists have identified four regime shifts during the twentieth century, with the most recent occurring in 1976/1977, when a warm phase began. This has produced less productive ocean conditions off the West Coast and more favorable conditions around Alaska. For example, Hare *et al.*(1999) document the inverse relationship between salmon production in Alaska and the Pacific Northwest and relate this to PDO-influenced ocean conditions. Researchers have identified similar relationships between meso-scale climate regimes and the productivity of other fish populations, including groundfish (see Francis *et al.* 1998 for a review). Researchers have recently identified a second regime shift, occurring in 1989 (Hare and Mantua 2000), which apparently resulted in a further decline in the productivity of some fish populations in the northeast Pacific, including some groundfish species (McFarlane *et al.* 2000). (Pacific hake and sardine populations, in contrast, showed increases.) Hare and Mantua (2000) hypothesize that a still longer, 50 year to 70 year oscillation may combine with the 15 year to 25 year PDO to produce shifts that vary in their characteristics, as do the 1977 and 1989 phenomena. However, a shift to a more favorable PDO cold phase may have occurred in the late 1990s, as evidenced in recent measurements of sea surface temperature (Bernton 2000).

The influence of ocean conditions, and in particular meso-scale climate regimes that can rapidly shift phases, is an important issue for annual management. As Hare and Mantua (2000) point out, current assessment models do not account for these changes in environmental conditions, which may lead to under- or over-estimation of population productivity. In turn, the range of OY values in the harvest level alternatives are derived from these assessments. Unfortunately, the ability to predict regime shifts and determine the precise correlation between environmental conditions and population productivity, preclude the incorporation of such measurements into assessment models. In contrast, fishers' direct empirical evidence (albeit unquantified) of recent increases in productivity (visible, for example, in the abundance of juvenile bocaccio due to a strong year class) causes some to distrust scientific assessments that lead to further reductions in harvest specifications. (These issues are closely related to the nature of scientific uncertainty in the management process, discussed in section 3.4.4.)

In summary, harvest level alternatives can be evaluated for their effects on several ecosystem-related issues. By specifying the maximum amount of fish that may be removed through fishing, these alternatives affect abundance, which in turn can contribute to changes in trophic relationships (target species as either predators or prey) and community structure (relative abundance of species within an assemblage). As just discussed, climate variation at various time scales (e.g., ENSO, PDO) complicates accurate determination of OY harvests through medium- to long-term shifts in population productivity. These effects are indirect and cumulative, especially since ecosystem effects are more likely to affect population changes that are the result of harvests over several years.

TABLE 3.1-1. Latitudinal and depth distributions of groundfish species (adults) managed under the Pacific Coast Groundfish Fishery Management Plan.[a/] (Page 1 of 2)

Common Name	Scientific Name	Latitudinal Distribution Overall	Latitudinal Distribution Highest Density	Depth Distribution (fm) Overall	Depth Distribution (fm) Highest Density
		Flatfish Species			
Arrowtooth flounder	*Atheresthes stomias*	N. 34° N. lat.	N. 40° N. lat.	10-400	27-270
Butter sole	*Isopsetta isolepis*	N. 34° N. lat.	N. 34° N. lat.	0-200	0-100
Curlfin sole	*Pleuronichthys decurrens*	Coastwide	Coastwide	4-291	4-50
Dover sole	*Microstomus pacificus*	Coastwide	Coastwide	10-500	110-270
English sole	*Parophrys vetulus*	Coastwide	Coastwide	0-300	40-200
Flathead sole	*Hippoglossoides elassodon*	N. 38° N. lat.	N. 40° N. lat.	3-300	100-200
Pacific sanddab	*Citharichthys sordidus*	Coastwide	Coastwide	0-300	0-82
Petrale sole	*Eopsetta jordani*	Coastwide	Coastwide	10-250	160-250
Rex sole	*Glyptocephalus zachirus*	Coastwide	Coastwide	10-350	27-250
Rock sole	*Lepidopsetta bilineata*	Coastwide	N. 32°30' N. lat.	0-200	summer 10-44
Sand sole	*Psettichthys melanostictus*	Coastwide	N. 33°50' N. lat.	0-100	0-44
Starry flounder	*Platichthys stellatus*	Coastwide	N. 34°20' N. lat.	0-150	0-82
		Rockfish Species			
Aurora rockfish	*Sebastes aurora*	Coastwide	Coastwide	80-420	82-270
Bank rockfish	*Sebastes rufus*	S. 39°30' N. lat.	S. 39°30' N. lat.	17-135	115-140
Black rockfish	*Sebastes melanops*	N. 34° N. lat.	N. 34° N. lat.	0-200	0-30
Black-and-yellow rockfish	*Sebastes chrysomelas*	S. 40° N. lat.	S. 40° N. lat.	0-20	0-10
Blackgill rockfish	*Sebastes melanostomus*	Coastwide	S. 40° N. lat.	48-420	125-300
Blue rockfish	*Sebastes mystinus*	Coastwide	Coastwide	0-300	13-21
Bocaccio b/	*Sebastes paucispinis*	Coastwide	S. 40° N. lat.,	15-180	54-82
Bronzespotted Rockfish	*Sebastes gilli*	S. 37° N. lat.	S. 37° N. lat.	41-205	110-160
Brown rockfish	*Sebastes auriculatus*	Coastwide	S. 40° N. lat.	0-70	0-50
Calico rockfish	*Sebastes dallii*	S. 38° N. lat.	S. 33° N. lat.	10-140	33-50
California scorpionfish	*Scorpaena gutatta*	S. 37° N. lat.	S. 34°27' N. lat.	0-100	0-100
Canary rockfish	*Sebastes pinniger*	Coastwide	Coastwide	50-150	50-100
Chameleon rockfish	*Sebastes phillipsi*	37°- 33° N. lat.	37°- 33° N. lat.	95-150	95-150
Chilipepper	*Sebastes goodei*	Coastwide	34°- 40° N. lat.	27-190	27-190
China rockfish	*Sebastes nebulosus*	N. 34° N. lat.	N. 35° N. lat.	0-70	2-50
Copper rockfish	*Sebastes caurinus*	Coastwide	S. 40° N. lat.	0-100	0-100
Cowcod	*Sebastes levis*	S. 40° N. lat.	S. 34°27' N. lat.	22-203	100-130
Darkblotched rockfish	*Sebastes crameri*	N. 33° N. lat.	N. 38° N. lat.	16-300	96-220
Dusky rockfish[c/]	*Sebastes ciliatus*	N. 55° N .lat.	N. 55° N. lat.	0-150	0-150
Dwarf-Red rockfish[d/]	*Sebastes rufinanus*	33° N. lat.	33° N. lat.	>100	>100
Flag rockfish	*Sebastes rubrivinctus*	S. 38° N. lat.	S. 37° N. lat.	17-100	17-100
Freckled rockfish	*Sebastes lentignosus*	S. 33° N. lat.	S. 33° N. lat.	22-92	22-92
Gopher rockfish	*Sebastes carnatus*	S. 40° N. lat.	S. 40° N. lat.	0-30	0-16
Grass rockfish	*Sebastes rastrelliger*	S. 44°40' N. lat.	S. 40° N. lat.	0-25	0-8
Greenblotched rockfish	*Sebastes rosenblatti*	S. 38° N. lat.	S. 38° N. lat.	33-217	115-130
Greenspotted rockfish	*Sebastes chlorostictus*	S. 47° N. lat.	S. 40° N. lat.	27-110	50-100
Greenstriped rockfish	*Sebastes elongatus*	Coastwide	Coastwide	33-220	27-136
Halfbanded rockfish	*Sebastes semicinctus*	S. 36°40' N. lat.	S. 36°40' N. lat.	32-220	32-220
Harlequin rockfish[e/]	*Sebastes variegatus*	N. 40° N. lat.	N. 51° N. lat.	38-167	38-167
Honeycomb rockfish	*Sebastes umbrosus*	S. 36°40' N. lat.	S. 34°27' N. lat.	16-65	16-38
Kelp rockfish	*Sebastes atrovirens*	S. 39° N. lat.	S. 37° N. lat.	0-25	3-4
Longspine thornyhead	*Sebastolobus altivelis*	Coastwide	Coastwide	167->833	320-550
Mexican rockfish	*Sebastes macdonaldi*	S. 36°20' N. lat.	S. 36°20' N. lat.	50-140	50-140
Olive rockfish	*Sebastes serranoides*	S. 41°20' N. lat.	S. 40° N. lat.	0-80	0-16
Pacific ocean perch	*Sebastes alutus*	Coastwide	N. 42° N. lat.	30-350	110-220
Pink rockfish	*Sebastes eos*	S. 37° N. lat.	S. 35° N. lat.	40-200	40-200
Pinkrose rockfish	*Sebastes simulator*	S. 34° N. lat.	S. 34° N. lat.	54-160	108
Puget Sound rockfish	*Sebastes emphaeus*	N. 40° N. lat.	N. 40° N. lat.	6-200	6-200
Pygmy rockfish	*Sebastes wilsoni*	N. 32°30' N. lat.	N. 32°30' N. lat.	17-150	17-150
Quillback rockfish	*Sebastes maliger*	N. 36°20' N. lat.	N. 40° N. lat.	0-150	22-33
Redbanded rockfish	*Sebastes babcocki*	Coastwide	N. 37° N. lat.	50-260	82-245
Redstripe rockfish	*Sebastes proriger*	N. 37° N. lat.	N. 37° N. lat.	7-190	55-190

TABLE 3.1-1. Latitudinal and depth distributions of groundfish species (adults) managed under the Pacific Coast Groundfish Fishery Management Plan.[a/] (Page 2 of 2)

Common Name	Scientific Name	Latitudinal Distribution		Depth Distribution (fm)	
		Overall	Highest Density	Overall	Highest Density
Rosethorn rockfish	*Sebastes helvomaculatus*	Coastwide	N. 38° N. lat.	65-300	55-190
Rosy rockfish	*Sebastes rosaceus*	S. 42° N. lat.	S. 40° N. lat.	8-70	30-58
Rougheye rockfish	*Sebastes aleutianus*	Coastwide	N. 40° N. lat.	27-400	27-250
Semaphore rockfish	*Sebastes melanosema*	S. 34°27' N. lat.	S. 34°27' N. lat.	75-100	75-100
Sharpchin rockfish	*Sebastes zacentrus*	Coastwide	Coastwide	50-175	50-175
Shortbelly rockfish	*Sebastes jordani*	Coastwide	S. 46° N. lat.	50-175	50-155
Shortraker rockfish	*Sebastes borealis*	N. 39°30' N. lat.	N. 44° N. lat.	110-220	110-220
Shortspine thornyhead	*Sebastolobus alascanus*	Coastwide	Coastwide	14->833	55-550
Silvergray rockfish	*Sebastes brevispinis*	Coastwide	N. 40° N. lat.	17-200	55-160
Speckled rockfish	*Sebastes ovalis*	S. 38° N. lat.	S. 37° N. lat.	17-200	41-83
Splitnose rockfish	*Sebastes diploproa*	Coastwide	Coastwide	50-317	55-250
Squarespot rockfish	*Sebastes hopkinsi*	S. 38° N. lat.	S. 36° N. lat.	10-100	10-100
Starry rockfish	*Sebastes constellatus*	S. 38° N. lat.	S. 37° N. lat.	13-150	13-150
Stripetail rockfish	*Sebastes saxicola*	Coastwide	Coastwide	5-230	5-190
Swordspine rockfish	*Sebastes ensifer*	S. 38° N. lat.	S. 38° N. lat.	38-237	38-237
Tiger rockfish	*Sebastes nigrocinctus*	N. 35° N. lat.	N. 35° N. lat.	30-170	35-170
Treefish	*Sebastes serriceps*	S. 38° N. lat.	S. 34°27' N. lat.	0-25	3-16
Vermillion rockfish	*Sebastes miniatus*	Coastwide	Coastwide	0-150	4-130
Widow rockfish	*Sebastes entomelas*	Coastwide	N. 37° N. lat.	13-200	55-160
Yelloweye rockfish	*Sebastes ruberrimus*	Coastwide	N. 36° N. lat.	25-300	27-220
Yellowmouth rockfish	*Sebastes reedi*	N. 40° N. lat.	N. 40° N. lat.	77-200	150-200
Yellowtail rockfish	*Sebastes flavidus*	Coastwide	N. 37° N. lat.	27-300	27-160
Roundfish Species					
Cabezon	*Scorpaenichthys marmoratus*	Coastwide	Coastwide	0-42	0-27
Kelp greenling	*Hexagrammos decagrammus*	Coastwide	N. 40° N. lat.	0-25	0-10
Lingcod	*Ophiodon elongatus*	Coastwide	Coastwide	0-233	0-40
Pacific cod	*Gadus macrocephalus*	N. 34° N. lat.	N. 40° N. lat.	7-300	27-160
Pacific whiting	*Merluccius productus*	Coastwide	Coastwide	20-500	27-270
Sablefish	*Anoplopoma fimbria*	Coastwide	Coastwide	27->1,000	110-550
Shark and Skate Species					
Big skate	*Raja binoculata*	Coastwide	S. 46° N. lat.	2-110	27-110
California skate	*Raja inornata*	Coastwide	S. 39° N. lat.	0-367	0-10
Leopard shark	*Triakis semifasciata*	S. 46° N. lat.	S. 46° N. lat.	0-50	0-2
Longnose skate	*Raja rhina*	Coastwide	N. 46° N. lat.	30-410	30-340
Soupfin shark	*Galeorhinus zyopterus*	Coastwide	Coastwide	0-225	0-225
Spiny dogfish	*Squalus acanthias*	Coastwide	Coastwide	0->640	0-190
Other Species					
Finescale codling	*Antimora microlepis*	Coastwide	N. 38° N. lat.	190-1,588	190-470
Pacific rattail	*Coryphaenoides acrolepis*	Coastwide	N. 38° N. lat.	85-1,350	500-1,350
Ratfish	*Hydrolagus colliei*	Coastwide	Coastwide	0-499	55-82

a/ Data from Casillas *et al.* 1998, Eschmeyer *et al.* 1983, Hart 1973, Miller and Lea 1972, and NMFS survey data. Depth distributions refer to offshore distributions, not vertical distributions in the water column.

b/ Only the southern stock of bocaccio south of 40°10' N latitude is listed as overfished.

c/ Dusky rockfish do not occur on the U.S. West Coast south of 49° N latitude. The species needs to be removed from the FMP.

d/ Dwarf-Red rockfish are a very rare species with only one occurrence listed in the literature (2 specimens from an underwater explosion off San Clemente Island., California in 1970; Eschmeyer *et al.* 1983). The species is not in the FMP.

e/ Only 2 occurrences of harlequin rockfish south of 51° N latitude (off Newport, Oregon and La Push, Washington; Casillas *et al.* 1998).

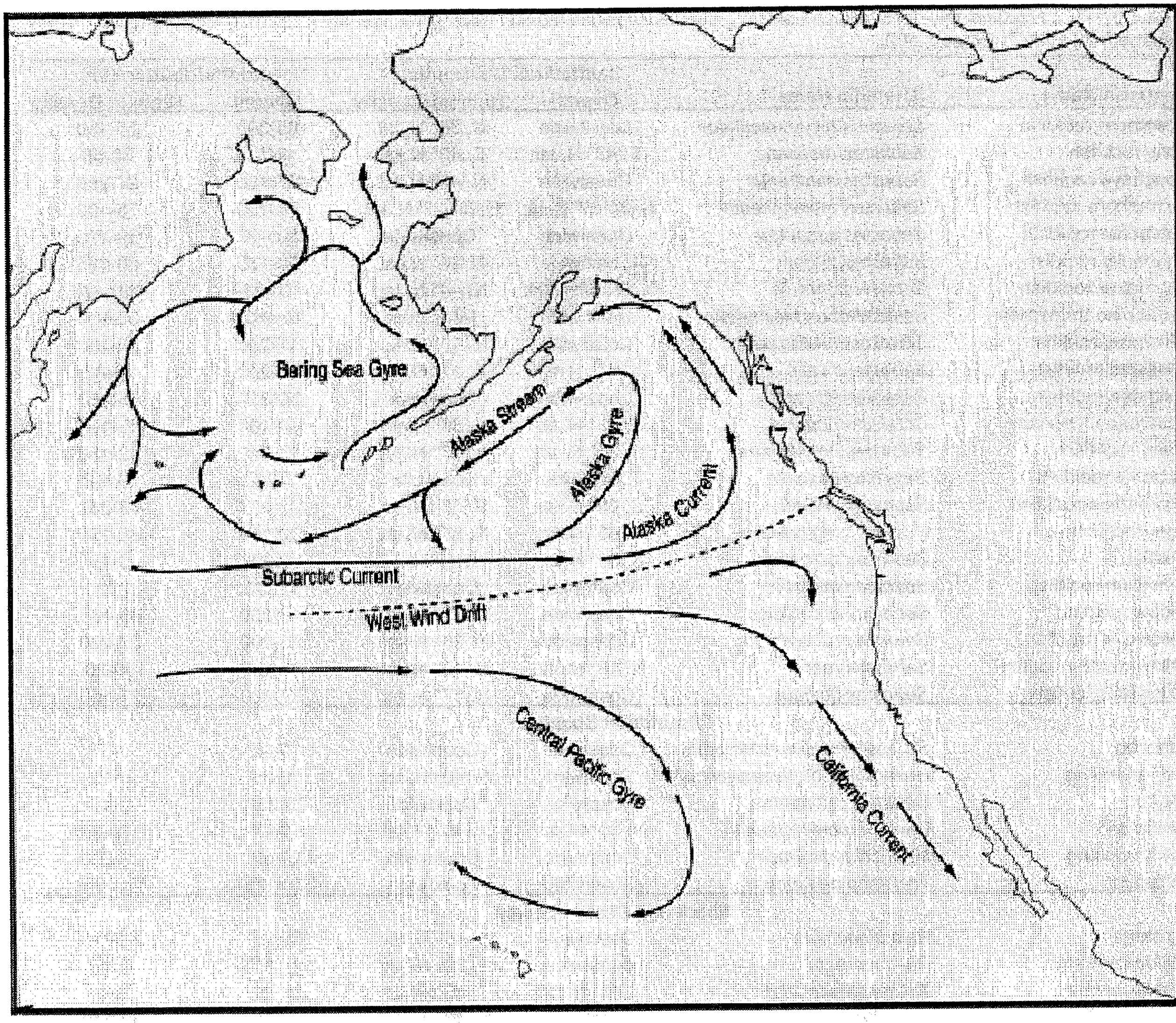

FIGURE 3.1-1. Surface current systems of the northeast Pacific Ocean.

3.2 Biological Environment

3.2.1 Overfished Species Subject to Rebuilding Plans Evaluated in This EIS

3.2.1.1 Darkblotched Rockfish

Darkblotched Rockfish Life History

Darkblotched have a low potential productivity and a long mean generation time of 33 years. There is no evidence of genetic stock structuring in the darkblotched population. Rogers *et al.* (2000) observed this was consistent with the smooth cline in age, size, and relative abundance indices of the coastwide population with no obvious breaks within the species range. Larger fish are generally found in deeper water (>200 fm Nichol 1990). Lenarz (1993) reported evidence from the 1977 through 1992 NMFS triennial surveys of a higher proportion of larger fish in southern areas. The center of biomass distribution on the West Coast is off Oregon (Rogers *et al.* 2000), which comports with the majority of landings in the Columbia INPFC area.

Darkblotched, like many *Sebastes* species, are long-lived, slow growing, and late to mature. Females grow faster than males and attain a larger mean size (Table 3.2-1). The maximum reported age for darkblotched is 66 years.

The age at 50% maturity for males is estimated to be 5.1 years and 8.4 years for females (Nichol and Pikitch 1994). The estimated length at 50% maturity is 29.6 cm and 36.5 cm for males and females, respectively. Westrheim (1975) reported a smaller size at 50% maturity for darkblotched in Alaska and British Columbia waters than Nichol (1990) did for the stock off Oregon. Nichol and Pikitch (1994) report darkblotched fecundities ranging from 19,815 oocytes (565.0 g) for a 32.5 cm female to 489,064 oocytes (1,724.0 g) for a 47.0 cm female.

Darkblotched reproduce via internal fertilization and are viviparous (live-bearers). Spawning occurs from December through March off Oregon (Nichol and Pikitch 1994). Wourms (1991) describes one clear seasonal peak of spawning annually. Darkblotched larvae are planktonic and are distributed from southern California to the Bering Sea (Matarese *et al.* 1989). A long planktonic life stage would likely contribute to the apparent lack of genetic structuring in the West Coast population.

Darkblotched Rockfish Stock Status

Darkblotched rockfish were managed as part of a coastwide *Sebastes* complex which was later segregated into north and south management units divided at 40°30' N latitude The first assessment of darkblotched estimated the proxy MSY harvest rate and overfishing rate for the stock (Lenarz 1993). Lenarz (1993) estimated a range of likely natural mortalities (M = 0.025-0.05) for darkblotched based on a range of maximum ages (60 years to 105 years). He also estimated fishery selectivity from length compositions from the California fishery which he converted to an age-based selectivity function. He then plotted the relative fecundity per recruit as a function of fishing-related and natural mortality to estimate $F_{35\%}$ (the target MSY proxy harvest rate at that time) and $F_{20\%}$ (the overfishing harvest rate) relative to fecundity per recruit. He estimated the range of likely harvest rates (F) at the MSY target ($F_{35\%}$) was 0.04-0.06 and the overfishing harvest rate ($F_{20\%}$) ranged between 0.07 and 0.11. While Lenarz (1993) did not calculate an ABC for darkblotched, he did note the estimated harvest rates at MSY and overfishing were lower than expected. He also noted a trend of decreasing size of darkblotched from the length composition data he evaluated.

The next informative assessment for darkblotched addressed all West Coast *Sebastes* without individual ABCs (Rogers *et al.* 1996). Two methodologies were explored for estimating an ABC for darkblotched, (1) fishing-related mortality was assumed to equal natural mortality (F=M) to estimate an $F_{35\%}$ harvest rate, and (2) estimation of $F_{35\%}$ using a simple stock synthesis model. In the F=M approach, a proxy adjustment (Q) to triennial survey data was calculated to estimate relative biomass of generic *Sebastes*. It was determined that adjusting Q by 0.5 and then by M approximated $F_{35\%}$ estimates from stock synthesis models for most rockfish. A Q of 0.8 (instead of 0.5) was assumed for darkblotched since the survey swept most of the depth range of darkblotched and caught smaller fish than the fishery. The other factors that influenced the magnitude of Q was a noted decreasing trend in estimated survey biomass over time and the estimated size at 50% maturity was greater than estimated size at 50% selectivity (i.e., the survey caught darkblotched at sizes less than those estimated for most maturing and mature fish). The F=M method was compared to a stock synthesis modeling approach that incorporated triennial survey data and a Pacific ocean perch bycatch effort index.

Rogers *et al.* (2000) assessed darkblotched stock status in 2000 and determined the stock was at 14% to 31% of its unfished level, depending on assumptions regarding the historic catch of darkblotched rockfish in the foreign fishery from 1965 through 1978. They incorporated five relative abundance indices in a length based stock synthesis model (Methot 1990) to derive current estimates of abundance and productivity. The five indices included three NMFS surveys with different latitudinal and depth coverages, the Pacific ocean perch effort index developed in the generic *Sebastes* assessment (Rogers *et al.* 1996), and a logbook index derived from California trawl logbook and species composition data stratified by major California port (Ralston 1999). Major uncertainties in the assessment model included the uncertain foreign catch composition, which had a significant effect on estimated unfished biomass (B_0), and assumptions regarding maturity, discard rates, and unchanging selectivity over time. Of these, the foreign catch of darkblotched influences our understanding of stock status the most; larger assumed historical catches increase estimates of B_0. Four accepted model runs varied the assumed foreign catch proportion from 0% to 20%, which resulted in significant differences in B_0 and the spawning index. Only one of those model runs (assuming 0% foreign catch of darkblotched) estimated the stock was not overfished. In all cases, the spawning biomass increased over the three-year time period with the reduced catch and the estimated very large 1994 year class reaching maturity. The Stock Assessment Review (STAR) Panel (PFMC 2000a) and the GMT were unable to resolve the uncertainty in foreign catch composition. While the GMT thought it implausible that no darkblotched were caught in the foreign fishery, they could not offer a definitive recommendation. Therefore, the Stock Assessment Team's (STAT) assumption of 10% of foreign catch was comprised of darkblotched (Rogers *et al.* 2000) was accepted, leading to the conclusion that the spawning stock biomass was 22% of its unfished level.

Methot and Rogers (2001, Appendix A-1) recommended by the SSC and adopted by the Council in 2001. On the earlier recommendation of the SSC (June 2001 Council meeting), they incorporated results of the 2000 triennial slope trawl survey conducted by the Alaska Fishery Science Center and modeled a more recent time series of recruitments. Incorporating these data resulted in a downward revision in the estimated recruitment and abundance throughout the time series in the Rogers *et al.* (2000) assessment. The mean recruitment in 1983 through 1996 was estimated to be about 67% of earlier estimates. This led to a revised estimate of spawning stock biomass at the beginning of 2002 of 14% of its unfished level. The minimum time to rebuild (T_{MIN}) in the absence of fishing was estimated to be 14 years with a median rebuilding year of 2014. The maximum time to rebuild (T_{MAX}) in accordance with the National Standard Guidelines was 47 years (2047).

A new expedited update of the Rogers *et al.* (2000) assessment is scheduled for 2003. Expedited assessments are designed to update previous assessment models with new catch, survey and other input data. Expedited assessments are reviewed by the Groundfish Subcommittee of the SSC before being recommended to the Council for use in management. It is anticipated that allocation of darkblotched in historical foreign catches from retrospective analysis (Rogers In prep) will address some of the uncertainty in the previous assessment. Species composition information of historical foreign catch is sparse. Foreign catches of West Coast rockfish species were typically reported as "Pacific ocean perch," "rockfish," or "other rockfish." Rogers (In prep) compiled the available information on species composition from limited sampling of trawl landings from the domestic fleet, research surveys, and observations of the areal deployment of foreign vessels. She applied these data to reported foreign catches to allocate the tonnage of slope and shelf rockfish species catch by INPFC area (Table 3.2-2). While these data were not incorporated in the most recent darkblotched assessment, they are anticipated to be used in the 2003 assessment update. The updated darkblotched assessment is scheduled to be available to the Council in June 2003 for use in setting 2004 groundfish specifications and management measures.

3.2.1.2 Pacific Ocean Perch

Pacific Ocean Perch Life History

Pacific ocean perch have a low potential productivity and a very low population resilience with a minimum population doubling time of more than 14 years (Musick *et al.* 2000). Genetic analyses suggest a significant mixing of the population across the species' range (Seeb and Gunderson 1988; Wishard *et al.* 1980). This could be explained by a widespread dispersal of larvae and juveniles transported to deeper waters in a prolonged pelagic phase.

Adult POP make seasonal onshore migrations to feeding grounds in shallower water (180 m to 220 m) during June to August to allow gonads to ripen. They form large schools as much as 30 m wide, 80 m deep, and 1,300 m long. They then migrate offshore to spawn in deeper water (>275 m) in large spawning aggregations. Spawning occurs in September and October in Washington and British Columbia waters. Pacific ocean perch are viviparous (bear live young) and eggs are internally fertilized. Young are born in January and February off Oregon (Hitz 1962) and one to three months later in the season in more northern waters (Westrheim 1970). Juveniles remain pelagic for two or three years before becoming demersal (Alverson and Westrheim 1959). Juvenile POP form ball-shaped schools near the surface or hide in rocks. Pacific ocean perch migrate to deeper waters as they mature and attain adulthood on the continental slope.

Pacific ocean perch are carnivorous. Larvae eat small zooplankton. Small juveniles eat copepods and larger juveniles feed on euphausiids. Adults eat euphausiids, shrimps, squids, and small fishes. Adults occurring shallower than 150 m feed during the day; those at greater depths move toward the surface to feed at dawn and dusk. Immature fish feed throughout the year, but adults feed only seasonally, mostly April through August. Predators of POP include sablefish (*Anoplopoma fimbria),* Pacific halibut (*Hippoglossus stenolepis*), (*Physeter catodon*), and albacore tuna (*Thunnus alalunga*).

Pacific ocean perch are slow growing, long-lived, and late to mature. Larvae are 5 mm to 8 mm SL (standard length) at birth, and the larval period lasts several weeks. Juveniles range up to 22 cm to 35 cm depending on sex and region. Growth is slower for males. Largest size is about 54 cm and 2 kg. Maximum age of POP has been revised upwards with recent advances in ageing techniques. Gunderson (1977) originally estimated a maximum age of 30 years for POP. However, estimated longevity using the break and burn technique of ageing otoliths indicate POP can live up to 98 years (Heifetz *et al.* 2000). Estimated age at 50% maturity of POP is 10 years (Heifetz *et al.* 1996). Relatively small numbers of young are produced during parturition with only about 300,000 for a female of 20 years of age (Frimodt 1995).

Pacific Ocean Perch Stock Status

The first POP stock assessments were done after the heavy exploitation of the 1960s. Westrheim *et al.* (1972) assessed the POP population in the Columbia and Vancouver INPFC areas and determined the mean exploitable biomass during 1966 through 1968 was 34,000 mt. Catch rates declined about 55% for the Washington fleet from that period; the biomass was then estimated to be 18,700 mt during 1969 through 1971 (Technical Subcommittee 1972). Biomass was estimated to have declined another 11% during 1972 through 1974 based on a further decline in catch rates (Gunderson 1977). While the catch rate increased during 1975 through 1977 (Fraidenburg *et al.* 1978), it was believed this was due to the advent of more efficient high rise nets. Biomass was estimated to be between 8,000 and 9,600 mt.

A rockfish survey conducted in 1977 (Gunderson and Sample 1980) was the first fishery-independent index of Pacific ocean perch and the beginning of triennial surveys on the West Coast. Pacific ocean perch biomass estimates were imprecise prompting fishermen to ask for closer scrutiny of POP assessments. Therefore, in 1979 NMFS, Washington Department of Fish and Wildlife (WDFW), and Oregon Department of Fish and Wildlife (ODFW) cooperated in a research survey of POP stocks off Washington and Oregon. More precise biomass estimates indicated stock sizes had not changed since 1977 (Wilkins and Golden 1983). Six years later another survey was conducted to determine the effect of regulations imposed on the fishery in the interim which was considered minimal. Subsequent assessments (Ianelli *et al.* 1992; Ianelli *et al.* 1995) explored an age-structured statistical model (Methot 1990), laying the foundation for more recent assessment work.

Ianelli and Zimmerman (1998) estimated POP female spawning biomass in 1997 was at 13% of its unfished level, thereby confirming the stock was overfished. NMFS formally declared POP overfished in March 1999 after the Groundfish FMP was amended to incorporate the tenets of the Sustainable Fisheries Act. The Council adopted and NMFS enacted more conservative management measures in 1999 as part of a redoubled rebuilding effort.

A new assessment for POP was done in 2000 which suggests the stock was more productive than originally thought (Ianelli *et al.* 2000). A revised POP rebuilding analysis was completed and adopted by the Council in 2001 (Punt and Ianelli 2001). This analysis estimated a T_{MIN} of 12 years (2012) and a T_{MAX} of 42 years

(2042) (Table 2.0-1). It was noted in the rebuilding analysis the ongoing retrospective analysis of historic foreign fleet catches (Rogers In prep, Table 3.2-2) is likely to change projections of POP rebuilding downward.

The West Coast POP stock will be re-assessed in 2003. The Rogers retrospective analysis is anticipated to be incorporated in the new assessment and rebuilding analysis. The review and Council adoption process for the new POP assessment and rebuilding analysis will be complete by June 2003 and will be used to set POP specifications and management measures for 2004.

3.2.1.3 Canary Rockfish

Canary Rockfish Life History

Canary rockfish off the West Coast exhibit a protracted spawning period from September through March, probably peaking in December and January off Washington and Oregon (Hart 1988; Johnson *et al.* 1982). Female canary rockfish reach sexual maturity at roughly eight years of age. Like many members of *Sebastes*, canary rockfish are ovoviviparous, whereby eggs are internally fertilized within females, and hatched eggs are released as live young (Bond 1979; Golden and Demory 1984; Kendall and Lenarz 1986). Canary rockfish are a relatively fecund species, with egg production being correlated with size, (e.g., a 49-cm female can produce roughly 0.8 million eggs, and a female that has realized maximum length (approximately 60 cm) produces approximately 1.5 million eggs). Very little is known about the early life history strategies of canary rockfish, but limited research indicates larvae which are strictly pelagic (near ocean surface) for a short period of time, begin to migrate to demersal waters during the summer of their first year of life and develop into juveniles around nearshore rocky reefs, where they may congregate for up to three years (Boehlert 1980; Sampson 1996). Evaluations of length distributions by depth developed from NMFS shelf trawl survey data generally supported other research that suggests this species is characterized by an increasing trend in mean size of fish with depth (Archibald *et al.* 1981; Boehlert 1980). Female canary rockfish generally grow faster and reach slightly larger sizes than males, but do not appear to live longer than males. Adult canary rockfish feed primarily on small fishes, as well as planktonic creatures, such as krill and euphausiids (Love 1991; Phillips 1964).

Canary Rockfish Stock Status

Canary rockfish were first assessed on the West Coast in 1984, but the assessment was more a qualitative trend analysis using survey and catch data (Golden and Demory 1984). Highly variable or unavailable sample data precluded a more quantitative approach. This assessment concluded that the stock was stable and the ABC and management measures in place were adequate.

The 1990 canary rockfish stock assessment (Golden and Wood 1990) was the first to use the Stock Synthesis Model (Methot 1990) and a catch-at-age analysis. Data sources in this assessment included commercial landings (1967 through 1989), fishery age distribution (1980 through 1988), a commercial trawl effort index from logbooks (1980 through 1987), a CPUE index from the NMFS trawl survey (1977 through 1989), and size distribution data from the survey (1977 through 1989). Only the canary rockfish resource in the Columbia INPFC area was modeled. Golden and Wood (1990) were the first to offer competing hypotheses to explain the lack of older females in the population. These two hypotheses, which have still not been resolved, are that older females have a higher natural mortality than older males or they are less susceptible to capture by fishing gears than older males. This assessment indicated that stock biomass had declined in the Columbia INPFC area.

The next canary rockfish assessment was in 1994 (Sampson and Stewart 1994). An age-based version of the Stock Synthesis Model was used to assess the status of the resource in the Columbia and U.S. Vancouver INPFC areas. All of the same data sources from the previous assessment were updated and used except the trawl effort index because of sample and estimation biases associated with logbook data. Results indicated the harvest rate exceeded the $F_{20\%}$ overfishing threshold and a reduction in the ABC was recommended. The assessment was updated in 1996 (Sampson 1996). It verified continued exploitation in excess of the $F_{20\%}$ threshold.

Two age-based stock assessments in 1999 documented the stock had declined below the overfished level ($B_{25\%}$) in the northern area (Columbia and U.S. Vancouver INPFC areas Crone *et al.* 1999) and in the southern area (Conception, Monterey, and Eureka INPFC areas Williams *et al.* 1999) and was declared overfished in January 2000. The first rebuilding analysis (Methot 2000a) used results from the northern area assessment to project rates of potential stock recovery. The stock was found to have extremely low productivity, defined as production of recruits in excess of the level necessary to maintain the stock at its current, low level. Rates of recovery were highly dependent upon the level of recent recruitment, which could not be estimated with high certainty. The initial rebuilding OY for 2001 and 2002 was set at 93 mt based upon a 50% probability of rebuilding by the year 2057, a medium level for these recent recruitments, and maintaining a constant annual catch of 93 mt through 2002.

A new assessment was done coastwide in 2002 for canary rockfish, treating the stock as a single unit from the Monterey INPFC area north through the U.S. Vancouver INPFC area, and thus, departing from the methodologies of past assessments (Methot and Piner 2002b). Although there is some evidence of genetic separation of the northern and southern stocks (Boehlert and Kappenman 1980; Wishard *et al.* 1980), the observed variability in growth rate by sex and area was not significantly different at small versus large spatial scales. They also determined the areas of highest canary rockfish density were off headlands that separate INPFC areas, which would tend to bias results if the assessment was stratified by INPFC area. A critical uncertainty in canary rockfish assessments is the lack of older, mature females in surveys and other assessment indices. There are two competing explanations for this observation. Older females could have a higher natural mortality rate, resulting in their disproportionate disappearance from the population. Alternatively, survey and fishing gears may be less effective at catching them, because older females hide in places inaccessible to the gear, for example. If this is the case, then these fish (which, because of their higher spawning output may make an important contribution to future recruitment) are part of the population, but remain un-sampled. Methot and Piner (2002b) combined these two hypotheses in a single age-structured version of the SSC-endorsed stock synthesis assessment model (Methot 2000b) by allowing female natural mortality to increase with the maturity function, but also allowing selectivity to be domed (the model determines the selectivity of survey and fishery gear as opposed to assuming a fixed selectivity). They estimated the 2002 abundance of canary rockfish coastwide was about 8% of B_0. The historical time series of canary rockfish recruitments and spawning biomass is shown in Figure 3.2.1-1.

3.2.1.4 Lingcod

Lingcod Life History

Lingcod are demersal at all life stages (Allen and Smith 1988; NOAA 1990; Shaw and Hassler 1989). Adult lingcod prefer two main habitat types: slopes of submerged banks 10 m to 70 m below the surface with seaweed, kelp, and eelgrass beds and channels with swift currents that flow around rocky reefs (Emmett *et al.* 1991; Giorgi and Congleton 1984; NOAA 1990; Shaw and Hassler 1989). Juveniles prefer sandy substrates in estuaries and shallow subtidal zones (Emmett *et al.* 1991; Forrester 1969; Hart 1988; NOAA 1990). As the juveniles grow they move to deeper waters. Adult lingcod are considered a relatively sedentary species, but there are reports of migrations of greater than 100 km by sexually immature fish (Jagielo 1990; Mathews and LaRiviere 1987; Matthews 1992; Smith *et al.* 1990).

Mature females live in deeper water than males and move from deep water to shallow water in the winter to spawn (Forrester 1969; Hart 1988; Jagielo 1990; LaRiviere *et al.* 1980; Mathews and LaRiviere 1987; Matthews 1992; Smith *et al.* 1990). Mature males may live their whole lives associated with a single rock reef, possibly out of fidelity to a prime spawning or feeding area . Spawning generally occurs over rocky reefs in areas of swift current (Adams 1986; Adams and Hardwick 1992; Giorgi 1981; Giorgi and Congleton 1984; LaRiviere *et al.* 1980). After the females leave the spawning grounds, the males remain in nearshore areas to guard the nests until the eggs hatch. Hatching occurs in April off Washington, but as early as January and as late as June at the geographic extremes of the lingcod range. Males begin maturing at about two years (50 cm), whereas females mature at three plus years (76 cm). In the northern extent of their range, fish mature at an older age and larger size (Emmett *et al.* 1991; Hart 1988; Mathews and LaRiviere 1987; Miller and Geibel 1973; Shaw and Hassler 1989). The maximum age for lingcod is about 20 years (Adams and Hardwick 1992).

Lingcod are a visual predator, feeding primarily by day. Larvae are zooplanktivores (NOAA 1990). Small demersal juveniles prey upon copepods, shrimps, and other small crustaceans. Larger juveniles shift to clupeids and other small fishes (Emmett *et al.* 1991; NOAA 1990). Adults feed primarily on demersal fishes (including smaller lingcod), squids, octopi, and crabs (Hart 1988; Miller and Geibel 1973; Shaw and Hassler

1989). Lingcod eggs are eaten by gastropods, crabs, echinoderms, spiny dogfish, and cabezon. Juveniles and adults are eaten by marine mammals, sharks, and larger lingcod (Miller and Geibel 1973; NOAA 1990).

Lingcod Stock Status

In 1997, U.S. scientists assessed the size and condition of the portion of the stock in the Columbia and Vancouver areas (including the Canadian portion of the Vancouver management area) and concluded the stock had fallen to below 10% of its unfished size (Jagielo *et al.* 1997). The Council responded by imposing substantial harvest reductions coastwide, reducing the harvest targets for the Eureka, Monterey, and Conception areas by the same percentage as in the north. In 1999, scientists assessed the southern portion of the stock and concluded the condition of the southern stock was similar to the northern stock, thus confirming the Council had taken appropriate action to reduce harvest coastwide (Adams *et al.* 1999).

Jagielo (Jagielo *et al.* 2000) conducted a coastwide lingcod assessment and determined the total biomass increased from 6,500 mt in the mid-1990s to about 8,900 mt in 2000. In the south, the population has also increased slightly from 5,600 mt in 1998 to 6,200 mt in 2000. In addition, the assessment concluded previous aging methods portrayed an older population; whereas new aging efforts showed the stock to be younger and more productive. Therefore, the ABC and OY were increased in 2001 on the basis of the new assessment. A revised rebuilding analysis of coastwide lingcod (Jagielo and Hastie 2001) was adopted by the Council in September 2001. It confirmed the major conclusions of the 2000 assessment and rebuilding analysis, but slightly modified recruitment projections to stay on the rebuilding trajectory that reaches target biomass in 2009. This modification resulted in a slight decrease in the 2002 ABC and OY.

A new lingcod assessment is anticipated to be available in fall of 2003. The assessment and Council adoption process for the lingcod assessment and rebuilding analysis is scheduled to be complete by November 2003 for use in the first groundfish biennial management period of 2005 through 2006.

3.2.2 FMP Species Co-occurring with the Overfished Species Subject to Rebuilding Plans Evaluated in this EIS

Table 3.1-1 depicts the overall and highest density latitudinal and depth distributions of the groundfish species managed under the FMP. Species with overlapping highest density distributions are considered to be co-occurring withy the overfished species subject to rebuilding plans evaluated in this EIS.

3.2.2.1 Species Co-occurring With Darkblotched Rockfish and Pacific Ocean Perch

Darkblotched rockfish and Pacific ocean perch are part of the northern slope rockfish complex (Table 3.2-3) and are primarily associated with these rockfish species. The north-south slope rockfish management line near Cape Mendocino at 40°10' N latitude used prior to 2003 did not conform perfectly with the estimated distribution of darkblotched biomass (Rogers *et al.* 2000); there are some landings in fisheries targeting the southern slope rockfish complex (Table 3.2-3). Therefore, starting in 2003, the slope management line was moved south to Point Reyes at 38° N latitude

The deep-water trawl fishery targeting Dover sole (*Microstomus pacificus*), shortspine and longspine thornyheads (*Sebastolobus alascanus* and *S. altivelis*, respectively), and sablefish (*Anoplopoma fimbria*; collectively referred to as the DTS complex) incidentally catch darkblotched and Pacific ocean perch. There are also strong seasonal associations with other deepwater flatfishes caught in bottom trawl fisheries such as petrale sole (*Eopsetta jordani*) in the winter and rex sole (*Errex zachirus*); and, to a lesser extent, English sole (*Pleuronectes vetulus*). The latitudinal and depth distributions of West Coast groundfish species are depicted in Table 3.1-1.

3.2.2.2 Species Co-occurring With Canary Rockfish

Table 3.1-1 shows the groundfish species managed under the FMP. Those species with an overlapping distribution in the 50 fm to 150 fm depth range where canary rockfish are considered co-occurring. This includes most of the rockfish species (*Sebastes* spp.) managed under the FMP as well as some commercially important flatfish species such as Dover sole (*Microstomus pacificus*) that make seasonal migrations on the shelf. Principal and secondary groundfish FMP species which occur on the continental shelf are summarize in Table 3.2-4. Of the *Sebastes* species that co-occur with canary rockfish, four are overfished. These are bocaccio (*S. paucispinis*), cowcod (*S. levi*), widow rockfish (*S. entomelas*), and yelloweye rockfish (*S. ruberrimus*). Canary rockfish often associate with yellowtail (*S. flavidus*), widow, and silvergray rockfish (*S. brevispinis*). Important roundfish species that also occur with canary rockfish are sablefish (*Anoplopoma fimbria*), which make seasonal migrations on the shelf and lingcod (*Ophiodon elongatus*), another overfished groundfish species.

3.2.2.3 Species Co-occurring with Lingcod

Table 3.1-1 shows the groundfish species managed under the FMP. Those species with a distribution overlapping lingcod distribution in the 0 fm to 233 fm depth range are considered co-occurring. This includes most of the rockfish species (*Sebastes* spp.) managed under the FMP as well as some commercially important flatfish species such as Dover sole (*Microstomus pacificus*) that make seasonal migrations on the shelf. Of the *Sebastes* species that co-occur with lingcod, five are overfished. These are bocaccio (*S. paucispinis*), canary (*S. pinniger*), cowcod (*S. levi*), widow rockfish (*S. entomelas*), and yelloweye rockfish (*S. ruberrimus*). Important roundfish species that also occur with lingcod are sablefish (*Anoplopoma fimbria*), which make seasonal migrations on the shelf. Lingcod are of coastwide distribution and utilize nearshore and continental shelf habitats. Groundfish FMP species are summarized by continental shelf and nearshore species (Table 3.2-4 and Table 3.2-5).

TABLE 3.2-1. Biological reference points for the overfished species subject to rebuilding plans evaluated in this EIS. (Page 1 of 1)

Biological Reference Point	Value
	Darkblotched Rockfish
Maximum age	66 yrs
Maximum length	58 cm
Age at 50% maturity	8.4 yrs females; 5.1 yrs males
Length at 50% maturity	36.5 cm females; 29.6 cm males
Natural mortality rate (M)	0.05
	Pacific Ocean Perch
Maximum age	98 years
Maximum length	54 cm
Maximum weight	2 kg
Age at 50% maturity	10 yrs females
Length at 50% maturity	34 cm females
Natural mortality rate (M)	0.05
	Canary Rockfish
Maximum age	69 yrs females; 67 yrs male
Maximum length	69 cm females; 63 cm males
Maximum weight	3.6 kg females; 2.5 kg male
Age at 50% maturity	7.3 yrs. females
Length at 50% maturity	37.6 cm females
Natural mortality rate (M)	0.06 - 0.12, increases with fraction mature for females
	Lingcod
Maximum age	20 yrs
Maximum length	127 cm females; 95 cm males
Maximum weight	3.1 kg females; 1.2 kg male
Age at 50% maturity	5 yrs females; 3 yrs males
Length at 50% maturity	69 cm females; 50 cm males
Natural mortality rate (M)	0.18 females; 0.32 males

TABLE 3.2-2. Allocation of the rockfish species subject to rebuilding plans evaluated in this EIS in the reported foreign rockfish catch (mt) off Washington, Oregon, and California in 1966-1976 by INPFC area and year. Data from Rogers (in prep). (Page 1 of 1)

INPFC Area	Year											
	66	67	68	69	70	71	72	73	74	75	76	Total
Darkblotched Rockfish												
U.S./Vancouver	101	93	52	2	2	73	61	78	144	0	0	606
Columbia	3,654	2,550	1,280	147	146	205	298	610	190	254	87	9,421
Eureka	0	22	927	3	1	0	14	50	9	26	16	1,068
Monterey	52	41	29	1	0	0	1	30	3	13	15	185
Pacific Ocean Perch												
U.S./Vancouver	4,595	4,319	2,417	64	68	548	421	607	992	0	29	14,060
Columbia	10,966	8,038	4,222	405	373	354	529	1,166	465	496	210	27,224
Eureka	0	9	344	1	0	0	17	62	15	35	93	576
Monterey	0	11	1	3	0	0	0	11	19	40	40	125
Canary Rockfish												
U.S./Vancouver	113	90	109	12	28	70	68	68	288	0	0	846
Columbia	1,445	658	286	50	73	118	318	525	81	141	114	3,809
Eureka	0	2	385	3	0	0	12	335	46	35	22	840
Monterey	41	101	30	2	0	0	1	37	104	28	27	371

TABLE 3.2-3. Rockfish species found on the U.S. West Coast continental slope. (Page 1 of 1)

Principal Species		Secondary Species	
Common name	**Scientific name**	**Common name**	**Scientific name**
North of Cape Mendocino			
Aurora rockfish	*Sebastes aurora*	Bank rockfish	*Sebastes rufus*
Darkblotched rockfish	*Sebastes crameri*	Blackgill rockfish	*Sebastes melanostomus*
Pacific ocean perch	*Sebastes alutus*		
Redbanded rockfish	*Sebastes babcocki*		
Rougheye rockfish	*Sebastes aleutianus*		
Sharpchin rockfish	*Sebastes zacentrus*		
Shortraker rockfish	*Sebastes borealis*		
Splitnose rockfish	*Sebastes diploproa*		
Yellowmouth rockfish	*Sebastes reedi*		
South of Cape Mendocino			
Aurora rockfish	*Sebastes aurora*	Darkblotched rockfish	*Sebastes crameri*
Bank rockfish	*Sebastes rufus*	Pacific ocean perch	*Sebastes alutus*
Blackgill rockfish	*Sebastes melanostomus*	Sharpchin rockfish	*Sebastes zacentrus*
Redbanded rockfish	*Sebastes babcocki*	Shortraker rockfish	*Sebastes borealis*
Rougheye rockfish	*Sebastes aleutianus*	Yellowmouth rockfish	*Sebastes reedi*
Splitnose rockfish	*Sebastes diploproa*		

TABLE 3.2-4. Groundfish FMP species found on the U.S. West Coast continental shelf. (Page 1 of 1)

Principal Species		Secondary Species	
Common name	**Scientific name**	**Common name**	**Scientific name**
North of Cape Mendocino			
Arrowtooth flounder	*Atheresthes stomias*	Greenstriped rockfish	*Sebastes elongatus*
Canary rockfish	*Sebastes pinniger*	Redstripe rockfish	*Sebastes proriger*
Lingcod	*Ophiodon elongatus*	Rosethorn rockfish	*Sebastes helvomaculatus*
Tiger rockfish	*Sebastes nigrocinctus*	Sablefish (seasonal)	*Anoplopoma fimbria*
Vermillion rockfish	*Sebastes miniatus*	Silvergray rockfish	*Sebastes brevispinis*
Widow rockfish	*Sebastes entomelas*	Spiny dogfish	*Squalus acanthias*
Yelloweye rockfish	*Sebastes ruberrimus*	Yellowtail rockfish	*Sebastes flavidus*
South of Cape Mendocino			
Bocaccio	*Sebastes paucispinis*	Mexican rockfish	*Sebastes macdonaldi*
California scorpionfish	*Scorpaena gutatta*	Sablefish (seasonal)	*Anoplopoma fimbria*
Canary rockfish	*Sebastes pinniger*	Spiny dogfish	*Squalus acanthias*
Chilipepper	*Sebastes goodei*	Tiger rockfish	*Sebastes nigrocinctus*
Cowcod	*Sebastes levis*	Yellowtail rockfish	*Sebastes flavidus*
Lingcod	*Ophiodon elongatus*		
Vermillion rockfish	*Sebastes miniatus*		
Widow rockfish	*Sebastes entomelas*		
Yelloweye rockfish	*Sebastes ruberrimus*		

TABLE 3.2-5. Groundfish FMP species found on the U.S. West Coast in nearshore areas of the continental shelf. (Page 1 of 1)

Principal Species		Secondary Species	
Common name	**Scientific name**	**Common name**	**Scientific name**
North of Cape Mendocino			
Black rockfish	*Sebastes melanops*	Brown rockfish	*Sebastes auriculatus*
Blue rockfish	*Sebastes mystinus*	Vermillion rockfish	*Sebastes miniatus*
Cabezon	*Scorpaenichthys marmoratus*		
China rockfish	*Sebastes nebulosus*		
Copper rockfish	*Sebastes caurinus*		
Lingcod	*Ophiodon elongatus*		
Kelp greenling	*Hexagrammos decagrammus*		
Quillback rockfish	*Sebastes maliger*		
South of Cape Mendocino			
Black rockfish	*Sebastes melanops*	Black-and-yellow rockfish	*Sebastes chrysomelas*
Blue rockfish	*Sebastes mystinus*	Calico rockfish	*Sebastes dallii*
Brown rockfish	*Sebastes auriculatus*	Grass rockfish	*Sebastes rastrelliger*
Cabezon	*Scorpaenichthys marmoratus*	Kelp rockfish	*Sebastes atrovirens*
California scorpionfish	*Scorpaena gutatta*		
Copper rockfish	*Sebastes caurinus*		
Gopher rockfish	*Sebastes carnatus*		
Lingcod	*Ophiodon elongatus*		
Olive rockfish	*Sebastes serranoides*		
Treefish	*Sebastes serriceps*		

3.3 Management Regime

3.3.1 Management History

3.3.1.1 Darkblotched

Slope rockfish are exclusively caught in commercial fisheries with darkblotched primarily harvested by trawls (about 96% of 1981 through 2002 landings, see Figure 3.3-1 and Figure 3.3-2). A relatively small domestic fleet harvested slope rockfish prior to 1965. The primary target species was Pacific ocean perch with most of the effort in the Columbia and Vancouver INPFC areas. Exploitation of darkblotched rockfish and the other commercially-important slope rockfish species intensified during 1966 through 1975 when foreign Soviet and Japanese trawlers targeted slope and shelf rockfish off the West Coast (mostly in the Columbia and Vancouver INPFC areas). The foreign fishery ended in 1977 after passage of the MSA and the transition to a domestic fishery.

Darkblotched were historically managed as part of a coastwide *Sebastes* complex until 2001 when an individual ABC and OY were specified for darkblotched, thus excluding them from the complex. Rogers *et al.* (1996) calculated a species-specific ABC for darkblotched and other rockfish in the *Sebastes* complex. However, these ABCs were summed to determine the management target for the complex in entirety. Therefore, the complex limit could be taken from any member species of the complex. A history of commercial trawl regulations for the *Sebastes* complex and darkblotched rockfish is summarized in Table 3.3-1. The *Sebastes* complex historically included about 50 species of rockfish except widow, shortbelly, and Pacific ocean perch (in the Columbia and U.S./Vancouver INPFC areas only). In 1999 splitnose rockfish were excluded from the *Sebastes* complex in the south (south of the Eureka/Columbia INPFC boundary) and, in August of that year, yellowtail and canary rockfish were excluded from the complex limit in the north. The fishing mortality rate target commonly accepted for shelf and slope rockfish was $F_{35\%}$, but changed on the advice of the SSC to an $F_{50\%}$ harvest rate in 2001 (PFMC 2000b).

Rogers *et al.* (2000) estimated the abundance of darkblotched in 2000 to be at 22% of its unfished biomass, below the minimum stock size threshold of $B_{25\%}$. In response, NMFS declared darkblotched overfished in January 2001. The assessment (Rogers *et al.* 2000) indicated the stock could be rebuilt within ten years; therefore, there was a legal mandate to do so[6/]. The GMT recommended a range of OYs in 2001 to reflect a range of 10% darkblotched in the historical foreign catch and 0%. The lower OY (95 mt) was based on a constant annual catch that would rebuild the stock in 10 years and the 10% foreign catch assumption. The upper OY (159 mt) was based on a constant catch to rebuild in 10 years, assuming 0% of darkblotched in foreign catches. However, the GMT did not believe the latter assumption of 0% foreign darkblotched catch to be plausible. The Council chose an intermediate value (130 mt) given this uncertainty. This became the harvest guideline for darkblotched and represented the first year the stock was managed with its own OY. Commercial fishing regulations required sorting of darkblotched in 2001; previously darkblotched were landed in combination with other species in the *Sebastes* complex. Darkblotched harvest was tracked separately in 2001 using Quota Species Monitoring (see QSM discussion in section 3.3.3.1).

The change in outlook of darkblotched stock status with the advent of the rebuilding analysis was the conclusion that the stock could not be rebuilt within ten years (Methot and Rogers 2001). In November 2001, the Council chose a darkblotched rebuilding strategy which was estimated to achieve B_{MSY} by T_{MAX} with a 70% probability. The expected year to rebuild the stock under this P_{MAX} (0.7) is 2034 (Table 2.0-1). This resulted in a 2002 OY of 168 mt. In April 2002, the Natural Resources Defense Council (NRDC) and other defendants filed a complaint in the U.S. District Court for the Northern District of California (NRDC *et al. v.* Evans *et al.*, Case # C02 1650 BZ) challenging the 2002 annual groundfish specifications. Among other 2002 specifications, NRDC *et al.* challenged the increased darkblotched OY in 2002 and the extended rebuilding period predicted in the Methot and Rogers (2001) rebuilding analysis. Plaintiffs claimed that the MSA requires the shortest possible rebuilding period should be prescribed and the difference in the 2002 OY relative to the

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6/ The MSA specifies in §304(e)(4)(A)(ii), "For a fishery that is overfished, any fishery management plan, amendment, or proposed regulations ...shall specify a time period for ending overfishing and rebuilding the fishery that ... shall not exceed 10 years, except in cases where the biology of the stock of fish, other environmental conditions, or management measures under an international agreement in which the United States participates dictate otherwise."

2001 OY did not comport with this legal mandate. NMFS argued that the change in understanding of stock status prompted the change in management and the MSA allows extended rebuilding is such cases. The MSA (§304(e)(4)(A)(i)&(ii)) allows the stock's biology to dictate the rebuilding period as well as the "needs of fishing communities." A ruling in this case is pending; plaintiffs and defendants are in settlement negotiations.

The Council adopted a more conservative groundfish management regime for 2003 largely in response to new, more pessimistic assessments for bocaccio (south of Cape Mendocino, California), canary rockfish, and yelloweye rockfish. The centerpiece of the new management regime is a strategy of seasonal depth-based area closures that are designed to reduce mortality of overfished groundfish species. Table 3.3-2 includes management line regulatory actions beginning in 2002. The Council also adopted a more conservative rebuilding strategy for darkblotched that has an 80% probability of rebuilding by T_{MAX} and a rebuilding period four years shorter than the previous strategy (T_{TARGET} = 2030; Table 2.0-1). (This is the basis for structuring the *Council Interim* rebuilding strategy in this rebuilding plan.) While the 2003 darkblotched OY of 172 mt is slightly higher than the 2002 OY of 168 mt, it is based on a more conservative rebuilding strategy and harvest control rule (F; Table 2.0-1). Both the 70% and 80% P_{MAX} strategies are based on the assessment and rebuilding analysis projections of increasing biomass. Under the constant harvest rate strategy for rebuilding darkblotched, rebuilding OYs increase steadily over time until the stock is rebuilt. The 2003 OY under the 70% P_{MAX} strategy is 184 mt (see Section 4.4.1.1). Also in 2003, the Council recommended the slope management line be moved further south from 40°10' N latitude at Cape Mendocino, California to 38° N latitude at Point Reyes, California. This was due to the realization of higher darkblotched catches south of Cape Mendocino than previously assumed or modeled. There are differential depth-based management lines and prescribed landing limits for slope species north and south of the slope management line. These differential management measures are designed according to the conservation need to rebuild darkblotched and Pacific ocean perch. NMFS approved these management measures which are currently in place.

3.3.1.2 Pacific Ocean Perch

Pacific ocean perch were harvested exclusively by U.S. and Canadian vessels in the Columbia and Vancouver INPFC areas prior to 1965. Large Soviet and Japanese factory trawlers began fishing for POP in 1965 in the Vancouver area and in the Columbia area a year later. Intense fishing pressure by these foreign fleets occurred during the 1966 through 1975 period (Figure 3.3-3). The foreign fishery ended in 1977 after passage of the MSA and the transition to a domestic fishery. Domestic landings by INPFC catch area are shown in Figure 3.3-4 and Figure 3.3-5.

The POP resource off the West Coast was overfished before implementation of the Pacific Coast Groundfish FMP. Large removals of POP in the foreign trawl fishery, followed by significant declines in catch and abundance led the Council to limit harvest beginning in 1979. A 20-year rebuilding plan for POP was adopted in 1981. A history of regulatory actions regarding POP since implementation of the FMP is provided in Table 3.3-2. Rebuilding under the original plan was largely influenced by a cohort analysis of 1966 through 1976 catch and age composition data (Gunderson 1979), updated with 1977 through 1980 data (Gunderson 1981), and an evaluation of trip limits as a management tool (Tagart *et al.* 1980). This was the first time trip limits were used by the Council to discourage targeting and overharvest of an overfished stock. This is a management strategy still in use today in the West Coast groundfish fishery. The allowable catch (optimum yield) for POP was also lowered significantly. After twenty years of rebuilding under the original plan, the stock was stabilized at a lower equilibrium than estimated in the pre-fishing condition. While continuing stock decline was abated, rebuilding was not achieved as the stock failed to increase in abundance to B_{MSY}.

3.3.1.3 Canary Rockfish

Canary rockfish exploitation began in the early 1940s when World War II increased demand for protein (Alverson *et al.* 1964; Browning 1980). Through this decade the trawl fishery expanded in Oregon and Washington accounting for most of the canary rockfish catch then, while rockfish were primarily targeted using longlines in California. The primary gear type to harvest canary rockfish has historically been trawls, followed by hook-and-line (primarily vertical longline), shrimp trawls, and other gears such as pots and traps. Foreign trawlers were responsible for most of the harvest in the 1966 through 1976 period (Table 3.2-2), but the fishery transitioned to a domestic one after passage of the MSA in 1977. Canary rockfish has become an important recreational target in recent years north of Cape Mendocino.

Annual catches of canary rockfish dropped substantially from the late 1940s through the mid-1960s when foreign fleets started fishing off the West Coast and averaged less than 500 mt (Figure 3.3-6 Golden and Wood 1990). High Asian demand for rockfish resulted in catches that averaged between 2,000 mt and 4,000 mt per year from the late 1960s through the early 1990s. In 1983, a 40,000 pound trip limit was imposed on the *Sebastes* complex for the Columbia and U.S. Vancouver INPFC areas. Canary rockfish were managed as part of this complex, so this represented the first regulation of canary harvest. Sampson and Stewart (1994) recommended a reduced ABC for canary for 1995 to decrease the harvest rate which was estimated to be greater than the overfishing threshold of $F_{20\%}$. Beginning in 1995 the canary rockfish ABC was reduced by nearly 60%; this harvest level (ABC) has remained at about 1,000 mt since. A history of commercial trawl regulations for the *Sebastes* complex is summarized in Table 3.3-1.

The first species-specific trip limit was also imposed for canary rockfish in 1995 (6,000 pounds per month) when the stock was first required to be sorted from the other *Sebastes* (Table 3.3-3). In 1998, canary rockfish were still managed as part of the *Sebastes* complex, but no more than 15,000 pounds of the 40,000 two-month cumulative limit of *Sebastes* could be canary. Since 1998, commercial harvest of canary rockfish has been drastically reduced. The stock is managed separately from the *Sebastes* complex with its own total catch OY. There is no commercial targeting of canary, and the total catch OY is managed for incidental catch or bycatch. Small footrope trawls were required beginning in 2000 to land shelf rockfish. This gear restriction eliminated trawl targeting of shelf rockfish since bottom trawls with small footropes would be destroyed if they were to venture into high relief habitats.

In 2003, the new assessment by Methot and Piner (2002b) indicated a more pessimistic outlook for canary rockfish. The total catch OY was reduced by about half from the 2000 through 2002 period resulting in implementation of significantly conservative management measures. Depth-based restrictions were put in place to avoid canary rockfish and other overfished groundfish species. No retention regulations were imposed for fixed gear commercial fisheries (line gears can more readily target canary in high relief habitats) and reduced bag limits were imposed on recreational fisheries. A small trip limit was adopted for the limited entry trawl fishery to allow landings of incidentally-caught canary rockfish that would otherwise be discarded at sea. Shrimp trawls were required to have fish excluders or bycatch reduction devices (BRDs) year round starting in 2003. Previously, BRDs were required inseason when the shrimp fishery reached their canary rockfish harvest guideline.

Recreational fishery regulations for canary rockfish have become increasingly restrictive in recent years as well (Table 3.3-4). Decreased rockfish bag limits and the implementation of canary rockfish sub-limits were first used to reduce recreational harvest. Depth based restrictions and non-retention fisheries were implemented in 2003. Additionally, north of 40°10' N latitude, recreational fisheries will be limited to areas shallower than depths inhabited by canary rockfish if predetermined recreational catch thresholds are reached. See Section 3.4.6 for a description of recreational fishery sectors relative to overfished species.

3.3.1.4 Lingcod

Lingcod are an important species for both recreational and commercial fisheries (Figure 3.3-7). From 1983 through 1993, a coastwide ABC of 7,000 mt was in effect with the INPFC area components: U.S. Vancouver (1,000 mt), Columbia (4,000 mt), Eureka (500 mt), Monterey (1,100 mt) and Conception (400 mt). In 1994, ABC's were unchanged and a coastwide Harvest Guideline of 4,000 mt was established. Following a new assessment for the northern area (Jagielo 1994), the coastwide ABC and harvest guideline were reduced for 1995 through 1997 to 2,400 mt with separate ABC's for the U.S. Vancouver/Columbia (1,300 mt), Eureka (300 mt), Monterey (700 mt), and Conception (100 mt) areas. In 1998, following an updated assessment for the northern area (Jagielo *et al.* 1997), the coastwide ABC was reduced to 1,532 mt with a harvest guideline of 838 mt. Separate ABC's by area were: Vancouver (including Canada)/Columbia (1,021 mt), Eureka (139 mt), Monterey (325 mt), and Conception (46 mt). For 1999, the Council established a coastwide ABC of 960 mt and a harvest guideline of 730 mt, with area-specific ABC's of U.S. Vancouver/Columbia (450 mt), Eureka (139 mt), Monterey (325 mt), and Conception (46 mt). Following a new assessment for the southern area (Adams *et al.* 1999) and a rebuilding analysis (Jagielo 1999), the coastwide ABC for 2000 was reduced to 700 mt which included area values of U.S. Vancouver/Columbia (450 mt) and Eureka/Monterey/Conception (250 mt). In 2001, the Council established a coastwide ABC of 960 mt and an OY of 730 mt. Following the most recent assessment for lingcod (Jagielo *et al.* 2000) and rebuilding analysis (Jagielo and Hastie 2001, Appendix D-1) the Council approved ABCs for 2002 and 2003 of 745 mt and 841 mt respectively.

A history of lingcod commercial trawl trip limits is summarized in Table 3.3-5. No trip limits were in effect prior to 1995, and trip limits have become increasingly restrictive. The Council adopted a new, more conservative groundfish management regime for 2003 largely in response to new, more pessimistic assessments for bocaccio (south of Cape Mendocino, California), canary rockfish, and yelloweye rockfish. The centerpiece of the new management regime is a strategy of seasonal depth-based area closures that are designed to reduce mortality of overfished groundfish species. In response to these restrictions, lingcod landings in the commercial trawl fishery have declined substantially from landings in the 1980s (Figure 3.3-8).

Management tools used to reduce the recreational take of lingcod include the establishment of increasing minimum size limits and decreasing bag limits (Table 3.3-6). Additionally, seasonal closures have been utilized to both reduce recreational landings and to provide protection for nest-guarding males in the winter months. In 2003 for example, retention of lingcod in Washington recreational fisheries is restricted to the period from March 16 through October 15 and California recreational fisheries south of Cape Mendocino are close from January through June. Depth-based management measures were also implemented in 2003 as a means of minimizing mortality of shelf rockfish species designated as overfished. California recreational fisheries are restricted to waters shallower that 20 fm, and Washington and Oregon recreational fisheries will be restricted to waters shallower than 25 fm and 27 fm respectively if harvest guidelines for canary rockfish or yelloweye rockfish are exceeded before the end of the year. The Council also established the Yelloweye Rockfish Conservation Area (YRCA) off the northern Washington coast where recreational fishing is prohibited. See Section 3.4.6 for a description of recreational fisheries sectors relative to overfished species.

3.3.2 License Limitation

Most of the Pacific Coast non-tribal, commercial groundfish harvest is taken by the limited entry fleet. The groundfish limited entry program was established in 1994 for trawl, longline, and trap (or pot) gears. There are also several open access fisheries that take groundfish incidentally or in small amounts; participants in those fisheries may use, but are not limited to longline, vertical hook-and-line, troll, pot, setnet, trammel net, shrimp and prawn trawl, California halibut trawl, and sea cucumber trawl. Directed open access fisheries are described below in this section, and fisheries that harvest groundfish incidentally or serve as part of the economic make-up for West Coast groundfish vessels are discussed in section 3.4.2.6.

In 1994, NMFS implemented Amendment 6 to the Groundfish FMP, a license limitation program intended to restrict vessel participation in the directed commercial groundfish fisheries off Washington, Oregon, and California. The limited entry permits created through that program specify the gear type a permitted vessel may use to participate in the limited entry fishery and the vessel length associated with the permit. A vessel may only participate in the fishery with the gear designated on its permit(s) and may only be registered to a permit appropriate to the vessel's length. Since 1994, the Council has created further license restrictions for the limited entry fixed gear (longline and fishpot gear) fleet that restrict the number of permits useable in the primary sablefish fishery (Amendment 9) and that allow up to three sablefish-endorsed permits to be used per vessel (Amendment 14).

As of March 2002, there were 450 vessels with Pacific Coast groundfish limited entry permits, of which approximately 54% were trawl vessels, 40% were longline vessels, and 6% were trap vessels. The number of vessels registered for use with limited entry permits has decreased since the 2001 implementation of the permit stacking program for sablefish-endorsed limited entry fixed gear permits. Of the approximately 164 sablefish-endorsed permits, 83 are held by vessels registered with more than one sablefish-endorsed permit. Of the vessels that are registered with multiple sablefish-endorsed permits, 25 are registered with two permits and 11 are registered with three permits.

Limited entry permits may be sold and leased out by their owners, so the distribution of permits between the three states often shifts. In 2002, roughly 23% of the limited entry permits were assigned to vessels making landings in California, 39% to vessels making landings in Oregon, and 37% to vessels making landings in Washington. In 1999, this division of permits was approximately 41% for California, 37% for Oregon, and 21% for Washington. This change in state distribution of limited entry permits may also be due to the implementation of the permit stacking program. Vessels operating from northern ports may have purchased or leased sablefish-endorsed permits from vessels that had been operating out of California ports.

3.3.3 Data Systems

3.3.3.1 Catch Monitoring

Various state/federal catch monitoring systems are used in West Coast groundfish management. These are coordinated through the Pacific States Marine Fisheries Commission (PSMFC). PacFIN (Pacific Fisheries Information Network) is the commercial catch monitoring database and RecFIN (Recreational Fishery Information Network) is the database for recreational fishery catch monitoring. Since darkblotched are caught exclusively in commercial fisheries, recreational catch monitoring is not addressed in this rebuilding plan. There are two components to total catch, (1) catch landed in port, and (2) catch discarded at sea. Discards occur for regulatory reasons (i.e., catch in excess of trip and/or landing limits) and market reasons (i.e., catch of unmarketable species or size). A description of the relevant data systems used to monitor total catch and manage commercial fisheries that harvest darkblotched follows.

Monitoring Commercial Landings

Sorting requirements are now in place for darkblotched rockfish. This requires accounting for the weight of landed darkblotched rockfish when catches are hailed at sea or landed. Limited entry groundfish trawl fishermen are also required to maintain logbooks that record the start location, time, and duration of trawl tows, as well as the total catch by species market category (i.e., those species and complexes with sorting requirements). Landings are recorded on state fish receiving tickets. Fishtickets are designed by the individual states, but there is an effort to coordinate record-keeping requirements with state and federal managers. Poundage by sorted species category, area of catch, vessel identification number, and other data elements are required on fishtickets. Landings are also sampled in port by state personnel to collect species composition data, otoliths for ageing, lengths, and other biological data. Sample rates vary between fishery and state, but there is an effort to sample about 20% of the landed catch. A suspension of at-sea sorting requirements and full retention of catch is allowed in the whiting fishery (by FMP Amendment 10 and an annual Exempted Fishing Permit [EFP] in the Shoreside Whiting sector). The at-sea whiting fishery has 100% on-board observer coverage, while the shoreside whiting sector brings 100% of their catch to port for sampling. Landings, logbook data, and state port sampling data are reported inseason to the PacFIN database managed by the PSMFC (www.psmfc.org/pacfin/index.html). The GMT and PSMFC manage the Quota Species Monitoring (QSM) dataset reported in PacFIN. All landings of groundfish stocks of concern (overfished stocks and stocks below B_{MSY}) and target stocks and stock complexes in West Coast fisheries are tracked in QSM reports of landed catch. The GMT recommends prescribed landing limits and other inseason management measures to the Council to attain, but not exceed total catch OYs of QSM species. Stock and complex landing limits are modified inseason to control total fishing-related mortality; QSM reports and landed catch forecasts are used to control the landed catch component.

Monitoring Recreational Catch

Recreational catch is monitored by the states as it is landed in port. These data are compiled by the Pacific States Marine Fisheries Commission (PSMFC) in the Recreational Fisheries Information Network (RecFIN) database. The types of data compiled in RecFIN include sampled biological data, estimates of landed catch plus discards, and economic data. These data are readily available to managers, assessment scientists, and the general public in prepared reports that can be accessed on the Internet (http://www.psmfc.org/recfin/index.html).

The Marine Recreational Fisheries Statistics Survey (MRFSS) is an integral part of the RecFIN program. Traditionally, there are two primary components of the survey, field intercept surveys (administered under supervision of PSMFC) and a random phone survey of coastal populations (administered by a third party contracted by NMFS). The field intercept surveys were used to estimate catch, and the phone survey was used to estimate effort. The results of these two efforts are combined in the RecFIN data system maintained by PSMFC, and estimates of total effort and fishing mortality are produced along with other data potentially useful for management and stock assessments. However, MRFSS was not designed to estimate catch and effort at the level of precision needed for management or assessment; it was designed to provide a broad picture look of national fisheries. Comparison with independent and more precise estimation procedures has shown wide variance in catch estimates. Inseason management of recreational fisheries using MRFSS has been compromised by huge inseason variance of catch estimates. In recent years, efforts have been made to improve MRFSS. For instance, in 2001 PSMFC, with support from NMFS, began a new survey to estimate party/charterboat (CPFV) fishing effort in California. This survey differed from the traditional MRFSS telephone survey of anglers to determine CPFV trips by two-month period. The survey sampled 10% of the active CPFV fleet each week to determine the number of trips taken and the anglers carried on each trip. This 10% sample is then expanded to make estimates of total angler trips for Southern California and Northern California. However, the requisite precision for managing for the low OYs of overfished species like canary rockfish and bocaccio was still lacking. Therefore, the Council and West Coast states lobbied for a different system to replace MRFSS on the West Coast. NMFS agreed, and a new catch and effort estimation season is being developed.

Washington and Oregon have used the MRFSS system as a supplement to their port sampling programs from which most of their recreational catch estimates are derived. California has had a greater dependence on MRFSS to estimate their recreational catch. One outcome of this dependence are highly uncertain catch estimates of California recreational catch. This has likely compromised efforts to control total mortality of recreational groundfish species in California such as bocaccio and canary rockfish.

Discard Estimation

Limiting discards (defined as bycatch in the MSA) to the extent practicable is an MSA mandate. Effective bycatch accounting and control mechanisms are also critical for staying within target total catch OYs. The first element in limiting bycatch is accurately measuring bycatch rates by time, area, depth, gear type, and fishing strategy. Bycatch rates of darkblotched rockfish in West Coast trawl (and nontrawl) fisheries are uncertain. NMFS first implemented the West Coast Groundfish Fishery Observer Program in August 2001 to make direct observations of commercial groundfish discards. Observer coverage initially extended to about 10% of the West Coast limited entry fleet effort, but increased to about 20% by the summer of 2002 (Elizabeth Clarke, NMFS NWFSC, pers. comm.). Given the skewed distribution of bycatch in West Coast groundfish fisheries, many observations in each sampling strata (i.e. target effort by gear type by area) are needed to estimate representative bycatch rates of overfished groundfish species. The Council and NMFS are currently in transition regarding the best approach to model bycatch and discard. There may be a period when a combination of Observer Program data and the best currently available methods for estimating bycatch are used to estimate bycatch. A preliminary report and summary analysis of the first year of Observer Program data was released in January 2003. The report is available on the Northwest Fisheries Science Center website at: http://www.nwfsc.noaa.gov/fram/Observer/datareport.htm.

The West Coast Groundfish Fishery Observer Program is designed to provide estimates of fleet-wide discards in commercial fisheries; fishtickets are the mandated landings accounting mechanism. All vessels that participate in the West Coast groundfish fishery are required to carry NMFS-trained observers when notified to do so by NMFS or its designated agent. In the initial phase of the Observer Program, about 20 observers were deployed. The program has since expanded to 40 observers stationed along the coast from Bellingham, Washington to Santa Barbara, California. Logbook data needs to be available to fully utilize observer data because observers initially record hail weights and logbook data for retained catch and these values need to be adjusted by fishticket information to achieve total catch estimates. One difficulty currently unresolved in the Observer Program data is the ability to reconcile all observer records with fishtickets (Han-Lin Lai, NMFS NWFSC, pers. comm.). Another difficulty is there needs to be a statistically significant number of observations of discard across all strata to determine representative bycatch rates for these strata. Implementation of depth-based management (as an emergency action in September of 2002) further exacerbated the data-sparseness of observations, since areas where many observations occurred in the first year of the Observer Program are now closed to fishing. The Council sponsored a Bycatch Workshop in January 2003 whose participants hailed from the ranks of the SSC, GMT, GAP, and the Council of Independent Experts to begin resolving these technical issues. The SSC and other Council advisors will further deliberate these issues this year before a decision on how and when to use observer data in management is made. It is anticipated that observer-based bycatch rates will be used for deciding 2004 management measures (either in September or November 2003) and may be available for 2003 inseason management decisions sometime this year.

Currently, the best available science (in the absence of useable observer data) that informs managers of bycatch and discard rates of groundfish in the non-whiting trawl fishery is a model that uses logbook and Enhanced Data Collection Program (EDCP) data to estimate coincident catch rates in target trawl efforts for other species (Hastie 2001). The Hastie model estimates bycatch rates (defined as coincident catch rates in this context) of bocaccio, canary rockfish, darkblotched rockfish, lingcod, POP, and widow rockfish in two-month blocks. The seasonality of bycatch is an important management consideration. Target opportunities for healthy flatfish and DTS species vary seasonally and geographically. It is reasonable to expect bycatch rates of overfished groundfish species to vary in accordance with the concurrence of target species and overfished species. In November 2001, the Council adopted the Hastie model to use for bycatch accounting and control starting in 2002. In 2002, Hastie restratified the bycatch rates used in the model by depth (using tow start locations in 1999 trawl logbooks) in anticipation of the new depth-based management regime. Depth-based bycatch rates from the Hastie model are applied to landed weight of the target species in the target fisheries depicted in Tables 3.3-7 through 3.3-10 to estimate seasonal bycatch of the overfished groundfish species subject to rebuilding plans evaluated in this EIS.

The Council decided in April 2003 to modify the Hastie trawl bycatch model by using bycatch rates derived from direct observations of trawl efforts in the West Coast Groundfish Observer Program for 2003 inseason management decision-making. These data and resulting analyses came to late for use in analyses in this EIS. The new observer bycatch rates are still considered a sparse dataset and are only available for the limited entry trawl sector prior to implementation of depth-based management in the fall of 2002. These data were filtered using starting and ending tow locations to emulate, to the extent possible, observations from areas that are outside currently closed trawl Rockfish Conservation Areas (RCAs). The data limitations required aggregation of observations to strata north and south of Cape Mendocino and deeper and shallower than the trawl RCA. Therefore, until more observer data is available, the seasonal and target strategy strata are collapsed in the Hastie model and only the trawl fishery is modeled for bycatch accountability. Table 3.3-7 compares total mortality estimates of those overfished groundfish species analyzed in the Hastie trawl bycatch model using both logbook-based and observer-based bycatch rates. The management implications of using observer data, as it currently exists, are greatest for bocaccio, canary rockfish, and lingcod.

Assumed Darkblotched Rockfish Bycatch Rates Used in This EIS

The choice of bycatch rates to use for darkblotched bycatch control for 2002 and 2003 management was uncertain, at best, given the lack of sorting requirements for darkblotched prior to 2001. The high range was not considered plausible, because accepting it would assume that vessels discarded significant quantities of darkblotched before they reached their north slope rockfish trip limits (Hastie 2001). This was considered unlikely since darkblotched are generally larger and more valued than other species in the minor north slope rockfish complex. The low range was considered riskier than the mid range; therefore, the choice of the mid range was adopted. The extent that this bycatch rate is a reasonable proxy for darkblotched in lieu of direct (contemporary) observations of fishery interceptions is unknown.

In this analysis, the mid range of bycatch rates is considered the most plausible and risk neutral. All rebuilding plan alternatives except *Maximum Conservation* use the mid range of bycatch rates estimated in the Hastie model to estimate darkblotched bycatch (Table 3.3-8). The *Maximum Conservation* alternative does not rely on modeled bycatch or any other bycatch accounting mechanism since all fishing-related mortality is eliminated.

Assumed Pacific Ocean Perch Bycatch Rates Used in This EIS

In November 2001, the Council chose the mid range of bycatch rates derived from logbooks for managing POP. The high range was not considered plausible, because accepting it would assume that vessels discard significant quantities of POP before they reach their trip limits. The low range was considered less plausible than the mid range since that scenario implied a projected catch that was lower than the actual recorded catch.

Therefore, all rebuilding plan alternatives except *Maximum Conservation* use the mid range of bycatch rates estimated in the Hastie model to estimate POP bycatch (Table 3.3-9). The *Maximum Conservation* alternative does not rely on modeled bycatch or any other bycatch accounting mechanism since all fishing-related mortality is eliminated.

Assumed Canary Rockfish Bycatch Rates Used in This EIS

In November 2001, the Council chose the low range of bycatch rates derived from logbooks for managing canary rockfish. Results from the first two years of conducting the Washington Arrowtooth Flounder Exempted Fishing Permit (EFP) showed significantly lower coincident catch rates of canary than the low range presented in Table 3.3-10. Therefore, the low range was considered risk-neutral for canary rockfish.

Therefore, all rebuilding plan alternatives except *Maximum Conservation* use the low range of bycatch rates estimated in the Hastie model to estimate canary rockfish bycatch (Table 3.3-10). The *Maximum Conservation* alternative does not rely on modeled bycatch or any other bycatch accounting mechanism since all fishing-related mortality is eliminated.

Assumed Lingcod Bycatch Rates Used in This EIS

In November 2001, the Council chose the mid range of bycatch rates derived from logbooks for managing lingcod. The high range was not considered plausible, because the effect of using small footropes in trawl efforts on the shelf was not represented in the 1999 logbook data input in the Hastie model. The low range was considered less plausible than the mid range since that scenario implied a projected catch that was lower than the actual recorded catch in 2000 and 2001. A discard mortality rate of 50% of lingcod trawl discards is assumed based on a 1997 WDFW study.

Therefore, all rebuilding plan alternatives except *Maximum Conservation* use the mid range of bycatch rates estimated in the Hastie model to estimate lingcod bycatch (Table 3.3-11). The *Maximum Conservation* alternative does not rely on modeled bycatch or any other bycatch accounting mechanism since all fishing-related mortality is eliminated.

3.3.3.2 The Stock Assessment Process

Stock assessments for Pacific Coast groundfish are generally conducted by staff scientists of the California Department of Fish and Game (CDFG), Oregon Department of Fish and Wildlife, Washington Department of Fish and Wildlife, Oregon State University, University of Washington, and the Southwest, Northwest, and NMFS Alaska Fisheries Science Centers. These assessments describe the condition or status of a particular stock and reports on its health. This allows biologically sustainable harvest levels to be forecast; scientists can then make management recommendations to maintain or restore the stock. If a stock is determined to be overfished (less than 25% of its unfished biomass), a rebuilding analysis and a rebuilding plan are developed.

For more than 20 years, groundfish assessments have primarily been concentrated on important commercial and recreational species. These species account for most of the historical catch and have been the targets of fishery monitoring and resource survey programs that provide basic information for quantitative stock assessments. However, not all groundfish assessments have the same level of information and precision.

Quantitative and non-quantitative assessments are used for groundfish stocks. Stocks are assessed quantitatively. Scientists use life history data to build a biologically realistic model of the fish stock for these stock assessments; they then calibrate the model, so it reproduces the observed fishery and survey data as closely as possible. During the 1990s, most West Coast groundfish assessments were conducted using the stock synthesis model. Recently there has been development of similar, but more powerful, models using state-of- the-art software tools. Assessment models and results are independently reviewed by the Council's stock assessment review (STAR) Panels. It is the responsibility of the STAR Panels to review draft stock assessment documents and relevant information to determine if they use the available scientific data effectively to provide an accurate assessment of the condition of the stock. In addition, the STAR Panels review the assessment documents to see that they are sufficiently complete and the research needed to improve assessments in the future is identified. The STAR process is a key element in an overall process designed to make timely use of new fishery and survey data, to analyze and understand these data as completely as possible, to provide opportunity for public comment, and to assure the assessment results are as accurate and error-free as possible.

Following review of assessment models by the STAR Panels and subsequently the GMT and SSC, the GMT uses the reviewed assessments to recommend preliminary ABCs and OYs to the Council. The SSC comments on the STAR review results and the GMT recommendations. Biomass estimates from an assessment may be for a single year or an the average of the current and several future years. In general, an ABC will be calculated by applying the appropriate harvest policy (MSY proxy) to the best estimate of current biomass. ABCs based on quantitative assessments remain in effect until revised by either a full or partial assessment.

Full assessments provide information on the abundance of the stock relative to historical and target levels, and provide information on current potential yield. Scientists conduct partial assessments when they do not have enough data for a full assessment. Even full assessments can vary widely in reliability, because of the amount of data available for modeling. Council-affiliated scientists conduct several assessments each year. Individual stocks are periodically reassessed as often as every year—currently only the case for Pacific whiting—to every three or four years. However some species have been assessed only once.

Stocks with ABCs set by non-quantitative assessments typically do not have a recent, quantitative assessment, but there may be a previous assessment or some indicators of the status of the stock. Detailed biological information is not routinely available for these stocks, and ABC levels have typically been established on the basis of average historical landings. Typically, the spawning biomass, level of recruitment, or the current fishing mortality rates are unknown.

Many species have never been assessed and lack the data necessary to conduct even a qualitative assessment, such as a general indication in biomass trend. ABC values have been established for only about 26 stocks. The remaining species are incidentally landed and usually are not listed separately on fish landing receipts. Information from fishery-independent surveys are often lacking for these stocks, because of their low abundance or invulnerability to survey sampling gear. Precautionary measures continue to be taken when setting harvest levels (the OYs) for species that have no or only rudimentary assessments. Since implementation of the 2000 specifications, ABCs have been reduced by 25% to set OYs for species with less rigorous stock assessments, and by 50% to set OYs for those species with no stock assessment. At-sea observer data are expected to be available for use in the near future to upgrade the assessment capability or evaluate overfishing potential of these stocks. Interim ABC values may be established for these stocks based on qualitative information.

The accuracy and reliability of various data used in assessments and the scientific assumptions on which they are based need to be further evaluated to improve the quality of forecasts. Uncertainty associated with fishery logbook data, calibration of surveys, and accuracy of aging techniques also need more evaluation when considering survey reliability. Finally, a better understanding of ecosystem change and its influence on groundfish abundance will also improve stock assessments. The Council and NMFS have identified a range of projects that will help to improve stock assessments:

- develop models to better quantify uncertainty and thus better specify precautionary management measures;
- develop models to specifically for species with limited data;
- make assessment methods more standardized and conduct a formal review of these methods in order to shorten subsequent review of each species' assessment, which could allow more assessments to be reviewed each year; and
- develop models to better represent spatially-structured populations, such as populations with low rates of internal mixing or populations with ontogenetic patterns spanning a range of habitats.

3.3.3.3 Research Fisheries

Research fisheries, or resource surveys, are an essential part of the management process. Two important issues arise in connection with these surveys. First, they provide fishery-independent data which, because it is gathered in a uniform, consistent manner, provide "benchmarks" used to track natural and anthropogenic changes in fish abundance. In some cases, a single survey or a short time series can be directly calibrated to absolute abundance. An annual survey will most closely track natural biological fluctuations and smooth out apparent fluctuations caused by environmental effects on catchability. However, a second issue stems from the fact that most current surveys involve catching fish, adding to total fishing mortality. For overfished stocks with low OY values, the research take can represent a significant proportion of the harvest specification. At the same time, the reduction in fishery catches means less data are available from this source, making it even more difficult to determine abundance, measure stock recovery, and estimate potential yields. Long-term groundfish survey efforts include:

- Acoustic and midwater trawl survey: A coastwide survey that is conducted triennially (1977 through 2001) for Pacific whiting. Recent surveys have been coordinated with the Canadian acoustic survey to assure adequate coverage in northern areas.

- Shelf survey: A bottom trawl survey conducted triennially in midsummer, with sufficient coastwide coverage for most target species. Areas south of Point Conception were not surveyed until recently, however. The survey covers bottom depths of 30 fm to 275 fm using two large (125 foot) chartered vessels.

- Slope survey: A bottom trawl survey conducted near annual in mid-autumn, covering bottom depths of 100 fm to 700 fm. Survey was started in 1998 and 1999.

- Nearshore survey: These are SCUBA and hook-and-line surveys for various nearshore rockfish off California and are conducted by CDFG.

- Mark-recapture survey: This effort targets black rockfish and lingcod by WDFW.

- Shelf rockfish recruitment survey: A midwater trawl survey off Central California by Southwest Fisheries Science Center (SWFSC) for age zero rockfish.

- California Cooperative Oceanographic Fisheries Investigation (CalCOFI): A multi-species, multi-disciplinary oceanographic and egg and larvae survey off Southern California, which is currently conducted quarterly.

- International Pacific Halibut Commission (IPHC) annual survey. This survey using longline vessels is important for management of Pacific halibut. However, it catches groundfish incidentally.

Additional surveys would increase the accuracy and reliability of management specifications. Increasing the number of surveys and geographic scope would provide information about distribution, abundance, and age structure of many groundfish populations while new types of survey could provide a better index of spawning biomass. A variety of other initiatives are needed to test the accuracy of existing techniques and develop new methods. Because catches of overfished species has become a critical concern, survey methods that do not involve capture need to be developed. For example, submersible surveys, where fish are counted and basic measurements taken through photography are being developed and tested. These may be especially appropriate for depleted rockfish species that occur in discrete habitats such as reefs and rock piles.

3.3.4 Enforcement

Traditional fishery enforcement techniques include air and surface craft surveillance, declaration requirements, landing inspections, and analysis of catch records and logbooks. Current assets for patrolling offshore areas include helicopter and fixed wing aircraft deployed by the U.S. Coast Guard and state enforcement entities, one large 210-foot Coast Guard cutter, and smaller Coast Guard and state enforcement vessels. Only the aircraft and large cutter are suitable for patrolling the more distant offshore closed areas. The availability of Coast Guard assets may be challenged by other missions such as Homeland Security and search and rescue. State enforcement assets may be compromised by pessimistic budget outlooks for next year that threaten to reduce these assets as state programs are rationalized under an increasingly more conservative fiscal environment.

Depth-based restrictions are a new management tool in Council-managed fisheries and were used on a large scale for the first time in 2003. The ability to monitor vessels' locations related to depth-based closed areas is considered essential to effective management and requires consideration for substantially increasing an at-sea enforcement presence coupled with a Vessel Monitoring System (VMS) that remotely tracks vessels using satellites and transponders. VMS can provide this information to enforcement agencies through the use of a specialized transmitter on subject fishing vessels, which transmits position information via satellite. There are several issues related to the implementation of VMS in a fishery, including the variety of equipment types and associated costs, vessels' ability to carry VMS, VMS operating requirements, VMS vessel coverage, and coordination of VMS with traditional enforcement techniques. As a new monitoring tool for West Coast groundfish fisheries, VMS will dramatically enhance rather than replace traditional techniques.

In response to enforcement complexities of the depth-based closures in 2003, the Council formed the Ad Hoc VMS Committee comprised of fishing industry representatives and Enforcement Consultant participants to further investigate VMS and other enforcement issues relative to depth-based management. NMFS, in consultation with the Council and the Ad Hoc VMS Committee, has prepared a proposed rule and an associated Environmental Assessment/ Regulatory Impact Statement/ Initial Regulatory Flexibility Analysis (RIR/IRFA) for a pilot VMS program for 2003. The RIR/IRFA provides a description of the range of fishery monitoring alternatives considered, including their associated costs, as well as an analysis of their impacts.

The burden of covering the costs associated with VMS is a significant issue, and federal funds have not been identified for these expenditures. The Council has recommended that VMS units be installed on the limited entry trawl and limited entry fixed gear fleets (over 400 vessels) and that NMFS fully fund all VMS requirements if funding becomes available. Currently, the estimated costs of a VMS transmitting unit ranges from $1,800 to $5,800 with transmission costs of $1 to $5 per day. In the absence of federal funding the costs may be bourne entirely by the vessel owners. NMFS is revising its type-approval process and will be testing emerging VMS technologies in time to notify the public of a list of approved VMS equipment before implementation of the final rule. The price of some of these new technologies is expected to be generally lower that those quoted above.

Declarations of fishing intentions have been required in the past to increase the efficiency of at-sea patrols and improve enforcement, particularly in areas closed to certain gear types or fishing strategies. State enforced declaration requirements are being replaced by a larger more comprehensive federal declaration system to be used in conjunction with VMS and traditional patrols in 2003. Under the federal declaration program, legal incursions into closed areas must be reported to enforcement authorities prior to fishing. This requirement is generally reserved for vessels that would otherwise appear to be fishing illegally when viewed from an at-sea patrol craft.

Shoreside enforcement activities complement at-sea monitoring and declaration requirements by inspecting recreational and commercial vessels for compliance with landing limits, gear restrictions, and seasonal fishery closures. State agencies are increasingly using dockside sampling as a means of assessing groundfish catch in recreational fisheries, which when combined with state and federal enforcement patrols at boat launches and marinas, provides a means of ensuring compliance with bag limits and fishery closures. Commercial landings are routinely investigated upon landing or delivering to buying stations or processing plants and can be tracked through fishticket and logbook records.

3.3.5 Managing with Risk and Uncertainty

Fishery managers are constantly confronted with uncertainty, and the environmental consequences of decision making is often a product of this uncertainty. Resource characteristics make this more of an issue in fisheries than in most other resource systems, because populations are widely dispersed in an inaccessible environment. In fact, the range of harvest level alternatives evaluated in this EIS is largely a product of uncertainty; given perfect knowledge (and perfect agreement about social objectives) it would be possible to precisely specify the optimal harvest level.[7/] Walters (1986) classifies uncertainty in three broad categories; Mace and Sissenwine (2002) identify an additional two management-related sources of uncertainty. These five sources of uncertainty are:

- Natural variation in the environment, including that caused by other, non-fishing human activities. Natural variability in recruitment is probably the most germane factor for estimating sustainable yields.

7/ Traditionally, MSY has been viewed as an OY or target harvest level; but for populations below MSY, harvest levels must be adjusted downward to allow rebuilding to the MSY biomass. Further, although fishery managers view MSY dynamically by specifying fishing mortality rates (versus constant catch), population productivity (recruitment) can vary due to environmental factors such as regime shifts. Over the long term these environmental factors need to be accounted for or the population size can move away from the MSY level. Even if the biological system were perfectly specified, society may value resources in complex ways, for example, by attaching non-consumptive value to some proportion of the resource. Finally, the precautionary approach and National Standards Guidelines treat MSY as a limit rather than a target. In summary, annual specification is ongoing, and in a world without uncertainty these variables would have to be correctly identified each year for future yields to achieve MSY.

- Observation errors, including measurement error—an inaccurate temperature reading for example—and sampling error, or the difference between the distribution of values in a set of measurements and the actual frequency and range of values in the population or phenomenon being measured.

- Model mis-specification, or the accuracy of abstract representations of reality (models) in terms of causal relationships and system dynamics.

- Translation of scientific advice into management measures. Scientists may express uncertainty by bracketing a value with a range or confidence interval. Managers may be tempted to choose a value at the high end of the range if there is no more specific information about the risk (versus short-term benefit) of such an action.

- Imperfect implementation of management measures. The most common implementation error stems from inaccurate monitoring of the fishery. If fishing mortality is not accurately measured on a reasonably "real time" basis total catch may exceed the harvest specification

Groundfish management (like many other management regimes) suffers from all of these sources of uncertainty.

Greater uncertainty about the outcome of a particular action or event generally increases the level of risk, depending on how many possible outcomes would be undesirable. Risk analysis evaluates the likelihood that a given action will produce an undesirable outcome, often using statistical methods to specify the probability of certain outcomes. The rebuilding analyses that underlie the range of harvest specifications for overfished species use these methods to compute the probability of a population rebuilding to B_{MSY} within the specified time period if a given level of harvest is allowed. This is a form of risk analysis; the residual probability value expresses the risk of the population not reaching B_{MSY}; but the rebuilding analyses only evaluate recruitment variability, one component of the many sources of uncertainty about future stock performance. These analyses do, however, present managers with a more explicit measure of risk on which to base their decisions.

Resources users' and the public's skepticism of the validity of science highlights the significance of uncertainty and risk. The following sources of uncertainty can be identified in relation to specifying 2003 management measures:

- Changes in the environmental regime (natural variability). Meso-scale climate variability influences stock productivity.

- The effect of human activity on population productivity. Although fishing and non-fishing impacts to habitat are demonstrably damaging, it is not possible to quantify the effect on stock productivity or precisely specify the relationship between habitat impacts and productivity. The effect of changes in trophic structure is also uncertain.

- Observation error comes into play in all cases where fishery-dependent and independent data are gathered. Measurement error is common to much fishery-dependent data; bycatch estimates represent one crucial source of error of this type. Although measurement error is more easily reduced in survey work, sampling error is almost always present. For example, random stratified assignment of fishery observes allows partial coverage to be representative of what occurs in a fishery as a whole, but some, albeit quantifiable, level of uncertainty exists.

- Model error is unavoidable and not always transparent. For this reason the STAR process described above, involves several stages of review by a range of experts and interested parties. This may reduce risk (even if sources of uncertainty are not formally addressed) through a shared understanding about the state of nature being modeled and described.

- Mistranslation and misapplication in the management process are ongoing issues. Mistranslation—the choice of "over-optimistic" harvest levels, for example—are reduced somewhat through the procedures such as the rebuilding analyses now used to determine harvest specifications for those species. In contrast to a point estimate bounded by a confidence interval, a rebuilding analysis can specify the risk (in terms of the probability of the stock rebuilding with a given time period) for any value within a range.

Misapplication is still a major problem, one that overlaps with observation error. Timely and accurate estimates of recreational catches are currently a major challenge to effective inseason management. Since bocaccio were declared overfished, for example, actual catches have exceeded harvest specifications, largely for this reason.

Uncertainty and risk are also translatable into socioeconomic impacts, an issue not explored by Mace and Sissenwine. Very broadly, mis-specification of harvest levels involves the assumption of either short-term or long-term risk. Short-term risk accords with under-harvest, if harvests are set below a level that is both sustainable in the long term and below some social optimum (representing a mix of consumptive market and non-consumptive, non-market values). Long-term risk is usually expressed as the potential of over-harvest compromising future returns from the fishery; it involves the tradeoff of short-term benefit (harvests now) against long-term gain (potentially higher harvests in the future). To a large degree the management process implicitly plays off these two types of risk. However, current analytical capability precludes effective quantification of the tradeoff.

TABLE 3.3-1 Management history of commercial trawl groundfish regulations affecting the landings of darkblotched rockfish.[a/] (Page 1 of 2)

Date		Area	Limit (lbs)	Times	Per [b/]	Period	Species Complex [c/]
1983	1-Jan.	Coastwide	40,000	Unlimited	Trip		*Sebastes*
	28-June	N of 43°	40,000	Once	Week		*Sebastes*
	10-Sept.	N of 43°	3,000	Unlimited	Trip		*Sebastes*
1984	1-Jan.	N of 43°	30,000	Once	Week		*Sebastes*
		S of 43°	40,000	Unlimited	Trip		*Sebastes*
	12-Feb.	N of 42°50'	30,000	Once	Week		*Sebastes*
		S of 42°50'	40,000	Unlimited	Trip		*Sebastes*
	6-May	N of 42°50'	15,000	Once	*Week		*Sebastes*
	1-Aug.	N of 42°50'	7,500	Once	*Week		*Sebastes*
1985	10-Jan.	N of 42°50'	30,000	Once	*Week		*Sebastes*
	28-Apr.	N of 42°50'	15,000	Once	**Week		*Sebastes*
	1-Sept.	N of 43°22'	15,000	Once	**Week		*Sebastes*
		S of 43°22'	40,000	Unlimited	Trip		*Sebastes*
	6-Oct.	N of 43°22'	20,000	Once	**Week		*Sebastes*
1986	1-Jan.	N of 43°22'	25,000	Once	**Week		*Sebastes*
	31-Aug.	N of 43°22'	30,000	Once	**Week		*Sebastes*
1987	1-Jan.	N of 43°21'34"	25,000	Once	**Week		*Sebastes*
		S of 43°21'34"	40,000	Unlimited	Trip		*Sebastes*
1991	1-Jan.	S of 43°21'34"	25,000	Unlimited	Trip		*Sebastes*
1992	1-Jan.	Coastwide	50,000	Once	Two Weeks		*Sebastes*
1994	1-Jan.	Coastwide	80,000	Cumulative	Month		*Sebastes*
	1-Sept.	S of 40°30'	100,000	Cumulative	Month		*Sebastes*
1995	1-Jan.	N of 45°20'15"	35,000	Cumulative	Month		*Sebastes*
		45°20'15" - 40°30'	50,000	Cumulative	Month		*Sebastes*
1996	1-Jan.	N of 45°20'15"	70,000	Cumulative	Two Months		*Sebastes*
		45°20'15" - 40°30'	100,000	Cumulative	Two Months		*Sebastes*
		S of 40°30'	200,000	Cumulative	Two Months		*Sebastes*
	1-Nov.	N of 45°20'15"	35,000	Cumulative	Month		*Sebastes*
		45°20'15" - 40°30'	50,000	Cumulative	Month		*Sebastes*
1997	1-Jan.	N of 40°30'	30,000	Cumulative	Two Months		*Sebastes*
		S of 40°30'	150,000	Cumulative	Two Months		*Sebastes*
	1-Oct.	N of 40°30'	20,000	Cumulative	Month		*Sebastes*
		S of 40°30'	75,000	Cumulative	Month		*Sebastes*
1998	1-Jan.	N of 40°30'	40,000	Cumulative	Two Months		*Sebastes*
		S of 40°30'	150,000	Cumulative	Two Months		*Sebastes*
	1-July	S of 40°30'	40,000	Cumulative	Two Months		*Sebastes*
1999	1-Jan.	N of 40°30'	24,000	Cumulative	Three Months	Jan.-March	*Sebastes*
			25,000	Cumulative	Two Months	April-Sept.	*Sebastes*
			10,000	Cumulative	One Month	Oct.-Dec.	*Sebastes*
		S of 40°30'	13,000	Cumulative	three Months	Jan.-March	*Sebastes*
			6,500	Cumulative	Two Months	April-Sept.	*Sebastes*
			5,000	Cumulative	One Month	Oct.-Dec.	*Sebastes*
	1-May	N of 40°30'	30,000	Cumulative	Two Months	June-Sept.	*Sebastes*
		S of 40°30'	3,500	Cumulative	Two Months	June-Sept.	*Sebastes*
	1-Aug.	N of 40°30'	10,000	Cumulative	Two Months	Aug.-Sept.	*Sebastes*
	1-Oct.	Coastwide	500	Cumulative	One Month	Oct.-Dec.	*Sebastes*
2000	1-Jan.	Coastwide	3,000	Cumulative	Two Months	Jan.-April	Minor Slope Rockfish
			5,000	Cumulative	Two Months	May-Oct.	Minor Slope Rockfish
			1,500	Cumulative	Two Months	Nov.-Dec.	Minor Slope Rockfish
	1-May	S of 40°10'	7,000	Cumulative	Two Months	May-Oct.	Minor Slope Rockfish
	2-Oct.	S of 40°10'	10,000	Cumulative	Two Months	Nov.-Dec.	Minor Slope Rockfish
2001	1-Jan.	N of 40°10'	1,500	Cumulative	Two Months	Jan.-Dec.	Minor Slope Rockfish
		N of 40°10'	1,500	Cumulative	Month	Nov.-Dec.	Minor Slope Rockfish
		S of 40°10'	14,000	Cumulative	Two Months	Jan.-Dec.	Minor Slope Rockfish
		S of 40°10'	14,000	Cumulative	Month	Nov.-Dec.	Minor Slope Rockfish
	1-July	N of 40°10'	2,000	Cumulative	Two Months	July-Dec.	Minor Slope Rockfish
		S of 40°10'	25,000	Cumulative	Month	July-Dec.	Minor Slope Rockfish
	1-Oct.	N of 40°10'	Closed	NA	NA	Oct.-Dec.	Minor Slope Rockfish

TABLE 3.3-1 Management history of commercial trawl groundfish regulations affecting the landings of darkblotched rockfish.[a] (Page 2 of 2)

Date		Area	Limit (lbs)	Times	Per [b]	Period	Species Complex [c]
2002	11-Jan.	N of 40°10'	1,800	Cumulative	Two Months	Jan.-Dec.	Minor Slope Rockfish
		S of 40°10'	50,000	Cumulative	Two Months	Jan.-Dec.	Minor Slope Rockfish
	7-May	40°10' - 36°	5,000	Cumulative	Two Months	May-Aug.	Minor Slope Rockfish
		40°10' - 36°	50,000	Cumulative	Two Months	Sept.-Dec.	Minor Slope Rockfish
		40°10' - 36°	1,800	Cumulative	Two Months	Sept.-Dec.	Minor Slope Rockfish
	25-July	N of 40°10'	Closed	NA	NA	Sept.-Dec.	Minor Slope Rockfish
		N of 36°	600	Cumulative	Two Months	Sept.-Oct.	Minor Slope Rockfish
		N of 36°	300	Cumulative	Two Months	Nov.-Dec.	Minor Slope Rockfish
	4-Oct.	N of 36°	1,800	Cumulative	Two Months	Nov.-Dec.	Minor Slope Rockfish
		S of 36°	25,000	Cumulative	Two Months	Sept.-Oct.	Minor Slope Rockfish
			40,000	Cumulative	Two Months	Nov.-Dec.	Minor Slope Rockfish
2003	11-Jan.	N of 38°	1,800	Cumulative	Two Months	Jan.-Dec.	Minor Slope Rockfish

a/ Regulations in a given year continue until modifed, superceded or rescinded. Discrepancies will be resolved in favor of the *Federal Register*. After 1994, regulations are only for the limited entry fleet.

b/ * means the option of twice the limit per two weeks. ** means options of twice the limit per two weeks or half the limit twice per week.

c/ 1983-1998: Sebastes Complex means all rockfish except widow rockfish, Pacific ocean perch, and shortbelly rockfish. 1999: south of 40°10' N latitude Sebastes Complex means all rockfish except widow rockfish, Pacific ocean perch, chilipepper rockfish, and splitnose rockfish; north of 40°10' N labitude all rockfish except widow rockfish, Pacifc ocean perch, yellowtail rockfish, and canary rockfish. 2002-Present: Minor Slope Rockfish includes the rockfish species listed in Table 3.3-4, except Pacific ocean perch north of 40°10' N latitude and splitnose rockfish south of 40°10' N latitude.

TABLE 3.3-2 Regulatory Actions including area closures regarding Pacific ocean perch since Fishery Management Plan implementation in 1982.[a/] (Page 1 of 2)

Date	Regulatory Action[b/]
November 10, 1983	Closed Columbia area to Pacific ocean perch (POP) fishing until the end of the year, as 950 mt OY for this species has been reached; retained 5,000-pound trip limit or 10% of total trip weight on landings of Pacific ocean perch in the Vancouver area.
January 1, 1984	Continued 5,000-pound trip limit or 10% of total trip weight on POP as specified in FMP. Fishery to close when area OYs are reached (see action effective November 10, 1983 above).
August 1, 1984	Reduced trip limit in the Vancouver and Columbia areas to 20% by weight of all fish on board, not to exceed 5,000 pounds per vessel per trip. Recommended that when OY is reached in either area, landings of POP will be prohibited in that area (Oregon and Washington implemented POP recommendation in mid July).
August 16, 1984	Automatic closure: commercial fishing for POP in the Columbia area closed for remainder of the year. (See items regarding this species effective January 1 and August 1, 1984 above.)
January 10, 1985	Established Vancouver and Columbia areas POP trip limit of 20% by weight of all fish on board (no 5,000-pound limit as specified in last half of 1984).
April 28, 1985	Reduced the Vancouver and Columbia areas POP trip limit to 5,000 pounds or 20% by weight of all fish on board, whichever is less. Landings of POP less than 1,000 pounds will be unrestricted. The fishery for this species will close when the OY in each area is reached.
June 10, 1985	Landings of POP up to 1,000 pounds per trip will be unrestricted regardless of the percentage of these fish on board
January 1, 1986	Established the POP trip limit north of Cape Blanco (42°50' N) at 20% (by weight) of all fish on board or 10,000 pounds whichever is less; landings of POP unrestricted if less than 1,000 pounds regardless of percentage on board; Vancouver area OY = 600 mt; Columbia area OY = 950 mt.
December 1, 1986	OY quota for POP reached in the Vancouver area; fishery closed until January 1, 1987.
January 1, 1987	Established coastwide POP limit at 20% of all legal fish on board or 5,000 pounds whichever is less (in round weight); landings of POP unrestricted if less than 1,000 pounds regardless of percentage on board; Vancouver area OY = 500 mt; Columbia area OY = 800 mt.
January 1, 1988	Established the coastwide POP trip limit at 20% (by weight) of all fish on board or 5,000 pounds, whichever is less; landings of POP unrestricted if less than 1,000 pounds regardless of percentage on board; Vancouver area OY = 500 mt; Columbia area OY = 800 mt.
January 1, 1989	Established the coastwide POP trip limit at 20% (by weight) of all fish on board or 5,000 pounds whichever is less; landings of POP unrestricted if less than 1,000 pounds regardless of percentage on board (Vancouver area OY = 500 mt; Columbia area OY = 800 mt).
July 26, 1989	Reduced the coastwide trip limit for POP to 2,000 pounds or 20% of all fish on board, whichever is less, with no trip frequency restriction. Increased the Columbia area POP OY from 800 mt to 1,040 mt.
December 13, 1989	Closed the POP fishery in the Columbia area because 1,040 mt OY reached.
January 1, 1990	Established the coastwide POP trip limit at 20% (by weight) of all fish on board or 3,000 pounds whichever is less; landings of POP be unrestricted if less than 1,000 pounds regardless of percentage on board. (Vancouver area OY = 500 mt; Columbia area OY = 1,040 mt).
January 1, 1991	Established the coastwide POP trip limit at 20% (by weight) of all groundfish on board or 3,000 pounds whichever is less; landings of POP be unrestricted if less than 1,000 pounds regardless of percentage on board (harvest guideline for combined Vancouver and Columbia areas = 1,000 mt).
January 1, 1992	Established the coastwide trip limit for POP at 20% (by weight) of all groundfish on board or 3,000 pounds whichever is less; landings of POP be unrestricted if less than 1,000 pounds regardless of percentage on board (harvest guideline for combined Vancouver and Columbia areas = 1,550 mt).
January 1, 1993	Continued the coastwide trip limit at 20% (by weight) of all groundfish on board or 3,000 pounds whichever is less; landings of POP unrestricted if less than 1,000 pounds regardless of percentage on board (harvest guideline for combined Vancouver and Columbia areas = 1,550 mt).
January 1, 1995	Established a cumulative trip limit of 6,000 pounds per month.

TABLE 3.3-2 Regulatory Actions including area closures regarding Pacific ocean perch since Fishery Management Plan implementation in 1982.[a] (Page 2 of 2)

Date	Regulatory Action[b]
January 1, 1996	Established cumulative trip limit of 10,000 pounds per two-month period.
July 1, 1996	Reduced the cumulative 2-month limit for POP to 8,000 pounds.
January 1, 1997	Established cumulative trip limit of 8,000 pounds per two-month period.
January 1, 1998	Established cumulative trip limit of 8,000 pounds per two-month period.
January 1, 1999	Established cumulative limits, January-March: 4,000 pounds per three-month period; April-September: 4,000 pounds per two-month period; October-December: 4,000 pounds per month.
January 1, 2000	Established cumulative limits, January-April: 500 pounds per month; May-October: 2,500 pounds per month; November-December: 500 pounds per month.
January 1, 2001	Established cumulative limits, January-April: 1,500 pounds per month; May-October: 2,500 pounds per month; November-December: 1,500 pounds per month.
July 1, 2001	Increased cumulative limits for July-October to 3,500 pounds per month.
October 1, 2001	Closed to taking, retaining, possessing, or landing POP.
January 1, 2002	Established cumulative limits, January-April: 2,000 pounds per month; May-October: 4,000 pounds per month; November-December: 2,000 pounds per month.
July 5, 2002	All trawling with large footrope trawl gear prohibited north of Cape Mendocino and all trawling for groundfish closed south of Cape Mendocino except for DTS complex, slope rockfish species, and grenadier taken incidentally in those fisheries.
July 5, 2002	Changed cumulative limits, July-December: 4,000 pounds per two-month cumulative limit.
August 8, 2002	September-December: closed to taking, retaining, possessing, or landing POP.
September 13, 2002	Darkblotched Conservation Area (DBCA) established between 100 fm and 250 fm. Trawling with groundfish gear prohibited within the DBCA. All trawling prohibited shoreward of the DBCA in September and small footrope trawl gear required October-December. Large footrope gear permitted seaward of the DBCA September-December.
September 13, 2002	Reinstated cumulative limits, September-October: 4,000 pounds per two-month period; November-December: 2,000 pounds per month.
January 11, 2003	Trawl Rockfish Conservation Area (RCA) established. • North of 40°10' N latitude 100 fm-250 fm (75 fm-250 fm July-August). • 40°10' N latitude to 38° N latitude 60 fm-250 fm (50 fm-250 fm January-February). • 38° N latitude to 34°27' N latitude 60 fm-150 fm (50 fm-150 fm January-February). • South of 34°27' N latitude 100 fm-150 fm along the mainland coast, shoreline - 150 fm around islands. • 250 fm lines are modified January-February and November-December to incorporate petrale sole fishing grounds,. Trawling with groundfish gear prohibited within the RCA. Small footrope trawl gear required shoreward of the RCA. Large and small footrope gear permitted seaward of the RCA.
January 11, 2003	Established 3,000 pound two-month cumulative limit, January-December.
May 1, 2003	Trawl Rockfish Conservation Area (RCA) modified. • North of 40°10' N latitude shoreline-250 fm May-June and 50 fm-200 fm July-December. • 40°10' N latitude to 34°27' N latitude shoreline-200 fm July-August and 60 fm-200 fm September- December. • South of 34°27' N latitude shoreline-200 fm July-August and 100 fm-200 fm along the mainland coast and shoreline to 200 fm around islands September-December. • 200 fm lines modified November-December to incorporate petrale sole fishing grounds. Trawling with groundfish gear prohibited within the RCA. Small footrope trawl gear required shoreward of the RCA. Large and small footrope gear permitted seaward of the RCA.

a/ Discrepancies resolved in favor of the *Federal Register*.
b/ Regulations in a given year continue until modified, superseded, or rescinded.

TABLE 3.3-3. Canary rockfish limited entry trawl cumulative limits (pounds), 1995-2003.[a/]

<table>
<tr><th></th><th>Jan.</th><th>Feb.</th><th>Mar.</th><th>Apr.</th><th>May</th><th>June</th><th>July</th><th>Aug.</th><th>Sept.</th><th>Oct.</th><th>Nov.</th><th>Dec.</th></tr>
<tr><td>1995</td><td>6,000</td><td>6,000</td><td>6,000</td><td>6,000</td><td>6,000</td><td>6,000</td><td>6,000</td><td>6,000</td><td>6,000</td><td>6,000</td><td>6,000</td><td>6,000</td></tr>
<tr><td>1996</td><td colspan="2">18,000</td><td colspan="2">18,000</td><td colspan="2">18,000</td><td colspan="2">18,000</td><td colspan="2">18,000</td><td colspan="2">18,000</td></tr>
<tr><td>1997</td><td colspan="2">14,000</td><td colspan="2">14,000</td><td colspan="2">14,000</td><td colspan="2">14,000</td><td>14,000</td><td>10,000</td><td>10,000</td><td>10,000</td></tr>
<tr><td>1998</td><td colspan="2">15,000</td><td colspan="2">15,000</td><td colspan="2">15,000</td><td colspan="2">15,000</td><td>15,000</td><td>500</td><td>500</td><td>500</td></tr>
<tr><td>1999</td><td colspan="3">9,000</td><td colspan="2">9,000</td><td colspan="2">9,000</td><td colspan="2">9,000</td><td>3,000</td><td>3,000</td><td>3,000</td></tr>
<tr><td>2000</td><td>100</td><td>100</td><td>100</td><td>100</td><td>300</td><td>300</td><td>300</td><td>300</td><td>100</td><td>100</td><td>100</td><td>100</td></tr>
<tr><td>2001</td><td>100</td><td>100</td><td>100</td><td>100</td><td>300</td><td>300</td><td>300</td><td>300</td><td>100</td><td colspan="3">Closed</td></tr>
<tr><td>2002 North[b/]</td><td colspan="2">200</td><td colspan="2">200</td><td colspan="2">600</td><td colspan="2">600</td><td colspan="2">Closed</td><td colspan="2">200</td></tr>
<tr><td>2002 South[b/]</td><td colspan="2">200</td><td colspan="2">200</td><td colspan="2">600</td><td colspan="6">Closed</td></tr>
<tr><td>2003</td><td>100</td><td>100</td><td>100</td><td>100</td><td>300</td><td>300</td><td>300</td><td>300</td><td>100</td><td>100</td><td>100</td><td>100</td></tr>
</table>

a/ Discrepancies will be resolved in favor of the *Federal Register*.
b/ North and south of Cape Mendocino, California (40°10' N latitude).

TABLE 3.3-4. History of canary rockfish recreational bag limits, 1995-2003.[a/]

Recreational Bag Limits (numbers of fish)[b/]									
	1995	1996	1997	1998	1999	2000	2001	2002	2003
Washington	15	10	10	10	10	2	2	2	1
Oregon and Northern California	15	15	15	15	15	3	1	1	1
California, south of 40^0 10' N. lat.	15	15	15	15	15	3	1	1	0

a/ Discrepancies will be resolved in favor of the *Federal Register*.
b/ Rockfish bag limits which include canary rockfish 1995-1999 and canary rockfish sub-limits 2000-2003.

TABLE 3.3-5. Lingcod commercial trawl trip limits (pounds), 1995-2003. No trip limits in effect prior to 1995.[a/]

	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
1995	20,000	20,000	20,000	20,000	20,000	20,000	20,000	20,000	20,000	20,000	20,000	20,000
1996	40,000		40,000		40,000		40,000		40,000		40,000	
1997	40,000		40,000		40,000		40,000		40,000		40,000	
1998	1,000		1,000		1,000		1,000		1,000		1,000	
1999	1,500			1,000		1,000		1,000		500	500	500
2000	Closed				400	400	400	400	400	400	Closed	
2001	No Retention				400	400	400	400	400	400	No Retention	
2002	800		800		800		800		800		800	
2003	800		800		1,000		1,000		800		800	

a/ Discrepancies will be resolved in favor of the *Federal Register*.

TABLE 3.3-6. History of lingcod minimum size limits and bag limits, 1995-2003.[a/]

	1995	1996	1997	1998	1999	2000	2001	2002	2003
Minimum Size Limits (inches)									
Limited Entry	22	22	22	24	24	24 N. 26 S.	24	24	24
Open Access	NA	NA	NA	24	24	24 N. 26 S.	24	24	24
Recreational	22	22	22	22	22	24 N. 26 S.	24	24	24
Maximum Size Limits (inches)									
Recreational - Oregon						34			
Recreational Bag Limits (number of fish)									
Washington	3	3	3	3	2	2	2	2	2
Oregon and Northern California	3	3	3	3	2	2	2	1	2
California, south of 40°10' N lat.	5	5	5	3	2	2	2	2	2

a/ Discrepancies will be resolved in favor of the *Federal Register*.

TABLE 3.3-7. Bycatch rates used in modeling trawl fishery bycatch of darkblotched rockfish for the 2003 season. (Page 1 of 2)

2-mo per.	Target fishery	All depths	In depths shallower than:				In depths deeper than:			
			50 fm	75 fm	100 fm	125 fm	150 fm	180 fm	200 fm	250 fm
North of Cape Mendocino										
1	DTS	0.656%	0.000%	0.000%	0.000%	2.000%	1.127%	1.028%	0.896%	0.000%
2	DTS	0.564%	0.000%	0.000%	0.000%	20.000%	1.047%	1.036%	0.974%	0.000%
3	DTS	2.374%	0.000%	0.000%	0.000%	6.890%	1.930%	1.728%	1.452%	0.000%
4	DTS	1.570%	0.000%	0.000%	0.000%	6.286%	1.139%	0.915%	0.683%	0.000%
5	DTS	0.825%	0.000%	0.000%	0.000%	2.442%	1.325%	1.202%	1.153%	0.000%
6	DTS	0.408%	0.000%	0.000%	0.000%	0.000%	2.483%	2.484%	2.330%	0.000%
1	Flatfish	1.804%	0.000%	0.000%	0.500%	10.279%	1.764%	1.721%		
2	Flatfish	1.983%	0.000%	0.000%	0.500%	2.621%	1.909%	1.432%		
3	Flatfish	3.170%	0.000%	0.000%	0.500%	2.809%	3.006%	2.510%		
4	Flatfish	3.701%	0.000%	0.000%	0.500%	4.074%	3.258%	2.617%		
5	Flatfish	3.264%	0.000%	0.000%	0.500%	5.791%	2.149%	1.207%		
6	Flatfish	1.141%	0.000%	0.000%	0.500%	6.183%	0.973%	0.955%		
1	AT	0.180%					0.180%	0.180%		
2	AT	0.537%					0.533%	0.551%		
6	AT	0.500%					0.500%	0.500%		
1	Petrale	3.940%					4.020%	4.317%		
2	Petrale	5.456%					5.164%	4.587%		
6	Petrale	3.037%					3.072%	2.870%		
1	MW	0.030%								
2	MW	0.030%								
3	MW	0.030%								
4	MW	0.030%								
5	MW	0.030%								
6	MW	0.030%								
1	Other	5.250%	0.000%	0.525%	1.050%	2.100%	3.150%	0.788%	0.525%	0.000%
2	Other	3.500%	0.000%	0.350%	0.700%	1.400%	2.100%	0.525%	0.350%	0.000%
3	Other	3.500%	0.000%	0.350%	0.700%	1.400%	2.100%	0.525%	0.350%	0.000%
4	Other	3.000%	0.000%	0.300%	0.600%	1.200%	1.800%	0.450%	0.300%	0.000%
5	Other	2.250%	0.000%	0.225%	0.450%	0.900%	1.350%	0.338%	0.225%	0.000%
6	Other	4.250%	0.000%	0.425%	0.850%	1.700%	2.550%	0.638%	0.425%	0.000%
South of Cape Mendocino										
1	Petrale						11.487	11.402		
2	Petrale						8.399%	13.075		
6	Petrale						7.161%	6.725%		
1	Flatfish						1.426%			
2	Flatfish						1.055%			
3	Flatfish						2.058%			
4	Flatfish						1.089%			

TABLE 3.3-7. Bycatch rates used in modeling trawl fishery bycatch of darkblotched rockfish for the 2003 season. (Page 2 of 2)

2-mo per.	Target fishery	All depths	In depths shallower than:				In depths deeper than:			
			50 fm	75 fm	100 fm	125 fm	150 fm	180 fm	200 fm	250 fm
5	Flatfish						1.833%			
6	Flatfish						3.187%			
1	DTS	0.567%					0.280%	0.280%		0.000%
2	DTS	0.596%					0.298%	0.298%		0.000%
3	DTS	1.483%					0.717%	0.649%		0.000%
4	DTS	0.563%					0.279%	0.222%		0.000%
5	DTS	1.168%					0.584%	0.557%		0.000%
6	DTS	0.731%					0.365%	0.350%		0.000%
1	Other	3.675%	0.000%	0.184%	0.184%	0.368%	2.205%	0.551%	0.368%	0.000%
2	Other	2.450%	0.000%	0.123%	0.123%	0.245%	1.470%	0.368%	0.245%	0.000%
3	Other	2.450%	0.000%	0.123%	0.123%	0.245%	1.470%	0.368%	0.245%	0.000%
4	Other	2.100%	0.000%	0.105%	0.105%	0.210%	1.260%	0.315%	0.210%	0.000%
5	Other	1.575%	0.000%	0.079%	0.079%	0.158%	0.945%	0.236%	0.158%	0.000%
6	Other	2.975%	0.000%	0.149%	0.149%	0.298%	1.785%	0.446%	0.298%	0.000%

TABLE 3.3-8. Bycatch rates used in modeling trawl fishery bycatch of Pacific ocean perch for the 2003 season. (Page 1 of 1)

2-mo per.	Target fishery	All depths	In depths shallower than: 50 fm	75 fm	100 fm	125 fm	In depths deeper than: 150 fm	180 fm	200 fm	250 fm
North of Cape Mendocino										
1	DTS	0.522%	0.000%	0.000%	0.631%	0.631%	0.521%	0.472%	0.474%	0.395%
2	DTS	1.243%	0.000%	0.000%	3.285%	4.672%	1.202%	1.132%	1.017%	0.472%
3	DTS	1.985%	0.000%	0.000%	2.743%	4.029%	1.705%	1.280%	1.116%	0.482%
4	DTS	1.562%	0.000%	0.000%	1.926%	4.545%	1.078%	0.918%	0.714%	0.497%
5	DTS	0.646%	0.000%	0.000%	0.764%	2.423%	0.385%	0.316%	0.298%	0.141%
6	DTS	1.014%	0.000%	0.000%	0.000%	15.454%	0.777%	0.397%	0.329%	
1	Flatfish	1.315%	0.000%	0.000%	0.306%	0.859%	1.330%	0.884%		
2	Flatfish	3.003%	0.000%	0.000%	2.706%	2.733%	2.391%	1.225%		
3	Flatfish	4.464%	0.000%	0.000%	2.262%	3.218%	6.824%	5.771%		
4	Flatfish	1.865%	0.000%	0.000%	0.627%	1.461%	2.570%	1.698%		
5	Flatfish	2.929%	0.000%	0.000%	0.529%	1.602%	4.211%	2.155%		
6	Flatfish	1.319%	0.000%	0.000%	0.481%	0.707%	1.325%	1.378%		
1	AT					2.369%	2.369%			
2	AT					1.129%	1.184%			
6	AT					2.276%	2.276%			
1	Petrale	2.337%					2.415%	1.454%		
2	Petrale	5.555%					6.122%	4.163%		
6	Petrale	6.903%					7.232%	7.477%		
1	MW									
2	MW									
3	MW									
4	MW									
5	MW									
6	MW									
1	Other	11.500	0.000%	1.150%	4.600%	6.900%	3.450%	2.300%	0.000%	
2	Other	2.750%	0.000%	0.000%	0.275%	1.100%	1.650%	0.825%	0.550%	0.000%
3	Other	5.000%	0.000%	0.000%	0.500%	2.000%	3.000%	1.500%	1.000%	0.000%
4	Other	10.750	0.000%	1.075%	4.300%	6.450%	3.225%	2.150%	0.000%	
5	Other	4.250%	0.000%	0.000%	0.425%	1.700%	2.550%	1.275%	0.850%	0.000%
6	Other	5.650%	0.000%	0.000%	0.565%	2.260%	3.390%	1.695%	1.130%	0.000%

TABLE 3.3-9. Bycatch rates used in modeling trawl fishery bycatch of canary rockfish for the 2003 season. (Page 1 of 2)

2-mo per.	Target fishery	All depths	In depths shallower than:				In depths deeper than:			
			50 fm	75 fm	100 fm	125 fm	150 fm	180 fm	200 fm	250 fm
North of Cape Mendocino										
1	DTS	0.010%	0.000%	0.101%	0.101%	0.101%	0.000%	0.000%	0.000%	0.000%
2	DTS	0.010%	0.000%	0.200%	0.035%	0.021%	0.000%	0.000%	0.000%	0.000%
3	DTS	0.010%	0.000%	0.119%	0.208%	0.130%	0.000%	0.000%	0.000%	0.000%
4	DTS	0.300%	0.000%	1.362%	1.403%	1.690%	0.000%	0.000%	0.000%	0.000%
5	DTS	0.797%	0.000%	10.359	6.348%	5.170%	0.000%	0.000%	0.000%	0.000%
6	DTS	0.010%	0.000%	0.000%	0.000%	0.000%	0.000%	0.000%	0.000%	0.000%
1	Flatfish	0.048%	0.191%	0.098%	0.230%	0.202%	0.000%	0.000%		
2	Flatfish	0.120%	0.386%	0.335%	0.469%	0.586%	0.000%	0.000%		
3	Flatfish	0.236%	0.030%	0.257%	0.437%	0.373%	0.000%	0.000%		
4	Flatfish	0.895%	0.091%	0.436%	1.260%	1.132%	0.000%	0.000%		
5	Flatfish	0.367%	0.405%	0.431%	0.488%	0.519%	0.000%	0.000%		
6	Flatfish	0.050%	0.046%	0.264%	0.214%	0.274%	0.000%	0.000%		
1	AT	0.010%					0.000%	0.000%		
2	AT	0.010%		0.000%	0.000%					
6	AT	0.010%					0.000%	0.000%		
1	Petrale	0.012%					0.000%	0.000%		
2	Petrale	0.452%					0.000%	0.000%		
6	Petrale	0.012%					0.000%	0.000%		
1	MW	0.013%								
2	MW	0.058%								
3	MW	2.758%								
4	MW	0.971%								
5	MW	0.775%								
6	MW	0.011%								
1	Other	0.010%	0.004%	0.009%	0.010%	0.010%	0.000%	0.000%	0.000%	0.000%
2	Other	0.100%	0.040%	0.090%	0.100%	0.100%	0.000%	0.000%	0.000%	0.000%
3	Other	0.500%	0.200%	0.450%	0.500%	0.500%	0.000%	0.000%	0.000%	0.000%
4	Other	1.000%	0.400%	0.900%	1.000%	1.000%	0.000%	0.000%	0.000%	0.000%
5	Other	0.150%	0.060%	0.135%	0.150%	0.150%	0.000%	0.000%	0.000%	0.000%
6	Other	0.100%	0.040%	0.090%	0.100%	0.100%	0.000%	0.000%	0.000%	0.000%
South of Cape Mendocino										
1	Petrale						0.000%	0.000%		
2	Petrale						0.000%	0.000%		
6	Petrale						0.000%	0.000%		
1	Flatfish	0.011%	0.000%	0.000%	0.000%	0.000%	0.000%			
2	Flatfish	0.098%	0.000%	0.000%	0.033%	0.134%	0.000%			
3	Flatfish	0.064%	0.000%	0.000%	0.000%	0.000%	0.000%			
4	Flatfish	0.046%	0.000%	0.000%	0.000%	0.000%	0.000%			

TABLE 3.3-9. Bycatch rates used in modeling trawl fishery bycatch of canary rockfish for the 2003 season. (Page 2 of 2)

2-mo per.	Target fishery	All depths	In depths shallower than:				In depths deeper than:			
			50 fm	75 fm	100 fm	125 fm	150 fm	180 fm	200 fm	250 fm
5	Flatfish	0.082%	0.000%	0.071%	0.099%	0.089%	0.000%			
6	Flatfish	0.039%	0.000%	0.561%	0.048%	0.020%	0.000%			
1	DTS	0.000%					0.000%	0.000%		0.000%
2	DTS	0.020%					0.000%	0.000%		0.020%
3	DTS	0.002%					0.000%	0.000%		0.000%
4	DTS	0.015%					0.000%	0.000%		0.001%
5	DTS	0.002%					0.000%	0.000%		0.000%
6	DTS	0.000%					0.000%	0.000%		0.000%
1	Other	0.010%	0.004%	0.006%	0.008%	0.010%	0.000%	0.000%	0.000%	0.000%
2	Other	0.010%	0.004%	0.006%	0.008%	0.010%	0.000%	0.000%	0.000%	0.000%
3	Other	0.010%	0.004%	0.006%	0.008%	0.010%	0.000%	0.000%	0.000%	0.000%
4	Other	0.010%	0.004%	0.006%	0.008%	0.010%	0.000%	0.000%	0.000%	0.000%
5	Other	0.010%	0.004%	0.006%	0.008%	0.010%	0.000%	0.000%	0.000%	0.000%
6	Other	0.121%	0.048%	0.073%	0.097%	0.115%	0.000%	0.000%	0.000%	0.000%

TABLE 3.3-10. Bycatch rates used in modeling trawl fishery bycatch of lingcod for the 2003 season. (Page 1 of 2)

2-mo per.	Target fishery	All depths	In depths shallower than:				In depths deeper than:			
			50 fm	75 fm	100 fm	125 fm	150 fm	180 fm	200 fm	250 fm
North of Cape Mendocino										
1	DTS	0.030%	0.000%	0.000%	0.000%	0.000%	0.030%	0.000%	0.000%	0.000%
2	DTS	0.275%	0.000%	0.300%	0.000%	1.032%	0.272%	0.000%	0.000%	0.000%
3	DTS	0.651%	0.000%	1.594%	1.335%	5.156%	0.334%	0.000%	0.000%	0.000%
4	DTS	0.818%	0.000%	3.783%	4.651%	4.189%	0.206%	0.000%	0.000%	0.000%
5	DTS	1.175%	0.000%	4.609%	4.900%	6.557%	0.778%	0.000%	0.000%	0.000%
6	DTS	0.055%	0.000%	0.000%	0.000%	1.951%	0.052%	0.000%	0.000%	0.000%
1	Flatfish	0.214%	1.395%	1.303%	1.184%	1.611%	0.160%	0.000%		
2	Flatfish	1.493%	2.440%	2.752%	4.830%	6.215%	0.649%	0.000%		
3	Flatfish	1.558%	0.345%	0.953%	1.594%	2.095%	0.635%	0.000%		
4	Flatfish	2.123%	0.767%	1.383%	2.016%	2.546%	0.765%	0.000%		
5	Flatfish	2.370%	0.619%	1.905%	2.370%	2.971%	1.014%	0.000%		
6	Flatfish	1.080%	2.802%	3.653%	2.778%	2.816%	0.715%	0.000%		
1	AT	0.030%					0.005%	0.000%		
2	AT	0.200%					0.115%	0.000%		
6	AT	0.030%					0.005%	0.000%		
1	Petrale	0.612%					0.551%	0.000%		
2	Petrale	1.752%					1.250%	0.000%		
6	Petrale	0.759%					0.532%	0.000%		
1	MW	0.072%								
2	MW	0.000%								
3	MW	0.000%								
4	MW	0.681%								
5	MW	0.712%								
6	MW	0.000%								
1	Other	1.650%	0.330%	1.238%	1.650%	1.650%	0.330%	0.000%	0.000%	0.000%
2	Other	0.500%	0.100%	0.375%	0.500%	0.500%	0.100%	0.000%	0.000%	0.000%
3	Other	0.850%	0.170%	0.638%	0.850%	0.850%	0.170%	0.000%	0.000%	0.000%
4	Other	2.900%	0.580%	2.175%	2.900%	2.900%	0.580%	0.000%	0.000%	0.000%
5	Other	3.150%	0.630%	2.363%	3.150%	3.150%	0.630%	0.000%	0.000%	0.000%
6	Other	1.950%	0.390%	1.463%	1.950%	1.950%	0.390%	0.000%	0.000%	0.000%
South of Cape Mendocino										
1	Petrale						0.614%	0.000%		
2	Petrale						2.074%	0.000%		
6	Petrale						0.855%	0.000%		
1	Flatfish	0.131%	0.000%	0.154%	0.075%	0.071%	0.092%			
2	Flatfish	0.246%	0.142%	0.065%	0.166%	0.163%	0.138%			
3	Flatfish	0.746%	0.657%	0.658%	0.384%	0.297%	0.314%			
4	Flatfish	0.603%	2.697%	2.125%	0.322%	0.383%	0.050%			

TABLE 3.3-10. Bycatch rates used in modeling trawl fishery bycatch of lingcod for the 2003 season. (Page 2 of 2)

2-mo per.	Target fishery	All depths	In depths shallower than: 50 fm	75 fm	100 fm	125 fm	In depths deeper than: 150 fm	180 fm	200 fm	250 fm
5	Flatfish	0.512%	0.666%	0.141%	0.105%	0.201%	0.282%			
6	Flatfish	0.471%	0.736%	0.856%	0.714%	0.462%	0.044%			
1	DTS	0.012%					0.012%	0.000%		0.000%
2	DTS	0.008%					0.008%	0.000%		0.000%
3	DTS	0.053%					0.016%	0.000%		0.000%
4	DTS	0.053%					0.015%	0.000%		0.000%
5	DTS	0.083%					0.065%	0.000%		0.000%
6	DTS	0.038%					0.038%	0.000%		0.000%
1	Other	0.368%	0.074%	0.147%	0.257%	0.294%	0.074%	0.000%	0.000%	0.000%
2	Other	3.269%	0.654%	1.308%	2.288%	2.615%	0.654%	0.000%	0.000%	0.000%
3	Other	6.098%	1.220%	2.439%	4.268%	4.878%	1.220%	0.000%	0.000%	0.000%
4	Other	0.000%	0.000%	0.000%	0.000%	0.000%	0.000%	0.000%	0.000%	0.000%
5	Other	0.840%	0.168%	0.336%	0.588%	0.672%	0.168%	0.000%	0.000%	0.000%
6	Other	0.858%	0.172%	0.343%	0.601%	0.686%	0.172%	0.000%	0.000%	0.000%

TABLE 3.3-11. A comparison of total mortality estimates (mt) of overfished groundfish species analyzed in the Hastie trawl bycatch model under management specifications and measures adopted for 2003 using logbook-based and observer-based bycatch rates. (Page 1 of 1)

Species	Estimated total mortality (mt) using logbook-based bycatch rates	Estimated total mortality (mt) using observer-based bycatch rates
Bocaccio	1.5	11.5
Canary Rockfish	13.0	52.8
Darkblotched Rockfish	87.0	132.3
Lingcod	66.8	315.2
Pacific Ocean Perch	97.7	112.9
Widow Rockfish	12.4	4.4

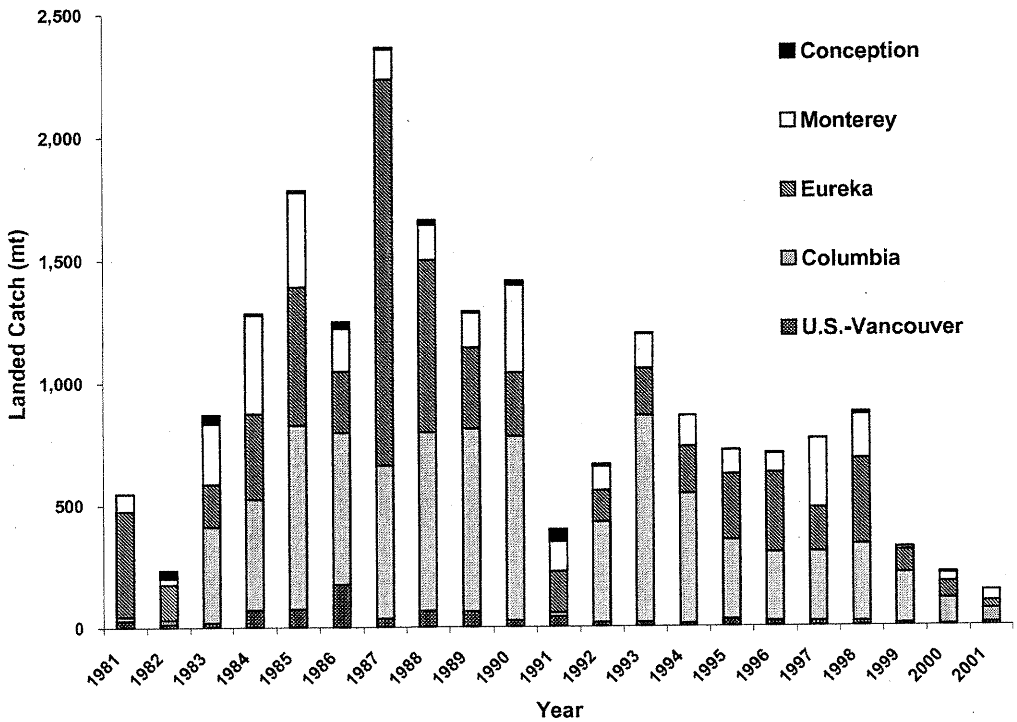

FIGURE 3.3-1. Landed catch (mt) of darkblotched rockfish by INPFC area on the U.S. West Coast, 1981 through 2001. Data from PacFIN ("darkblotched rockfish" and "nominal darkblotched rockfish" categories).

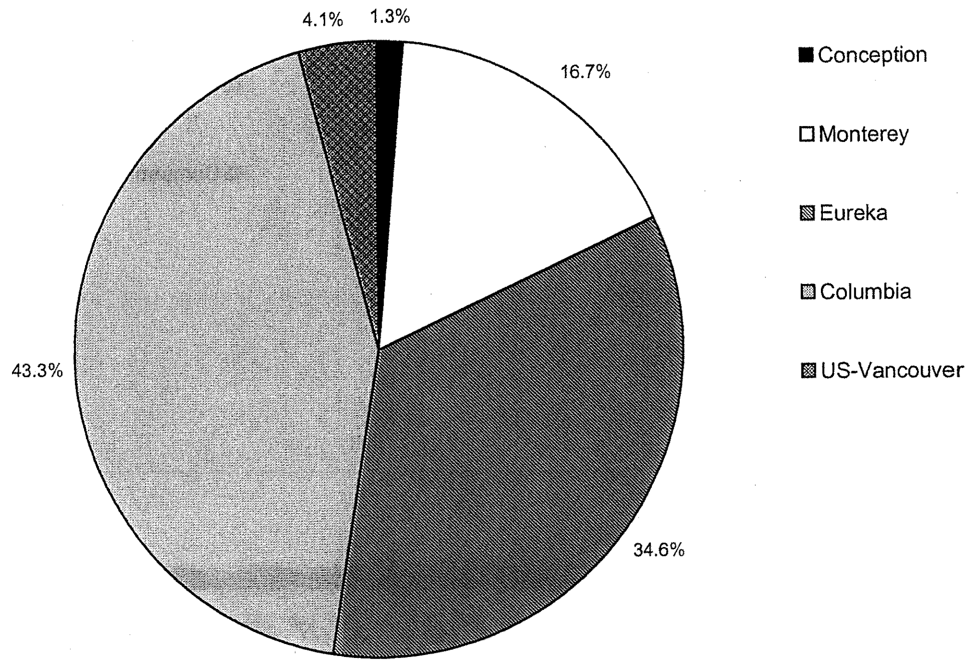

FIGURE 3.3-2. Average annual percent of landed darkblotched rockfish by INPFC area, 1981 through 2001.

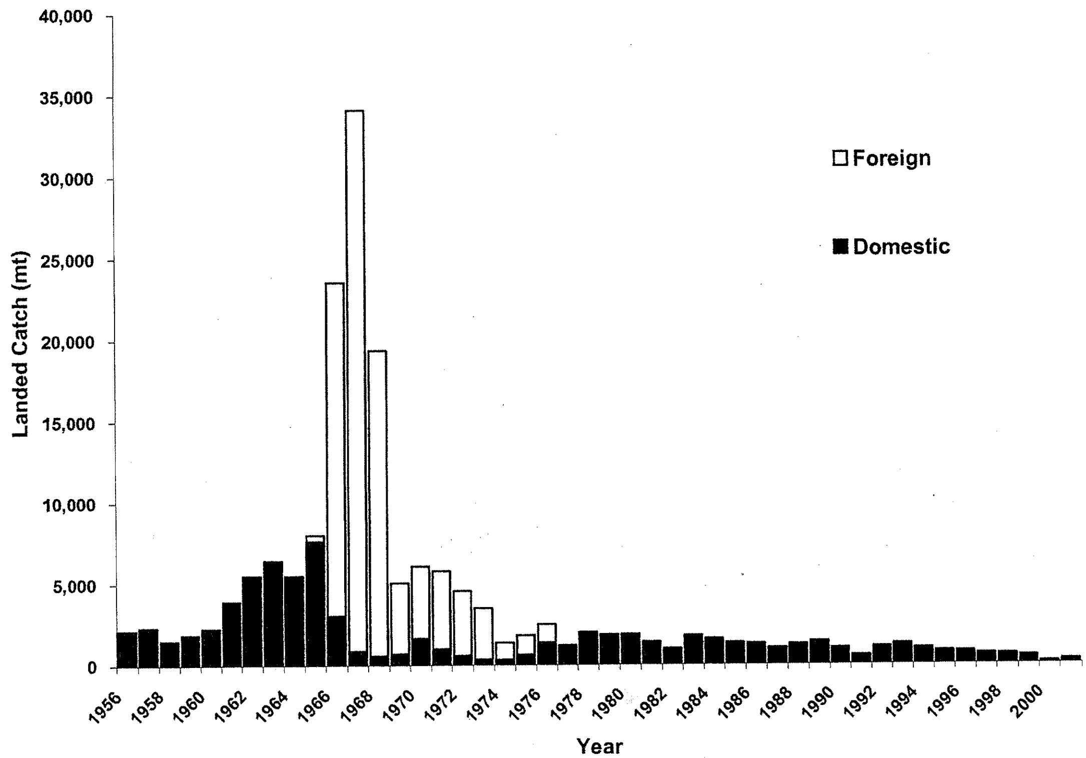

FIGURE 3.3-3. Landings of Pacific ocean perch by foreign and domestic vessels on the U.S. West Coast, 1956 through 2001.

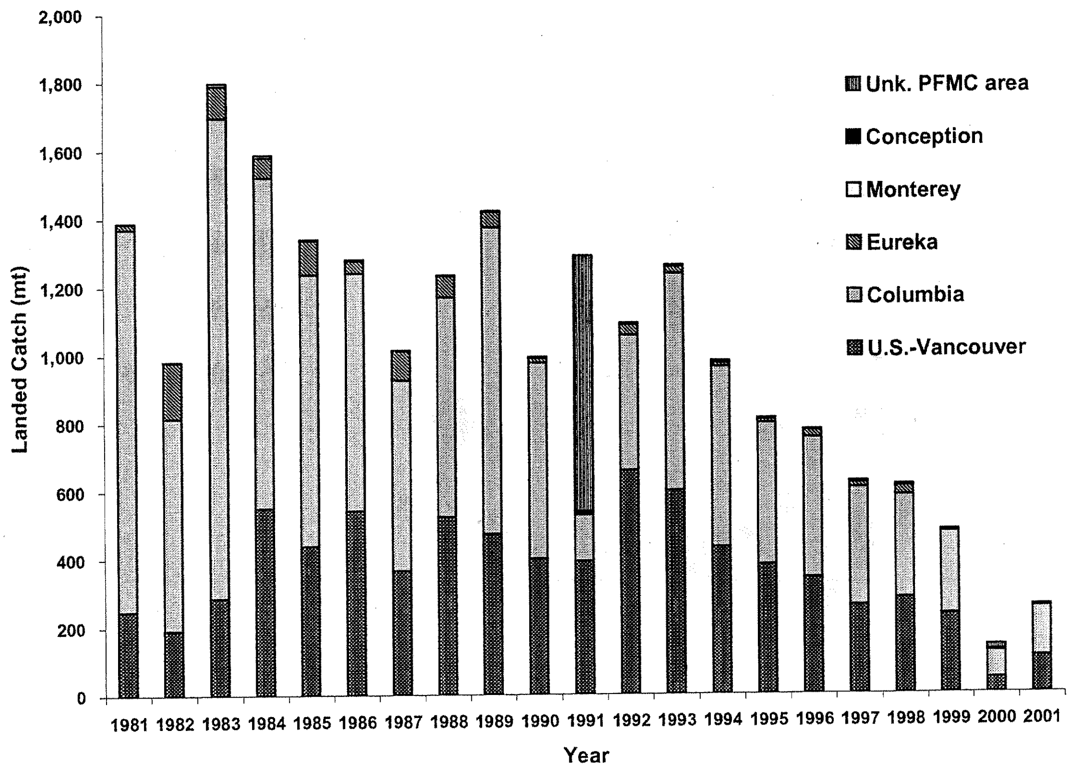

FIGURE 3.3-4. Landed catch (mt) of Pacific ocean perch by INPFC area on the U.S. West Coast, 1981 through 2001.

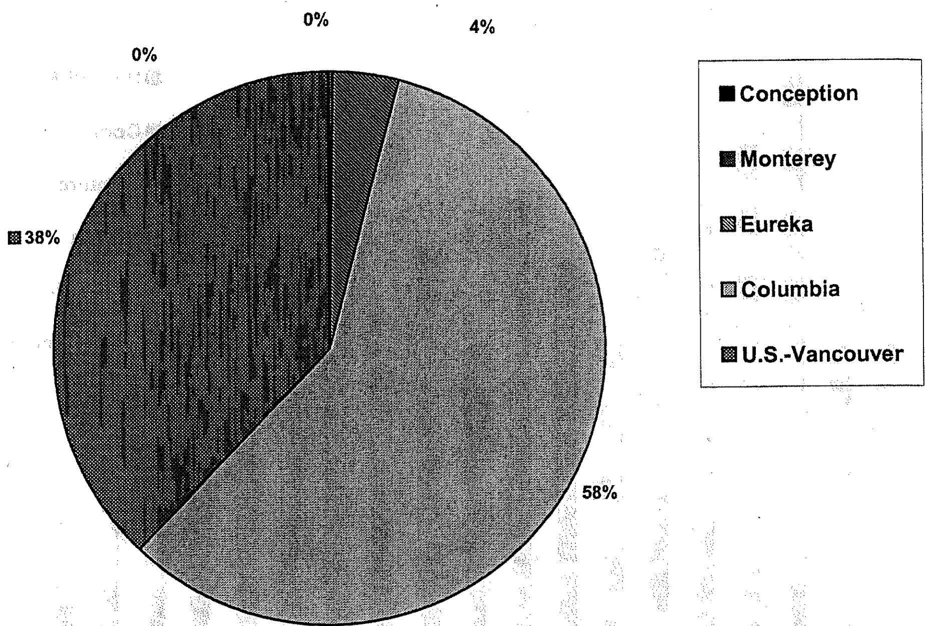

FIGURE 3.3-5. Average annual proportion of Pacific ocean perch landed catch by INPFC area, 1981 through 2001.

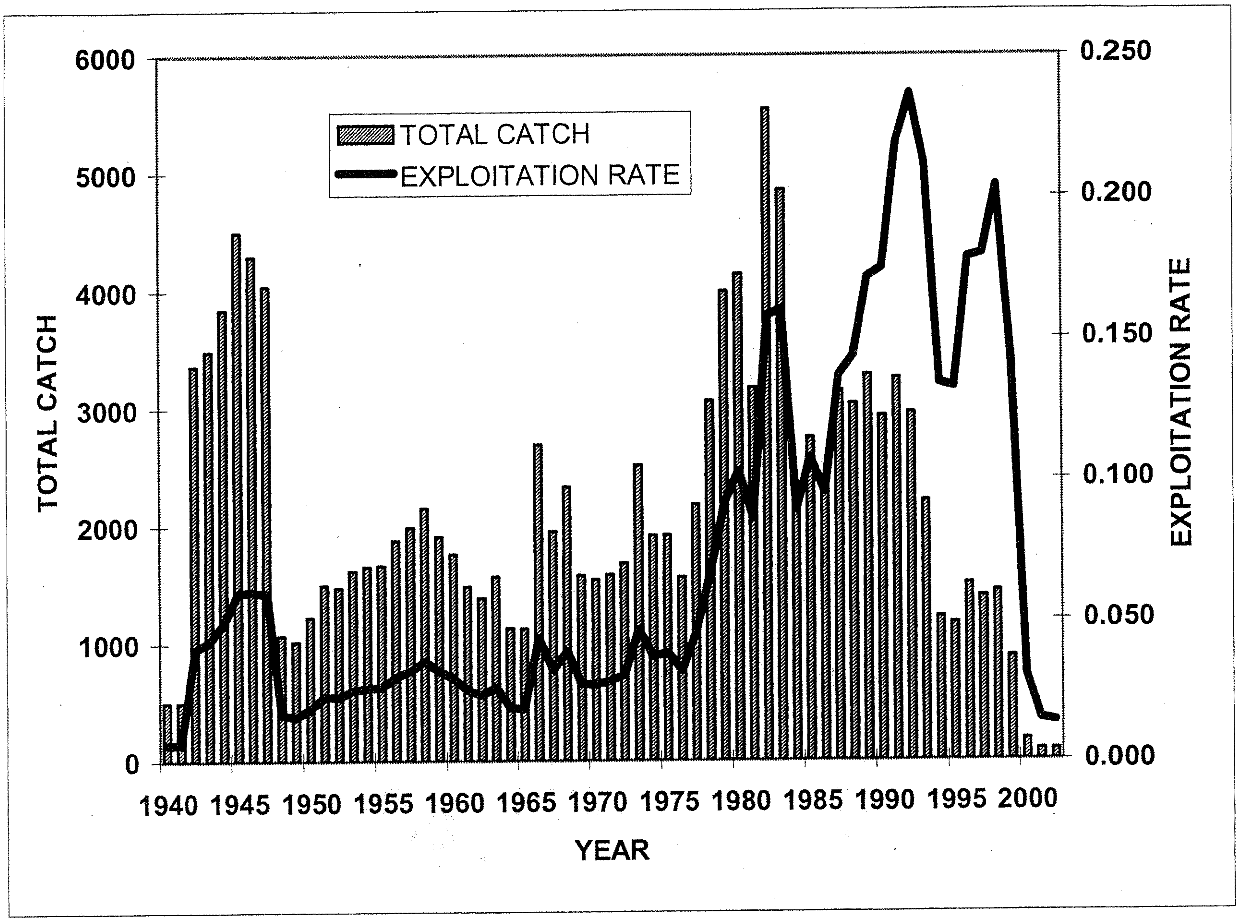

FIGURE 3.3-6. Historical catches and exploitation rate of canary rockfish on the U.S. West Coast, 1940 through 2002.

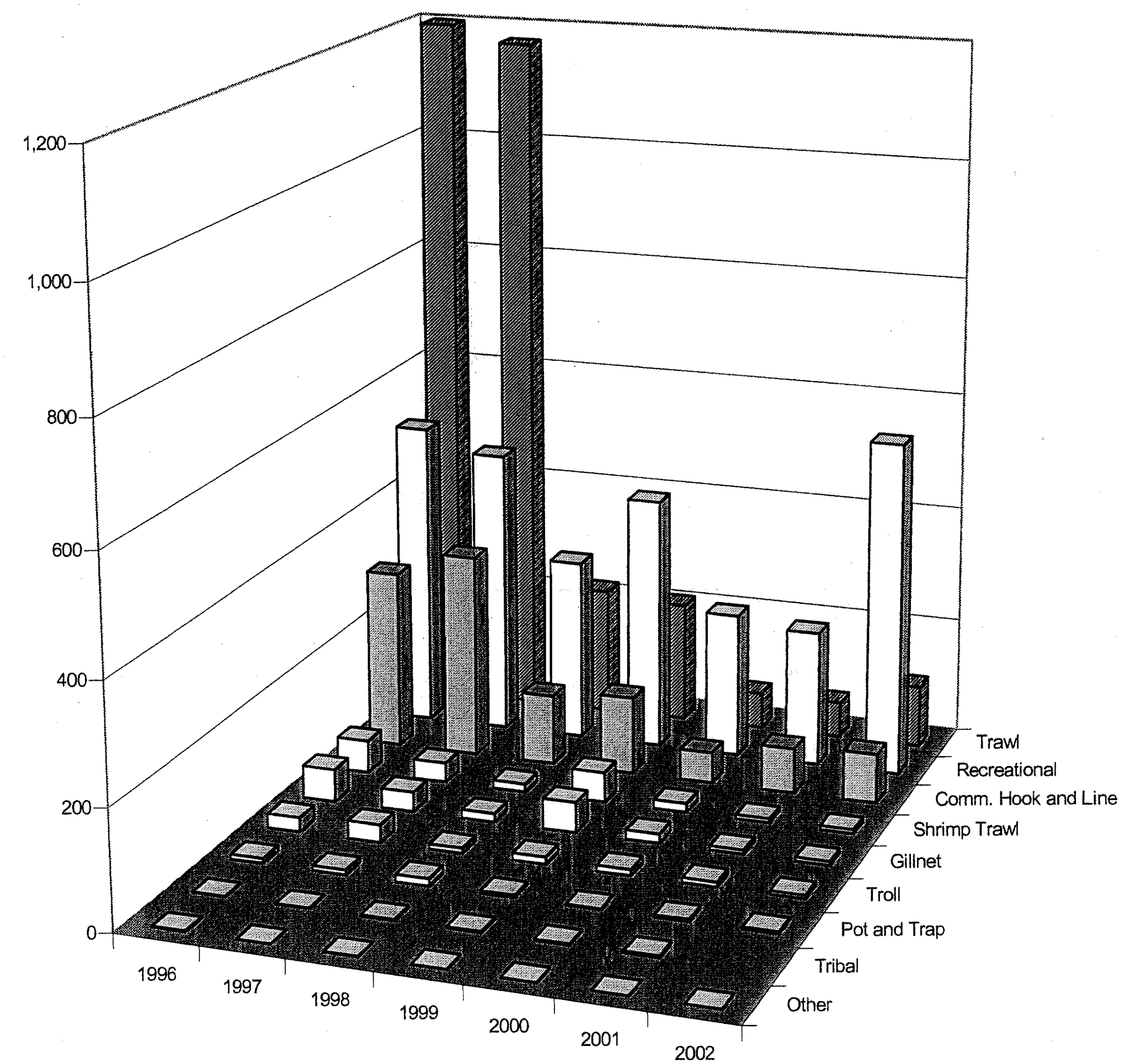

FIGURE 3.3-7. Landed catch (mt) of lingcod by fishing sector on the U.S. West Coast, 1996 through 2002.

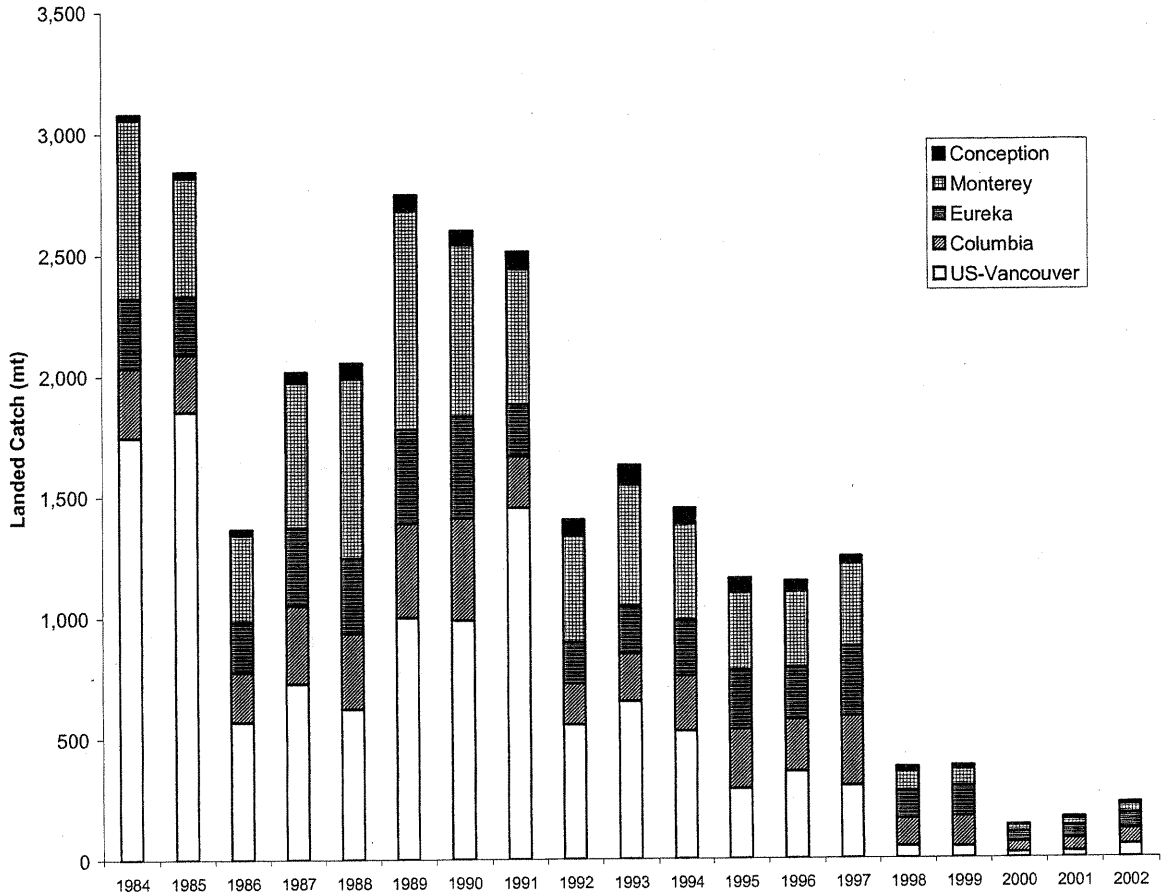

FIGURE 3.3-8. Commercial trawl landed catch (mt) of lingcod by INPFC area on the U.S. West Coast, 1984 through 2002.

3.4 Socioeconomic Environment

The Pacific Coast groundfish fishery is a multi-species fishery that takes place off the coasts of Washington, Oregon, and California. Maintaining year-round fishing opportunities for groundfish has been one of the primary management objectives for the fishery. Pacific Coast groundfish support or contribute to a wide range of commercial, recreational, and tribal fisheries and the communities dependent on these fisheries.

Groundfish is only one component of the West Coast fish harvest that supports commercial seafood vessels, processors, and commercial seafood dependent communities. The annual harvest pattern of the commercial seafood groundfish fishery in the context of all other fisheries is provided in Figures 3.4-1 through 3.4-5. Tables 3.4-1 and 3.4-2 provide a historical overview of landings and revenue, respectively, for the groundfish fishery. (Refer also to Tables 3.4-34 through 3.4-36 for information on numbers of vessels and buyers for each of these fisheries.) Commercial fisheries targeting groundfish are, for the most part, regulated under a license limitation program implemented in 1994. Fisheries targeting groundfish that are not under the license limitation program, and fisheries that catch groundfish incidentally while targeting nongroundfish species are termed open access. The Council allocates commercial harvest (OYs) between limited entry and open access fisheries. More information on target strategies and vessels is provided in Sections 3.4.2 and 3.4.4. Buyers and processors are an important value added component of regional fisheries and are described in more detail in Section 3.4.5.1.

Marine recreational fisheries consist of both charter and private vessels. Charter vessels are larger vessels for hire that can typically fish farther offshore than most vessels in the private recreational fleet. Both nearshore and shelf opportunities are important for West Coast recreational groundfish fisheries. Recreational fisheries are addressed in Section 3.4.6.

In addition to these fisheries, Indian tribes in Washington, primarily the Makah, Quileute, and Quinault, harvest groundfish in the EEZ. There are set tribal allocations for sablefish and Pacific whiting, while the other groundfish species' allocations are determined through the Council process in coordination with the tribes, states, and NMFS. Commercial tribal groundfish fisheries are described in Section 3.4.7, which describes ceremonial and substance harvests.

3.4.1 Overfished Species as a Constraint Over Time

3.4.1.1 Nonconsumptive vs. Consumptive Use

In economic terms, the choice between alternative rebuilding trajectories for an overfished species entails a fundamental tradeoff between current versus future costs and benefits. From the perspective of consumptive users of the resource, in the near term, additional costs are born by the commercial fleet, processors and recreational fishers who may be left with much smaller harvests than they were accustomed to. While this near term sacrifice may create much greater harvest opportunities in the future once the stock has been rebuilt, depending on the duration of the rebuilding period, many fishers and processors will be unlikely to weather a long down period, opting instead to go out of business. So many of the consumptive users emerging after the stock has been rebuilt may not be the same as those who were there before the rebuilding period began.

From the perspective of a nonconsumptive user, the faster the rebuilding trajectory the better.

3.4.1.2 Constraint in Consumptive Use

The degree to which overfished species are the constraining factor which shapes fishery regulations may vary through time. Because most overfished species are taken in mixed-stock fisheries, if during a period of time the regulations necessary to protect other species provide sufficient protection to a particular overfished species, then target harvest mortality levels for that particular species will not affect the regulatory regime. On the other hand, if regulations necessary to protect other species provide inadequate protection for a particular overfished species, then the need to protect that species may be a driving factor which shapes the regulatory regime. The degree to which an overfished species is a constraint is largely a function of productivity for that species (Sections 3.2.1 and 3.2.2) relative to other stocks in the complex and the ratio in which that species is taken relative to other stocks in the complex (Section 3.2.1.3 and 3.3.1.5). The complexes in which overfished species are taken are discussed in the following section.

3.4.2 Complex Values and Allocation Among Consumptive Sectors Over Time (Including Tribal)

Species harvest complexes are determined by association of the species in their habitat and the species selectivity of the gear.

3.4.2.1 Trip Categorization and Catch Composition

Using methods developed by Hastie (2001) groundfish trawl trips were categorized by primary target based on the primary catch complex present in the trip. For 2003 modeling Hastie eliminated seven trawl targets for which effort had diminished substantially, due to the severity of regulatory constraint (POP, Chilipepper, Yellowtail, Canary, Widow, Other Rock, and Lingcod). Because this analysis included 1998 through 2002 fisheries, these seven targets were maintained along with the targets Hastie used for analysis of the 2003 fishery (whiting, arrowtooth, petrale, flatfish, widow/yellowtail midwater, DTS (Dover sole, thornyhead, and sablefish), slope rock, and leftover).

Hastie's method only covered the groundfish trawl fisheries. In order to begin to develop indicators of possible bycatch in other fisheries, nontrawl trips were also assigned a target strategy based on the preponderance of a particular target species in the catch. For nontrawl groundfish trips, any trip in which 50% or more of the species landed was groundfish was categorized as a groundfish trip. Nontrawl groundfish trips were further subdivided by depth association of the species (slope, shelf, and nearshore). Trips in which sablefish were landed were assigned to a sablefish target if the amount of sablefish landed exceeded the amounts landed in the slope, shelf, or nearshore species groups. Trips were assigned to a whiting target strategy if there were more whiting landed than any of the other four species groups (sablefish, slope species, shelf species, nearshore species).

Nongroundfish trips (trips with <50% groundfish) were categorized into a target strategy based on the plurality of the species in the catch (i.e., based on the species that was most abundant in the landing, even if that species comprised less than 50% of the total catch).

A fairly liberal definition was used for identifying landings of POP, likely resulting in an overrepresentation of the amount of POP landed, particularly for the 1998 fishery. The following are the PacFIN codes which were classified as potential POP.

	Codes Classified as Potential Pacific Ocean Perch			
Code	POP	POP2	POP1	UPOP
Definition	Pacific Ocean Perch	Nominal POP	General Shelf/Slope Rockfish	Unspecified POP Group
	Metric Tons Landed			
1998	-	403	666	171
2000	3	100	0	33
2002	0	107	0	39

Note: "0" indicates less than 0.5 mt.

There are two sources of error that must be taken into account in using trip species composition information to assign a trip to a particular target strategy, (1) species may be discarded before landed, and (2) multiple strategies may be pursued on the same trip. In the former case, discarded species may result in an underestimate of the presence of a particular species in the catch complex associated with a particular target strategy. Discards may occur due to market place factors or regulatory constraints. In the latter case, catch taken during a target strategy that comprised only a minor portion of the total effort on a trip could be erroneously interpreted as incidental catch for the dominant target strategy. Therefore, landing data aggregated for an entire trip provides only an indicator of the species composition which might be encountered in a particular target strategy.

Where available, logbook and observer information provides a superior indicator of bycatch rates, because (1) estimates of the amounts of discarded bycatch associated with a particular strategy can be recorded, and (2) incidental catch can be attributed to a particular tow or set (i.e., to a particular harvest strategy when multiple strategies are used within a trip). At present, limited amounts of this information is available and only for the trawl fishery. New information is currently being collected and analyzed by the West Coast Observer Program. For the present analysis, bycatch information used in modeling the 2002 and 2003 seasons is used for the trawl fleet, along with landings information available from the PacFIN fishticket system. Tables 3.4-18 and 3.4-19 indicates the areas, time periods, target complexes, and overfished species for which bycatch rate information is available.

Absent the ability to modify fishing activities to avoid or reduce bycatch, incidental catch rates provide an estimate of the amount of the target species that might be accessed per unit of overfished species caught. From this information, estimates of total revenue generated per pound of overfished species can be made. Such estimates are likely to be most accurate where bycatch logbook or observer data is available, so effort directed on a particular target species can be separated from secondary target strategies used on the same trip. In lieu of more accurate information, trip information provides a very rough proxy.

At its April Council meeting, the Council moved to begin to incorporate new observer data into the inseason modeling for the 2003 fishery. Based on the preliminary information, the bycatch rates for a number of overfished (but not all) appeared to be higher than were assumed for the 2003 preseason modeling. Additionally, due to the relatively small number of observations currently available from the Observer Program, the bycatch model was aggregated such that the division of effort into different trawl target strategies was eliminated and numerous depth strata were aggregated into two strata (nearshore and slope). Most of the rebuilding plans covered by this analysis will be in place for periods of time stretching over decades. During that time the amount of data available will increase, and a return may be expected to a model like the more disaggregated model used preseason for the 2003 fishery. Depending on gear, regulatory innovation, and changing abundances and environmental conditions, bycatch rates are likely to vary substantially over the period covered by this analysis; increasing or decreasing compared to those used in the 2003 preseason and inseason models. Given these changing circumstances, use of the more disaggregated 2003 preseason model is a reasonable approach for providing a general understanding of the relative effects of the different options over time.

The following tables were generated using the methods discussed here, bycatch information and PacFIN data:

- Round weight landed by target strategy, north and south of Cape Mendocino, for species groups for 1998, 2000 and 2002 (Tables 3.4-3 through 3.4-8).
- Exvessel Revenue landed by target strategy, north and south of Cape Mendocino, for species groups for 1998, and 2002 (Tables 3.4.-9 through 3.4-12).
- Percent of trips landing each overfished species by target strategy, north and south of Cape Mendocino, for species groups for 1998 and 2002 (Tables 3.4-13 through 3.4-16).
- Exvessel revenue from target species per pound of overfished species in the landed catch (or based on all-depth bycatch rates where such information was available) by target strategy, north and south of Cape Mendocino, for 1998 and 2002 (Table 3.4-17).
- Exvessel revenue from target species per pound of overfished species based on estimated bycatch rates applied to 1998 and 2002 fisheries(Tables 3.4-18 and 19).
- Round weight of target species caught based on landed catch (or based on all-depth bycatch rates where such information was available) by target strategy, north and south of Cape Mendocino, for 1998 and 2002 (Table 3.4-20).

3.4.2.2 Groundfish Trawl Target Strategies

In order to be counted as a groundfish trawl trip in this analysis, a landing had to be composed of more than 50% groundfish (by weight), be caught by a limited entry trawl vessel using trawl gear, and not include more than 100 pounds of pink shrimp.

Trip, Primary Target: Whiting Trawl

Shoreside

Target Species: Pacific Whiting (Shoreside)				
Overfished Species Landed Incidentally (% of trips in which the indicated overfished species were landed)				
	North of Cape Mendocino		South of Cape Mendocino	
	1998	2002	1998	2002
Trips	1,326	632	No Whiting Trips	No Whiting Trips
Total Exves Rev ($ thousands)	5,400	4,825		
Lingcod	1.1%	10.1%		
Whiting	NA	-		
Darkblotched RF	0.8	0.5%		
POP	25.3%	1.7%		
Bocaccio	-	0.1%		
Canary RF	12.4%	14.2%		
Cowcod	-	-		
Widow RF	67.3%	18.8%		
Yelloweye RF	-	-		

Notes: Data from Tables 3.4-13 through 3.4-16. In 1998, sorting of darkblotched and yelloweye rockfish was not mandatory.

A limited entry trawl vessel landing with greater than 8 mt of whiting was counted as a whiting trips. Whiting is currently listed as an overfished species for which a rebuilding plan is under development in a separate amendment package. The whiting trawl fishery occurs only north of Cape Mendocino.

Of the nine overfished groundfish species, landings data show some occurrence of all but cowcod and yelloweye in trips with whiting as the primary trip target (Tables 3.4-13 and 3.4-15). In 1998, about 193.3 million pounds of whiting was landed in 1,326 trips (Table 3.4-3); in 2002, about 100.2 million pounds of whiting were landed shoreside in 632 trips (Table 3.4-7).

By weight, whiting composed 99.2% of the landings in shoreside whiting trips. Other incidental catch landed in the 2002 shoreside whiting fishery included sablefish (290,900 pounds), yellowtail rockfish (91,400 pounds), miscellaneous shelf species (26,000 pounds), species covered by the coastal pelagic FMP (15,700 pounds), widow rockfish (11,700 pounds), salmon (5,800 pounds, landed using exempted fishing permits), chilipepper rockfish (1,200 pounds), and arrowtooth flounder (1,000 pounds). No more than 1,000 pounds was landed of any other incidental species (Table 3.4-7). There were 500 pounds of other shelf rockfish species and 300 pounds of other slope rockfish species.

Total shoreside exvessel revenue from this fishery (including nontarget species) was $4.5 million and $4.8 million in 1998 and 2002, respectively (Tables 3.4-9 through 3.4-12). Absent the ability to modify fishing activities to avoid or reduce bycatch, incidental bycatch rates as estimated from logbooks, Observer Programs, studies or landed catch provide an estimate of the amount of the target species that might have to be forgone per unit of overfished species protected. Using exvessel landings and values we can roughly calculate the ratio of total value of target species landed per pound of overfished species landed. Because the bycatch rate in the whiting fishery is quite low, the value per pound of overfished species can be high, ranging from $7 per pound for widow to $9,358 per pound for lingcod in 1998 (Table 3.4-20) and from $412 per pound for widow to $603,000 per pound for bocaccio in 2002.

At-Sea

By weight, whiting composed 99.7% of the landings in at-sea whiting trips. Catch in the at-sea sector included in the NMFS whiting observation data are presented in Table 3.4-21 for 1998 through 2001 for all overfished species, except bocaccio and cowcod. Bocaccio and cowcod are distributed south of the whiting fishery area and generally do not show up in the catch of the whiting fishery. As with the shoreside sector, widow rockfish is the main overfished species taken as bycatch in the at-sea whiting fishery.

Trip, Primary Target: Arrowtooth Flounder Trawl

Target Species: Arrowtooth Flounder				
Overfished Species Landed Incidentally (% of trips in which the indicated overfished species were landed)				
	North of Cape Mendocino		South of Cape Mendocino	
	1998	2002	1998	2002
Trips	257	184	No Arrowtooth Trips	No Arrowtooth Trips
Total Exves Rev ($ thousands)	3,574	2,346		
Lingcod	71.2%	55.4%		
Whiting	1.6%	-		
Darkblotched RF	-	45.1%		
POP	88.7%	69.6%		
Bocaccio	-	-		
Canary RF	87.9%	57.1%		
Cowcod	-	-		
Widow RF	91.7%	33.2%		
Yelloweye RF	-	0.5%		

Notes: Data from Tables 3.4-13 through 3.4-16. In 1998, sorting of darkblotched and yelloweye rockfish was not mandatory.

Any trawl trip with more than 5,000 pounds of arrowtooth, or with arrowtooth composing more than 60% of the catch, is counted as a trawl arrowtooth trip. The arrowtooth criteria is relatively small, and therefore, a substantial amount of the actual landings in the trips are not arrowtooth flounder. For example, in periods 1, 2, and 6 (January through February, March through April, November through December) of 2002, arrowtooth comprised 39%of the weight of the trips. However, for the remainder of the year arrowtooth comprised 54% of the weight of all species landed on arrowtooth trips. Arrowtooth flounder trips occur only north of Cape Mendocino.

Six overfished species occur in trips with arrowtooth as the primary trip target: lingcod, darkblotched rockfish, Pacific ocean perch, canary rockfish, widow rockfish, and yelloweye rockfish (Tables 3.4-13 and 3.4-15). In 1998, about 5.7 million pounds of arrowtooth was landed in 257 trips (Table 3.4-3). In 2002, about 3.8 million pounds of arrowtooth was landed in 184 trips (Table 3.4-7). The vast majority of the landings (about 3.2 million pounds in 2002) occurred in the May through October fishery when the fish are up on the shelf.

Incidental catch or secondary target landings in the 2002 arrowtooth trawl fishery included between 500 thousand and 1 million pounds each of Dover sole, petrale sole and "other" shelf groundfish and between 100 thousand pounds and 500 thousand pounds each of sablefish, other shelf flatfish, thornyheads, and yellowtail rockfish. Of the overfished species, 31,400 pounds was lingcod, 11,200 pounds was darkblotched rockfish, 95,400 pounds was Pacific ocean perch, 27,100 pounds was canary, 41,400 pounds was widow rockfish, and less than 50 pounds was yelloweye rockfish. Also taken in this fishery were 83,800 pounds of rex sole and 15,700 pounds of sanddabs (Table 3.4-7).

Total shoreside exvessel revenue from this fishery (including nontarget species) was $3.6 million and $2.3 million in 1998 and 2002, respectively (Tables 3.4-9 through 3.4-12). While contributing about half the weight to the arrowtooth targeted trips, arrowtooth contributed 16% to 17% of the exvessel value for this fishery, in 1998 and 2002. Absent the ability to modify fishing activities to avoid or reduce bycatch, incidental bycatch rates as estimated from logbooks, Observer Programs, studies or landed catch provide an estimate of the amount of the target species that might have to be forgone per unit of overfished species protected. Using exvessel landings and values we can roughly calculate the ratio of total value of target species landed per pound of overfished species landed. The value of arrowtooth complex per pound of overfished species ran from $5 per pound for widow to $1,657 per pound for darkblotched rockfish in 1998 (Table 3.4-20) and ran from $27 per pound for Pacific ocean perch to $234,570 per pound for yelloweye rockfish in 2002. Because these estimates are based on landed catch there is the possibility that some of the landings were from effort made during the trip directed on complexes other than those associated with arrowtooth. For arrowtooth trips there is some information based on estimated bycatch rates used in the modeling of the 2003 fishery (Table 3.4-18). Value per pound of species taken as bycatch varies with bycatch rates which in turn vary by depth and season. For example, in 1998 and 2002, using the assumed bycatch rates, the exvessel revenue of arrowtooth per pound of lingcod taken deeper than 150 fathoms (but less than 250 fm) varied from about $100 per pound in March and April to about $2,000 per pound for November through February.

Trip, Primary Target: Petrale Sole Trawl

Target Species: Petrale Sole				
Overfished Species Landed Incidentally (% of trips in which the indicated overfished species were landed)				
	North of Cape Mendocino		South of Cape Mendocino	
	1998	2002	1998	2002
Trips	115	229	41	53
Total Exves Rev ($ thousands)	631	1,571	115	288
Lingcod	66.1%	38.4%	34.1%	30.2%
Whiting	0.9%	0.4%	-	-
Darkblotched RF	-	25.3%	-	1.9%
POP	49.6%	17.0%	-	-
Bocaccio	-	-	22.0%	13.2%
Canary RF	28.7%	21.8%	17.1%	11.3%
Cowcod	-	-	-	-
Widow RF	15.7%	2.6%	9.8%	5.7%
Yelloweye RF	-	0.9%	-	1.9%

Notes: Data from Tables 3.4-13 through 3.4-16. In 1998, sorting of darkblotched and yelloweye rockfish was not mandatory.

Any trawl trip in which the groundfish component is comprised of more than 40% petrale sole (and not falling under any of the previous categories) was counted a trip in which petrale sole was the primary target species. Trips often include multiple tows, some of which may be directed on other species complexes, as a secondary strategy. Therefore, landing data aggregated for an entire trip provide only an indicator of the species composition which might be encountered in the petrale target strategy tow. For the petrale target strategy there are some per tow bycatch estimates available. These estimates are presented below.

Trips targeted on petrale occur both north and south of Cape Mendocino. In 1998 and 2002 approximately 85% of the petrale landed in petrale target trips were caught north of Cape Mendocino. North of Cape Mendocino, in 1998, about 510 thousand pounds of petrale were landed in 115 petrale trips (Table 3.4-3); and in 2002, about 1.3 million pounds were landed in 229 petrale trips (Table 3.4-7). South of Cape Mendocino in 1998, about 84 thousand pounds of petrale were landed in 41 petrale trips (Table 3.4-4); and in 2002, about 205 thousand pounds were landed in 53 petrale trips (Table 3.4-8). In the north, approximately 80 percent of the petrale were taken in the "winter" (November and April) slope fishery in 1998 and 2002. In the south just over 95% of the petrale were taken in the "winter" (November and April) slope fishery in 1998 and over 99% were taken in the winter fishery in 2002.

All of the nine overfished species, except for cowcod, show up in either the northern or southern trips with petrale as the primary trip target. No bocaccio show up in the northern fishery. There was a substantial reduction in the frequency of occurrence of most overfished rockfish species and lingcod in the north between 1998 and 2002. The reductions in the south were also substantial, but somewhat less dramatic (Tables 3.4-13 through 3.4-16). Pacific ocean perch and whiting were not present in the southern fishery and the incidence of darkblotched was substantially lower as well, compared to the northern fishery.

In 1998 and 2002, by weight, petrale comprised 50% to 55% of the landed weight in northern petrale trips (Tables 3.4-3 and 3.4-7), and 55% to 60% of the landed weight in the southern trips (Tables 3.4-4 and 3.4-8). Incidental catch or secondary target landings in the 1998 northern petrale trawl fishery included about 20% to 30% other flatfish and 2% to 3% sablefish. In the 1998 fishery, landings of rockfish comprised 14% of the landing, but declined to 7% by 2002. rockfish. In the south, composition of landings for petrale trips was more stable: about 15% to 10% other flatfish, and 2% to 5% sablefish, and 15% to 16% rockfish. The proportion of sablefish and nongroundfish species was slightly greater in the south than in the north.

By weight, more overfished slope rockfish species (darkblotched rockfish and POP) are caught or landed in northern area petrale target trips than any other overfished species (Table 3.4-17). In Table 3.4-17 bycatch rates were used to estimate overfished species caught in periods 1, 2, and 6 (January through February, March through April, and November through December) of the petrale fishery. There were no May through October bycatch rates used for preseason modeling of the 2003 fishery; therefore, actual retained catch was used for the remainder of the year in Table 3.4-17 for 1998 and 2002 (see bycatch rates in Tables 3.4-18 and 3.4-19). Lingcod landings for trips identified as primarily petrale target trips were substantially higher in 2002 as compared to 1998 (18,000 vs. 6,000 pounds respectively).

Total shoreside exvessel revenue from this fishery (including nontarget species) was $746 thousand and $1.9 million in 1998 and 2002, respectively (Tables 3.4-9 through 3.4-12). While contributing about 50% to 60% of the weight to the petrale targeted trips, petrale contributed about 70% of the exvessel value for this fishery, in both 1998 and 2002. Absent the ability to modify fishing activities to avoid or reduce bycatch, incidental catch rates provide an estimate of the amount of the target species that might be accessed per unit of overfished species caught. From this information, estimates of total revenue generated per pound of overfished species can be made. Such estimates are likely to be most accurate where bycatch logbook or observer data is available, so petrale directed tows can be separated from secondary target strategies used on the same trip. In lieu of more accurate information, trip information provides a rough proxy. Table 3.4-20 provides annual average target species revenue per pound of overfished species based on the all depth bycatch rates documented for modeling of the 2002 fishery (Hastie 2003) for target strategies, areas, and time periods where such information was available (see Tables 3.4-18 and 3.4-19) and based on trip information where such information was not available. For the northern area fishery, the value of petrale per pound of overfished species ran from $28 per pound for POP to $1,261 per pound for whiting in 1998 (Table 3.4-20); and ran from $39 per pound for darkblotched to $26,179 per pound for yelloweye rockfish in 2002. Table 3.4-18, and Table 3.4-19 provide similar information using only bycatch rate estimates. Value per pound of species taken as bycatch varies with bycatch rates which in turn vary by depth and season. For example, applying the bycatch rates to 1998 exvessel prices shows that per pound of lingcod taken deeper than 150 fathoms (but less than 250 fm) there was $80 of petrale taken for the March through April but $12,416 of petrale taken for November through December.

Trip, Primary Target: Flatfish Trawl

Target Species: Flatfish (Other)				
Overfished Species Landed Incidentally (% of trips in which the indicated overfished species were landed)				
	North of Cape Mendocino		South of Cape Mendocino	
	1998	2002	1998	2002
Trips	957	1,275	386	369
Total Exves Rev ($ thousands)	4,000	4,975	1,151	1,026
Lingcod	63.8%	59.1%	40.9%	15.7%
Whiting	3.6%	1.2%	-	-
Darkblotched RF	-	12.1%	-	3.8%
POP	36.1%	11.4%	-	-
Bocaccio	2.3%	0.9%	24.1%	19.0%
Canary RF	47.1%	34.7%	12.2%	6.2%
Cowcod	0.2%	-	-	0.8%
Widow RF	26.0%	7.2%	18.1%	9.8%
Yelloweye RF	-	1.7%	0.3%	0.8%

Notes: Data from Tables 3.4-13 through 3.4-16. In 1998, sorting of darkblotched and yelloweye rockfish was not mandatory.

Any trawl trip in which the groundfish component is comprised of more than 70% flatfish (and not falling under any of the previous categories) was counted as a trip in which flatfish was the primary target species, so long as sablefish and thornyheads composed less than 10% of the trip weight. Trips often include multiple tows, some of which may be directed on other species complexes, as a secondary strategy. Therefore, landing data aggregated for an entire trip provide only an indicator of the species composition which might be encountered in the flatfish target strategy tow. For the flatfish target strategy there are some per tow bycatch estimates available. These are presented below.

Trips targeted on other flatfish occur both north and south of Cape Mendocino. In 1998 and 2002 approximately 80% of the flatfish landed in flatfish target trips were caught north of Cape Mendocino. North of Cape Mendocino, in 1998, about 6.3 million pounds of flatfish were landed in 957 flatfish trips (Table 3.4-3); and in 2002, about 8.5 million pounds of flatfish were landed in 1,275 flatfish trips (Table 3.4-7). South of Cape Mendocino, in 1998, about 1.9 million pounds of flatfish were landed in 386 flatfish trips (Table 3.4-4); and in 2002, about 1.6 million pounds were landed in 369 flatfish trips (Table 3.4-8).

All of the nine currently overfished species show up in either the northern or southern trips with other flatfish as the primary trip target. There was a substantial reduction in the frequency of occurrence of most overfished rockfish species in the north between 1998 and 2002 and a minor reduction for lingcod (Tables 3.4-13 through

3.4-16). The reductions in the south were also substantial, but somewhat less dramatic, with the exception of lingcod. In the south, the frequency of trips with lingcod dropped from 40.9% in 1998 to 15.7% in 2002 (Tables 3.4-14 and 3.4-16). The incidence of bocaccio in the southern fishery was much higher than in the north. Pacific ocean perch and whiting were not present in the southern fishery and the incidence of darkblotched was substantially lower as well, compared to the northern fishery.

In 1998 and 2002, by weight, flatfish composed 67% and 77%, respectively, of the landed weight in northern flatfish trips (Tables 3.4-3 and 3.4-7); and 68% and 83%, respectively, of the landed weight in the southern trips (tables 3.4-4 and 3.4-8). Incidental catch or secondary target landings in the 1998 and 2002 northern flatfish trawl fishery included about 5% "other groundfish" and 3% sablefish. The incidental rockfish component in the north declined from 18% in 1998 to 6% in 2002. In the south, the sablefish component increased from 1% in 1998 to 3% in 2002 while the rockfish component declined from 21% in 1998 to 10% in 2002.

By weight, more overfished slope rockfish species (darkblotched rockfish and POP) are caught or landed in northern and southern area flatfish target trips than any other overfished species (Table 3.4-17). In Table 3.4-17 bycatch rates were used to estimate lingcod, canary, POP, darkblotched and widow rockfish catch in the northern "other flatfish" fishery and bocaccio, lingcod, canary, darkblotched, and widow rockfish in the southern area fishery (see bycatch rates available in Table 3.4-18). There were no bycatch rates available for other overfished species in this fishery, therefore actual retained catch is provided for other overfished species in Table 3.4-17.

Total exvessel revenue from this fishery (including nontarget species) was $5.2 million and $6.0 million in 1998 and 2002, respectively (Tables 3.4-9 through 3.4-12). Flatfish contributed 66% and 75% of the coastwide exvessel value for this fishery, in 1998 and 2002, respectively. Absent the ability to modify fishing activities to avoid or reduce bycatch, incidental bycatch rates provide an estimate of the amount of the target species that might be accessed per unit of overfished species harvested. From this information estimates of total revenue generated per pound of overfished species can be made. Such estimates are likely to be most accurate where bycatch logbook or observer data is available, so flatfish-directed tows can be separated from secondary target strategies used on the same trip. In lieu of more accurate information, trip information provides a rough proxy. Table 3.4-20 provide annual average target species revenue per pound of overfished species based on the all depth bycatch rates documented for modeling of the 2002 fishery (Hastie 2003) for target strategies, areas and time periods where such information was available (see Tables 3.4-18 and 3.4-19) and based on trip information where such information was not available. For the northern area fishery, the value of flatfish per pound of overfished species ranged from $25 per pound for POP and darkblotched to $85,116 per pound for cowcod in 1998 (Table 3.4-20); and ranged from $27 per pound for darkblotched rockfish to $14,633 per pound for bocaccio in 2002. Cowcod and bocaccio generally appear in southern area fisheries, so their rare occurrence in northern catch results in these high values. Table 3.4-18 and Table 3.4-19 provide similar information using only bycatch rate estimates. Value per pound of species taken as bycatch varies with bycatch rates which in turn vary by depth and season. For example, applying the bycatch rates to 1998 exvessel prices shows that per pound of lingcod taken deeper than 150 fathoms (but less than 250 fm) there was $276 of flatfish taken in the January through February time period, but only $41 taken for the September through October period.

Trip, Primary Target: Widow/Yellowtail Midwater Trawl

Target Species: Yellowtail Rockfish and Widow Rockfish				
Overfished Species Landed Incidentally (% of trips in which the indicated overfished species were landed)				
	North of Cape Mendocino		South of Cape Mendocino	
	1998	2002	1998	2002 (1 trip)
Trips	255	63	16	2
Total Exves Rev ($ thousands)	1,462	602	88	1
Lingcod	55.7%	7.9%	68.8%	-
Whiting	1.2%	1.6%	-	-
Darkblotched RF	-	4.8%	-	-
POP	45.9%	1.6%	-	-
Bocaccio	3.1%	-	31.3%	-
Canary RF	65.1%	36.5%	31.3%	-
Cowcod	-	-	12.5%	-
Widow RF	91.4%	96.8%	100.0%	100.0%
Yelloweye RF	-	-	6.3%	-

Notes: Data from Tables 3.4-13 through 3.4-16. In 1998, sorting of darkblotched and yelloweye rockfish was not mandatory.

Any trawl trip in which the groundfish component is comprised of more than 60% yellowtail rockfish or widow rockfish species (and not falling under any of the previous categories) was counted as a trip in which yellowtail rockfish or widow rockfish was the primary target species (a yellowtail/widow trip). Important assumptions and caveats for the interpretation of target species and incidental catch information provided here are covered in Section 4.2.2.1.

Trips targeted on yellowtail/widow rockfish species occur both north and south of Cape Mendocino, but primarily in the northern area. In 1998, 95% of the yellowtail/widow rockfish landed in yellowtail/widow rockfish target trips were caught north of Cape Mendocino. The northern share of the yellowtail/widow rockfish fishery increased to virtually 100% in 2002. North of Cape Mendocino, in 1998, about 2.8 million pounds of yellowtail/widow rockfish were landed in 255 yellowtail/widow rockfish trips (Table 3.4-3); and in 2002, about 1.3 million pounds of yellowtail/widow rockfish were landed in 63 yellowtail/widow rockfish trips (Table 3.4-7). South of Cape Mendocino, in 1998, about 145 thousand pounds of yellowtail/widow rockfish were landed in 16 yellowtail/widow rockfish trips (Table 3.4-4); and in 2002, there was only one landing assigned to this target strategy (Table 3.4-8).

All of the nine currently overfished species show up in either the northern or southern trips with yellowtail/widow rockfish as the primary trip target. There was a substantial reduction in the frequency of occurrence of lingcod and most overfished rockfish species in the north between 1998 and 2002 (Tables 3.4-13 through 3.4-16). There was no bycatch of overfished species in the single yellowtail/widow rockfish trip recorded in the south for the 2002 fishery.

In 1998 and 2002, by weight, yellowtail/widow rockfish composed 76% and 77%, respectively, of the landed weight in northern yellowtail/widow rockfish trips (Tables 4.4-3 and 3.4-7), and a comparable 76% and 79%, respectively, of the landed weight in the southern trips (Tables 3.4-4 and 3.4-8). Incidental catch or secondary target landings in the 1998 northern yellowtail/widow rockfish trawl trips included 13% other rockfish, 7% other flatfish, and 2% sablefish. Incidental catch or secondary target landings in the 2002 northern yellowtail/widow rockfish trawl trips included 1% other rockfish and less than one half percent other flatfish and sablefish. In 1998, southern area trips included 17% other rockfish, 5% other sablefish, and 1% sablefish in 2002. For the southern area, the single trip in 2002 does not provide much trend information for comparing the catch composition between 2002 and 1998.

By weight, other than widow rockfish, there tends to be more canary and lingcod caught or landed in northern and southern area yellowtail/widow rockfish target trips than any other overfished species (Table 3.4-17). In Table 3.4-17 bycatch rates were used to estimate lingcod, canary, POP, darkblotched, and widow rockfish catch in the northern yellowtail/widow rockfish fishery. Bycatch rates were not available for the southern area fishery; therefore, actual retained catch is provided for the southern area overfished species in Table 3.4-17.

Total exvessel revenue from this fishery (including nontarget species) was $1.5 million and $0.6 million in 1998 and 2002, respectively (not adjusted for inflation) (Tables 3.4-9 through 3.4-12). Yellowtail/widow rockfish contributed 71% and 98% of the coastwide exvessel value for this fishery, in 1998 and 2002, respectively. Absent the ability to modify fishing activities to avoid or reduce bycatch, incidental bycatch rates provide an estimate of the amount of the target species that might be accessed per unit of overfished species harvested. From this information, estimates of total revenue generated per pound of overfished species can be made. Such estimates are likely to be most accurate where bycatch logbook or observer data is available so that yellowtail/widow rockfish directed tows can be separated from secondary target strategies used on the same trip. In lieu of more accurate information, trip information provides a rough proxy. Table 3.4-20 provides annual average target species revenue per pound of overfished species based on the all depth bycatch rates documented for modeling of the 2002 fishery (Hastie 2003) for target strategies, areas and time periods where such information was available (see Tables 3.4-18 and 3.4-19) and based on trip information where such information was not available. For the northern area fishery, the value of yellowtail/widow rockfish per pound of overfished species ranged from $0.70 per pound for widow rockfish to $4,731 per pound for bocaccio in 1998 (Table 3.4-20); and from $1.20 per pound for widow rockfish to $3,184 per pound for yelloweye rockfish in 2002. Bocaccio generally appears in southern area fisheries, so their rare occurrence in northern catch results in the very high values. Tables 3.4-18 and 3.4-19 provide similar information using only bycatch rate estimates. Value per pound of species taken as bycatch varies with bycatch rates which in turn vary by depth and season. For example, applying the all-depth bycatch rates to 1998 exvessel prices shows that per pound of lingcod taken there was $541 of yellowtail/widow rockfish taken in the January through February time period, $50 to $55 taken in the July through October period, and no bycatch for other periods of the year.

Trip, Primary Target: DTS Trawl

Target Species: DTS (Dover Sole, Shortspine and Longspine Thornyhead, Sablefish)				
Overfished Species Landed Incidentally (% of trips in which the indicated overfished species were landed)				
	North of Cape Mendocino		South of Cape Mendocino	
	1998	2002	1998	2002
Trips	1,627	1,020	548	625
Total Exves Rev ($ thousands)	10,067	7,477	3,416	4,279
Lingcod	52.3%	19.6%	35.0%	11.4%
Whiting	0.7%	0.7%	0.2%	-
Darkblotched RF	-	20.6%	-	6.4%
POP	43.0%	18.9%	-	-
Bocaccio	5.0%	0.1%	24.8%	11.7%
Canary RF	38.0%	12.3%	13.3%	7.7%
Cowcod	-	-	1.5%	0.2%
Widow RF	35.8%	3.1%	19.3%	6.2%
Yelloweye RF	0.7%	1.3%	1.3%	0.2%

Notes: Data from Tables 3.4-13 through 3.4-16. In 1998, sorting of darkblotched and yelloweye rockfish was not mandatory.

Any trawl trip in which the groundfish component is comprised of more than 60% DTS species (and not falling under any of the previous categories) was counted as a trip in which DTS was the primary target species. Important assumptions and caveats for the interpretation of target species and incidental catch information provided here are covered in Section 4.2.2.1

Trips targeted on DTS species occur both north and south of Cape Mendocino. In 1998, 73% of the DTS landed in DTS target trips were caught north of Cape Mendocino. The northern share of the DTS fishery declined to 59% in 2002. North of Cape Mendocino, in 1998, about 14.0 million pounds of DTS were landed in 1,627 DTS trips (Table 3.4-3); and in 2002, about 9.5 million pounds of DTS were landed in 1,020 DTS trips (Table 3.4-7). South of Cape Mendocino, in 1998, about 5.3 million pounds of DTS were landed in 548 DTS trips (Table 3.4-4); and in 2002, about 6.6 million pounds were landed in 625 DTS trips (Table 3.4-8).

All of the nine currently overfished species show up in either the northern or southern trips with DTS as the primary trip target. There was a substantial reduction in the frequency of occurrence of lingcod and most overfished rockfish species in the north between 1998 and 2002 (Tables 3.4-13 and 3.4-15). The reductions in the south were also substantial, but somewhat less dramatic, with the exception of lingcod. The frequency of trips with lingcod dropped from 35.0% in 1998 to 11.4% in 2002 (Tables 3.4-14 and 3.4-16). As would be expected based on species distributions, the incidence of bocaccio in the southern fishery was much higher than in the north. Pacific ocean perch and whiting were virtually not present in the southern fishery, and the incidence of darkblotched was substantially lower than in the northern fishery.

In 1998 and 2002, by weight, DTS composed 69% and 82%, respectively, of the landed weight in northern DTS trips (Tables 3.4-3 and 3.4-7), and 73% and 89%, respectively, of the landed weight in the southern trips (Tables 3.4-4 and 3.4-8). Incidental catch or secondary target landings in the 1998 northern DTS trawl trips included 15% other rockfish and 9% other flatfish. The 2002 northern DTS trawl trips included 10% other rockfish and 3% other flatfish. In the south, the other flatfish component held steady at 4%, comparing 1998 to 2002, while the rockfish component declined from 15% in 1998 to 5% in 2002.

By weight, more overfished slope rockfish species (darkblotched rockfish and POP) were caught or landed in northern and southern area DTS target trips than any other overfished species (Table 3.4-17). In Table 3.4-17 bycatch rates were used to estimate lingcod, canary, POP, darkblotched, and widow rockfish catch in the northern DTS fishery and bocaccio, lingcod, canary, darkblotched, and widow rockfish in the southern area fishery (see bycatch rates available in Table 3.4-18). There were no bycatch rates available for other overfished species in this fishery; therefore, actual retained catch is provided for other overfished species in Table 3.4-17.

Total exvessel revenue from this fishery (including nontarget species) was $13.5 million and $11.8 million in 1998 and 2002, respectively (not adjusted for inflation) (Tables 3.4-9 through 3.4-12). DTS contributed 79% and 90% of the coastwide exvessel value for this fishery, in 1998 and 2002, respectively. Table 3.4-20 provide annual average target species revenue per pound of overfished species based on the all depth bycatch rates documented for modeling of the 2002 fishery (Hastie 2003) for target strategies, areas and time periods where such information was available (see Tables 3.4-18 and 3.4-19) and based on trip information where such information was not available. Important assumptions and caveats for the interpretation of this information on exvessel revenue per pounds of overfished species catch is provided in Section 4.2.2.1. For the northern area fishery, the indicated exvessel value of DTS per pound of overfished species ran from $60 per pound for POP to $14,080 per pound for yelloweye in 1998 (Table 3.4-20); and ran from $74 per pound for POP to $325,103 per pound for bocaccio in 2002. Cowcod ad bocaccio generally appear in southern area fisheries, so their rare occurrence in northern catch results in these high values. Table 3.4-18, and 3.4-19 provide similar information using only bycatch rate estimates. Value per pound of species taken as bycatch varies with bycatch rates which in turn vary by depth and season. For example, applying the bycatch rates to 1998 exvessel prices shows that per pound of lingcod taken deeper than 150 fathoms (but less than 250 fm) there was $1,748 of DTS taken in the January through February time period but only $72 taken for the September through October period.

Trip, Primary Target: POP Trawl

Target Species: Pacific Ocean Perch				
Overfished Species Landed Incidentally (% of trips in which the indicated overfished species were landed)				
	North of Cape Mendocino		South of Cape Mendocino	
	1998	2002	1998	2002
Trips	14	0	0	0
Total Exves Rev ($ thousands)	67	-	-	-
Lingcod	57.1%	-	-	-
Whiting	-	-	-	-
Darkblotched RF	-	-	-	-
POP	100.0%	-	-	-
Bocaccio	-	-	-	-
Canary RF	57.1%	-	-	-
Cowcod	-	-	-	-
Widow RF	71.4%	-	-	-
Yelloweye RF	-	-	-	-

Notes: Data from Tables 3.4-13 through 3.4-16. In 1998, sorting of darkblotched and yelloweye rockfish was not mandatory.

Any trawl trip in which the groundfish component is comprised of more than 60% POP species (and not falling under any of the previous categories) was counted as a trip in which POP was the primary target species. Important assumptions and caveats for the interpretation of target species and incidental catch information provided here are covered in Section 4.2.2.1

Trips targeted on POP species occurred only north Cape Mendocino and in 2002 no trips met the POP targeting criteria due to adjustments in the fishery. North of Cape Mendocino, in 1998, about 112 thousand pounds of POP were landed in 14 POP trips (Table 3.4-3). Only 4% of the POP landed in 1998 was landed on trips for which POP is identified the primary target strategy under the criteria used here. Trips meeting the primary strategy classification criteria for arrowtooth, DTS and slope rockfish landed 58% of the POP and another 25% of the POP was landed on trips meeting the primary strategy classification for flatfish, widow, and other rockfish. In 1998 there were 2.7 million pounds of POP landed north of Cape Mendocino, and in 2002, 322 thousand pounds (Table 3.4-7). In 2002, 41% of the landings occurred on DTS trips and another 50% on arrowtooth and flatfish trips.

Of the nine currently overfished species, lingcod, canary rockfish, and widow rockfish showed up in 1998 POP targeted trips. In 1998, by weight, POP composed 69% of the landed weight in POP trips (Table 3.4-3). Incidental catch or secondary target landings in the 1998 POP trawl trips included 15% other rockfish, 10% other flatfish, and 4% sablefish. By weight, more widow rockfish were landed in POP target trips than any other overfished species (Table 3.4-17).

Total exvessel revenue from this fishery (including nontarget species) was $67 thousand in 1998 (not adjusted for inflation) (Table 3.4-9). POP contributed 56% of the coastwide exvessel value for this fishery, in 1998 and 2002, respectively. Table 3.4-20 provide annual average target species revenue per pound of overfished species based on the all depth bycatch rates documented for modeling of the 2002 fishery (Hastie 2003) for target strategies, areas and time periods where such information was available (see Tables 3.4-18 and 3.4-19) and based on trip information where such information was not available. Important assumptions and caveats for the interpretation of this information on exvessel revenue per pounds of overfished species catch is provided in Section 4.2.2.1. The indicated value of POP per pound of overfished species ran from $8 per pound for widows to $66 per pound for lingcod in 1998 (Table 3.4-20).

Trip, Primary Target: Slope Rockfish Trawl

Target Species: Slope Rockfish (see Table 3.2-2).				
Overfished Species Landed Incidentally (% of trips in which the indicated overfished species were landed)				
	North of Cape Mendocino		South of Cape Mendocino	
	1998	2002	1998	2002
Trips	212	19	316	53
Total Exves Rev ($ thousands)	1,326	108	1,792	251
Lingcod	70.8%	31.6%	42.4%	3.8%
Whiting	0.9%	-	0.3%	-
Darkblotched RF	-	26.3%	0.3%	9.4%
POP	64.2%	42.1%	-	-
Bocaccio	7.5%	5.3%	30.4%	5.7%
Canary RF	70.8%	21.1%	8.2%	1.9%
Cowcod	-	-	3.5%	-
Widow RF	75.0%	10.5%	28.5%	9.4%
Yelloweye RF	-	-	2.8%	1.9%

Notes: Data from Tables 3.4-13 through 3.4-16. In 1998, sorting of darkblotched and yelloweye rockfish was not mandatory.

Any trawl trip in which the groundfish component is comprised of more than 30% slope rockfish species (and not falling under any of the previous categories) was counted as a trip in which slope rockfish was the primary target species. Important assumptions and caveats for the interpretation of target species and incidental catch information provided here are covered in Section 4.2.2.1

Trips targeted on slope rockfish species occur both north and south of Cape Mendocino. In 1998, 31% of the slope rockfish landed in slope rockfish target trips were caught north of Cape Mendocino (Table 3.4-3). The northern share of the slope rockfish fishery declined to 19% in 2002 (Table 3.4-7). North of Cape Mendocino, in 1998, about 1.2 million pounds of slope rockfish were landed in 212 slope rockfish trips (Table 3.4-3); and in 2002, about 75 thousand pounds of slope rockfish were landed in 19 slope rockfish trips (Table 3.4-7). South of Cape Mendocino, in 1998, about 2.8 million pounds of slope rockfish were landed on 316 slope rockfish trips (Table 3.4-4); and in 2002, about 323 thousand pounds were landed on 53 slope rockfish trips (Table 3.4-8).

All of the nine currently overfished species show up in either the northern or southern trips with slope rockfish as the primary trip target. There was a substantial reduction in the frequency of occurrence of lingcod and most overfished rockfish species between 1998 and 2002 (Tables 3.4-13 through 3.4-16). As would be expected based on species distributions, the incidence of bocaccio in the southern fishery was much higher than in the north. Pacific ocean perch, widow rockfish, and canary rockfish occurred in more northern trips than southern trips.

In 1998 and 2002, by weight, slope rockfish composed 41% and 46%, respectively, of the landed weight in northern slope rockfish trips (Table 3.4-3 and 3.4-7), and 56% and 64%, respectively, of the landed weight in the southern trips (Tables 3.4-4 and 3.4-8). Incidental landings in the 1998 northern slope rockfish trawl trips included 25% other rockfish, 19% other flatfish and 5% sablefish. Incidental catch or secondary target landings in the 2002 northern slope rockfish trawl trips included only 1% other rockfish but 38% flatfish and 8% sablefish. Incidental catch or secondary target landings in the 1998 southern slope rockfish trawl trips included 19% other rockfish, 16% flatfish and 3% sablefish. The 2002 southern slope rockfish trawl trips included 10% other rockfish, 22% flatfish and 3% sablefish.

In 1998, by weight, more POP and widow rockfish were landed in slope rockfish target trips than any other overfished species (Table 3.4-17). In 2002, darkblotched show up as the dominate overfished species in the landings. The increase is likely related to the mandatory sorting requirement imposed for darkblotched between the 1998 and 2002 seasons. There were no bycatch rates used for this fishery in 2002 or 2003 modeling, therefore actual retained catch is provided for overfished species in Table 3.4-17.

Total exvessel revenue from this fishery (including nontarget species) was $3.1 million and $0.4 million in 1998 and 2002, respectively (not adjusted for inflation) (Tables 3.4-9 through 3.4-12). Slope rockfish contributed 44% and 59% of the coastwide exvessel value for this fishery, in 1998 and 2002, respectively. Table 3.4-20 provides annual average target species revenue per pound of overfished species based on the all depth bycatch rates documented for modeling of the 2002 fishery (Hastie 2003) for target strategies, areas and time periods where such information was available (see Tables 3.4-18 and 3.4-19) and based on trip information where such information was not available. Important assumptions and caveats for the interpretation of this information on exvessel revenue per pounds of overfished species catch is provided in Section 4.2.2.1. For the northern area fishery, the indicated exvessel value of slope rockfish per pound of overfished species ranged from $2 per pound for POP to $359 per pound for whiting in 1998; and ranged from $15 per pound for POP to $1,721 per pound for bocaccio in 2002 (Table 3.4-20).

Trip, Primary Target: Chilipepper Trawl

Target Species: Chilipepper Rockfish				
Overfished Species Landed Incidentally (% of trips in which the indicated overfished species were landed)				
	North of Cape Mendocino		South of Cape Mendocino	
	1998	2002	1998	2002
Trips	0	0	111	54
Total Exves Rev ($ thousands)	-	-	748	138
Lingcod	-	-	53.2%	44.4%
Whiting	-	-	-	-
Darkblotched RF	-	-	-	3.7%
POP	-	-	-	-
Bocaccio	-	-	45.9%	35.2%
Canary RF	-	-	13.5%	25.9%
Cowcod	-	-	9.9%	1.9%
Widow RF	-	-	36.0%	33.3%
Yelloweye RF	-	-	6.3%	-

Notes: Data from Tables 3.4-13 through 3.4-16. In 1998, sorting of darkblotched and yelloweye rockfish was not mandatory.

Any trawl trip in which the groundfish component is comprised of more than 30% chilipepper rockfish species (and not falling under any of the previous categories) was counted as a trip in which chilipepper rockfish was the primary target species. Important assumptions and caveats for the interpretation of target species and incidental catch information provided here are covered in Section 4.2.2.1

Trips targeted on chilipepper rockfish species occurred only south of Cape Mendocino. South of Cape Mendocino, in 1998, about 795 thousand pounds of chilipepper rockfish were landed in 111 chilipepper rockfish trips (Table 3.4-4); and in 2002, about 164 thousand pounds were landed in 54 chilipepper rockfish trips (Table 3.4-8).

Of the nine currently overfished species all but whiting and POP show up in trips on which chilipepper rockfish was the primary trip target. Between 1998 and 2002 there was some reduction in the frequency with which most overfished species showed up on chilipepper targeted trips. The most notable exception to this was canary rockfish.

In 1998 and 2002, by weight, chilipepper rockfish composed 48% and 67%, respectively, of the landed weight of chilipepper rockfish trips (Tables 3.4-4 and 3.4-8). Incidental catch or secondary target landings in the 1998 chilipepper rockfish trawl trips included 23% flatfish, 21% other rockfish and 2% sablefish. The 2002 chilipepper rockfish trawl trips included 17% flatfish, 9% other rockfish and 3% sablefish. There were no bycatch rates used for this fishery in 2002 or 2003 modeling, therefore actual catch was used to develop the total catch estimates for overfished species in Table 3.4-17. In 1998, 97% of the overfished species catch on chilipepper rockfish target trips was bocaccio, lingcod and widow (Table 3.4-17). In 2002, the catch of overfished species had declined from 130 thousand pounds to 13 thousand pounds and bocaccio, lingcod and widow composed 85% of the catch.

Total exvessel revenue from this fishery (including nontarget species) was $748 thousand and $137 thousand in 1998 and 2002, respectively (not adjusted for inflation) (Tables 3.4-10 and 3.4-12). Chilipepper rockfish contributed 45% and 60% of the coastwide exvessel value for this fishery, in 1998 and 2002, respectively. Table 3.4-20 provides annual average target species revenue per pound of overfished species based on trip information. Important assumptions and caveats for the interpretation of this information on exvessel revenue per pounds of overfished species catch is provided in Section 4.2.2.1. For the southern area fishery, the indicated exvessel value of chilipepper rockfish per pound of overfished species ran from $8 per pound for widow rockfish to $2,451 per pound for yelloweye in 1998 (Table 3.4-20); and ran from $29 per pound for bocaccio to $137,730 per pound for cowcod in 2002.

Trip, Primary Target: Yellowtail Rockfish Trawl

Target Species: Yellowtail Rockfish				
Overfished Species Landed Incidentally (% of trips in which the indicated overfished species were landed)				
	North of Cape Mendocino		South of Cape Mendocino	
	1998	2002	1998	2002
Trips	93	10	3	0
Total Exves Rev ($ thousands)	399	9	12	-
Lingcod	81.7%	60.0%	100.0%	-
Whiting	-	-	-	-
Darkblotched RF	-	-	-	-
POP	55.9%	10.0%	-	-
Bocaccio	2.2%	-	33.3%	-
Canary RF	82.8%	50.0%	33.3%	-
Cowcod	-	-	-	-
Widow RF	59.1%	-	33.3%	-
Yelloweye RF	-	-	66.7%	-

Notes: Data from Tables 3.4-13 through 3.4-16. In 1998, sorting of darkblotched and yelloweye rockfish was not mandatory.

Any trawl trip in which the groundfish component is comprised of more than 30% yellowtail rockfish species (and not falling under any of the previous categories) was counted as a trip in which yellowtail rockfish was the primary target species. Important assumptions and caveats for the interpretation of target species and incidental catch information provided here are covered in Section 4.2.2.1

Trips targeted on yellowtail rockfish species occur almost entirely north of Cape Mendocino. In 1998, 96% of the yellowtail rockfish landed in yellowtail rockfish target trips were caught north of Cape Mendocino (tables 3.4-3 and 3.4-4; and in 2002 there were no yellowtail rockfish trips south of Cape Mendocino. North of Cape Mendocino, in 1998, about 348 thousand pounds of yellowtail rockfish were landed in 93 yellowtail rockfish trips (Table 3.4-3); and in 2002, about 7 thousand pounds of yellowtail rockfish were landed in 10 yellowtail rockfish trips (Table 3.4-7). South of Cape Mendocino, in 1998, about 13 thousand pounds of yellowtail rockfish were landed in three yellowtail rockfish trips (Table 3.4-4).

Of the nine currently overfished species only whiting, darkblotched, and cowcod do not show up in either the northern or southern trips with yellowtail rockfish as the primary trip target. In 1998, lingcod, POP, canary rockfish and widow rockfish were present on over 50% of the yellowtail rockfish primary target trips. In the ten northern trips in 2002 lingcod, POP and canary were the only overfished species landed. Lingcod, bocaccio, canary, widow, and yelloweye were the overfished species landed on the 3 yellowtail trips taken in the 1998 fishery.

In 1998 and 2002, by weight, yellowtail rockfish composed 39% and 52%, respectively, of the landed weight in northern yellowtail rockfish trips (Tables 3.4-3 and 3.4-7). Incidental catch or secondary target landings in the 1998 northern yellowtail rockfish trawl trips included 24% other rockfish, 23% flatfish and 6% sablefish. The 2002 northern yellowtail rockfish trawl trips included 4% other rockfish, 16% flatfish and 1% sablefish.

By weight, POP, canary and widows composed 92% of the overfished species landed in 1998 and POP, canary and lingcod composed 96% of the overfished species landed in 2002 (Tables 3.4-3 and 3.4-7). In 1998, 12 thousand pounds of overfished species were landed and in 2002 less than 1,000 pounds of overfished species were landed (Table 3.4-17). There were no bycatch rates used for this fishery in 2002 or 2003 modeling; therefore, actual landings were used to develop the estimates for overfished species in Table 3.4-17.

Total exvessel revenue from this fishery (including nontarget species) was $136 thousand and $5 thousand in 1998 and 2002, respectively (not adjusted for inflation) (Tables 3.4-9 through 3.4-12). Yellowtail rockfish contributed 34% and 38% of the coastwide exvessel value for this fishery, in 1998 and 2002, respectively. Table 3.4-20 provides annual average target species revenue per pound of overfished species based on the all depth bycatch rates documented for modeling of the 2002 fishery (Hastie 2003) for target strategies, areas and time periods where such information was available (see Tables 3.4-18 and 3.4-19) and based on trip information where such information was not available. Important assumptions and caveats for the interpretation of this information on exvessel revenue per pounds of overfished species catch is provided in Section 4.2.2.1. For the northern area fishery, the indicated exvessel value of yellowtail rockfish per pound of overfished species ran from $2 per pound for POP to $276 per pound for yelloweye in 1998 (Table 3.4-20); and ran from $15 per pound for canary to $4,628 per pound for POP in 2002.

Trip, Primary Target: Canary Rockfish Trawl

Target Species: Canary Rockfish				
Overfished Species Landed Incidentally (trips and % of trips in which the indicated overfished species were landed)				
	North of Cape Mendocino		South of Cape Mendocino	
	1998	2002	1998	2002
Trips	35	1	5	0
Total Exvessel Revenue ($ thousands)	159	0	29	
Lingcod	65.7%	-	80.0%	-
Whiting	2.9%	-	-	-
Darkblotched RF	-	100.0%	-	-
POP	51.4%	100.0%	-	-
Bocaccio RF	2.9%	-	80.0%	-
Canary RF	100.0%	100.0%	100.0%	-
Cowcod	-	-	-	-
Widow RF	60.0%	-	100.0%	-
Yelloweye RF	-	-	-	-

Notes: Data from Tables 3.4-13 through 3.4-16. In 1998, sorting of darkblotched and yelloweye rockfish was not mandatory.

Any trawl trip in which the groundfish component is comprised of more than 30% canary rockfish species (and not falling under any of the previous categories) was counted as a trip in which canary rockfish was the primary target species. Important assumptions and caveats for the interpretation of target species and incidental catch information provided here are covered in Section 4.2.2.1

Trips targeted on canary rockfish species occurred primarily north of Cape Mendocino and by 2002 diminished to an insignificant level. In 1998, 86% of the canary rockfish landed in canary rockfish target trips were caught north of Cape Mendocino. North of Cape Mendocino, in 1998, about 136 thousand pounds of canary rockfish were landed in 35 canary rockfish trips (Table 3.4-3). South of Cape Mendocino, in 1998, about 22 thousand pounds of canary rockfish were landed in 5 canary rockfish trips (Table 3.4-7).

Six of the nine currently overfished species showed up in the 1998 trips. Darkblotched rockfish did not show up in 1998 trips, but did show up in the single 2002 trip classified has a canary rockfish trip.

In 1998, by weight, canary rockfish composed 37% of the landed weight in northern canary rockfish trips (Table 3.4-3), and 32% of the landed weight in the southern trips (Table 3.4-7). Incidental catch or secondary target in the 1998 northern canary rockfish trawl trips included 38% other rockfish 13% other flatfish, 4% sablefish and 2% lingcod. Incidental landings in the 1998 northern canary rockfish trawl trips included 55% other rockfish 8% other flatfish, 1% sablefish and 1% lingcod.

By weight, more widow rockfish were landed in northern and southern area canary rockfish target trips than any other overfished species (Table 3.4-17). There were no bycatch rates used for this fishery in 2002 or 2003 modeling; therefore, actual landings were used to develop the estimates for overfished species in Table 3.4-17.

Total exvessel revenue from this fishery (including nontarget species) was $188 thousand and $80 in 1998 and 2002, respectively (not adjusted for inflation). Canary rockfish contributed 78% of the coastwide exvessel value for this fishery, in 1998. For the northern area fishery, the indicated exvessel value of canary rockfish per pound of overfished species ran from $3 per pound for widow rockfish to $17,708 per pound for the one occurrence of bocaccio on 35 1998 trips (Table 3.4-20); and ran from $3 per pound for widow rockfish to $30 per pound for lingcod in the south in 1998.

Trip, Primary Target: Widow Rockfish Trawl

Target Species: Widow Rockfish				
Overfished Species Landed Incidentally (% of trips in which the indicated overfished species were landed)				
	North of Cape Mendocino		South of Cape Mendocino	
	1998	2002	1998	2002
Trips	144	0	29	1
Total Exves Rev ($ thousands)	1,583	-	266	4
Lingcod	68.1%	-	72.4%	-
Whiting	2.8%	-	-	-
Darkblotched RF	-	-	-	-
POP	70.1%	-	-	-
Bocaccio	12.5%	-	55.2%	-
Canary RF	83.3%	-	51.7%	100.0%
Cowcod	-	-	3.4%	-
Widow RF	100.0%	-	100.0%	100.0%
Yelloweye RF	1.4%	-	13.8%	-

Notes: Data from Tables 3.4-13 through 3.4-16. In 1998, sorting of darkblotched and yelloweye rockfish was not mandatory.

Any trawl trip in which the groundfish component is comprised of more than 30% widow rockfish species (and not falling under any of the previous categories) was counted as a trip in which widow rockfish was the primary target species. Important assumptions and caveats for the interpretation of target species and incidental catch information provided here are covered in Section 4.2.2.1

Trips targeted on widow rockfish species occurred both north and south of Cape Mendocino, in 1998. In 2002 the number of trips classified as widow was not significant. In 1998, 85% of the widow rockfish landed in widow rockfish target trips were caught north of Cape Mendocino (Tables 3.4-3 and 3.4-4). North of Cape Mendocino, in 1998, about 1.4 million pounds of widow rockfish were landed in 144 widow rockfish trips. South of Cape Mendocino, in 1998, about 251 thousand pounds of widow rockfish were landed in 29 widow rockfish trips.

Eight of the nine currently overfished species show up in either the northern or southern trips with widow rockfish as the primary trip target in 1998. Darkblotched were absent from both northern and southern trips in 1998, but may have been absent because of the lack of a sorting requirement. The number of trips in 2002 was to few to draw conclusions.

In 1998, by weight, widow rockfish composed 39% of the landed weight in northern widow rockfish trips, and 42% of the landed weight in the southern trips (Table 3.4-4). Incidental catch or secondary target landings in the 1998 northern widow rockfish trawl trips included 15% other rockfish 9% other flatfish. The 2002 northern widow rockfish trawl trips included 10% other rockfish and 3% other flatfish (Table 3.4-7). In the south, the other flatfish component held steady at 4%, comparing 1998 to 2002, while the rockfish component declined from 15% in 1998 to 5% in 2002 (Table 3.4-8).

By weight, more overfished canary and POP (see Section 3.4.2.1 for information on which species codes are included in the POP category) were landed in northern area widow rockfish target trips, and more canary were landed in southern area trips, than any other overfished species (Table 3.4-17). There were no bycatch rates used for this fishery in 2002 or 2003 modeling; therefore, actual landings were used to develop the estimates for overfished species in Table 3.4-17.

Total exvessel revenue from this fishery (including nontarget species) was $1.8 million and $4 thousand in 1998 and 2002, respectively (not adjusted for inflation) (Tables 3.4-9 through 3.4-12). Widow rockfish contributed 36% and 49% of the coastwide exvessel value for this fishery, in 1998 and 2002, respectively.

For the northern area fishery, the indicated exvessel value of widow rockfish per pound of overfished species ran from $8 per pound for canary rockfish to $16,844 per pound for yelloweye reported on two trips in 1998 (Table 3.4-20), and in the south from widow rockfish trips per pound of overfished species ran from $12 per pound for canary rockfish to $8,853 per pound for cowcod reported on one trip in 1998 (Table 3.4-20).

Trip, Primary Target: Other Rockfish Trawl

Target Species: Rockfish				
Overfished Species Landed Incidentally (% of trips in which the indicated overfished species were landed)				
	North of Cape Mendocino		South of Cape Mendocino	
	1998	2002	1998	2002
Trips	165	1	141	28
Total Exves Rev ($ thousands)	1,393	2	854	194
Lingcod	73.3%	100.0%	63.1%	10.7%
Whiting	-	-	-	3.6%
Darkblotched RF	-	-	-	-
POP	62.4%	-	-	-
Bocaccio	9.7%	-	49.6%	17.9%
Canary RF	80.6%	100.0%	33.3%	3.6%
Cowcod	-	-	2.8%	-
Widow RF	80.6%	-	54.6%	14.3%
Yelloweye RF	2.4%	-	10.6%	-

Notes: Data from Tables 3.4-13 through 3.4-16. In 1998, sorting of darkblotched and yelloweye rockfish was not mandatory.

Any trawl trip in which the groundfish component is comprised of more than 60% rockfish (and not falling under any of the previous categories) was counted as a trip in which rockfish in general were the primary target species. Important assumptions and caveats for the interpretation of target species and incidental catch information provided here are covered in Section 4.2.2.1

Trips targeted on rockfish species occur both north and south of Cape Mendocino in 1998 but were almost entirely south of Mendocino by 2002. In 1998, 58% of the rockfish landed in rockfish target trips were caught north of Cape Mendocino (Tables 3.4-3 and 3.4-4), however, by 2002 this type of trip had been all but eliminated. North of Cape Mendocino, in 1998, about 2.3 million pounds of rockfish were landed in 165 rockfish trips (Table 3.4-3). South of Cape Mendocino, in 1998, about 1.6 million pounds of rockfish were landed in 141 rockfish trips (Table 3.4-4); and in 2002, about 334 thousand pounds were landed in 28 rockfish trips (Table 3.4-8).

All of the currently overfished species except darkblotched show up in either the northern or southern trips with rockfish as the primary trip target. There was a substantial reduction in the frequency of occurrence of most overfished species between 1998 and 2002 (Tables 3.4-13 and 3.4-15).

In 1998, by weight, rockfish composed 70% of the landed weight in northern rockfish trips (Table 3.4-3) and 85% of the landed weight in the southern trips Table 3.4-3). In 2002, rockfish composed 93% of the southern area rockfish trips (Table 3.4-8). Incidental catch or secondary target landings in the 1998 northern rockfish trawl trips included 20% flatfish and 4.5% sablefish. Incidental catch or secondary target landings in the southern rockfish trawl trips included 10% flatfish and 2% sablefish in 1998 and 6% flatfish and 1% sablefish in 2002.

While the frequency of lingcod occurrence was relatively high in rockfish trip, by weight lingcod was a minor component of the rockfish trips (Table 3.4-17). There were no bycatch rates used for this fishery in 2002 or 2003 modeling; therefore, actual landings were used to develop the estimates for overfished species in Table 3.4-17.

Total exvessel revenue from this fishery (including nontarget species) was $2.2 million and $178 thousand in 1998 and 2002, respectively (not adjusted for inflation) (Tables 3.4-9 through 3.4-12). Rockfish contributed 72% and 91% of the coastwide exvessel value for this fishery, in 1998 and 2002, respectively. Table 3.4-20 provide annual average target species revenue per pound of overfished species based on trip information. Important assumptions and caveats for the interpretation of this information on exvessel revenue per pounds of overfished species catch is provided in Section 4.2.2.1. For the northern area fishery, the indicated exvessel value of rockfish per pound of overfished species ran from $3 per pound for widow rockfish to over $2,000 per pound for yelloweye in 1998 (Table 3.4-20); and ran from $74 per pound for POP to $325,103 per pound for bocaccio in 2002. For the southern area fishery, the indicated exvessel value of rockfish per pound of overfished species ran from $5 per pound for widow rockfish to over $2,400 per pound for cowcod in 1998 (Table 3.4-20); and ran from $66 per pound for bocaccio to over $32,000 per pound for the rare occurrence of canary rockfish in 2002.

Trip, Primary Target: "Leftover" Trawl

Target Species: groundfish species in concentrations not covered by previously listed strategies				
Overfished Species Landed Incidentally (% of trips in which the indicated overfished species were landed)				
	North of Cape Mendocino		South of Cape Mendocino	
	1998	2002	1998	2002
Trips	106	158	12	3
Total Exves Rev ($ thousands)	330	492	38	11
Lingcod	42.5%	48.1%	58.3%	33.3%
Whiting	30.2%	3.8%	-	-
Darkblotched RF	-	1.3%	-	-
POP	18.9%	2.5%	-	-
Bocaccio	2.8%	-	58.3%	66.7%
Canary RF	39.6%	20.9%	16.7%	33.3%
Cowcod	-	-	-	-
Widow RF	23.6%	3.8%	41.7%	33.3%
Yelloweye RF	-	-	-	-

Notes: Data from Tables 3.4-13 through 3.4-16. In 1998, sorting of darkblotched and yelloweye rockfish was not mandatory.

Any groundfish trawl trip (trip by a limited entry trawl vessel with more than 50% of the weight comprised of groundfish) not falling under any of the previous categories was counted as a "Leftover" trawl trip. Important assumptions and caveats for the interpretation of target species and incidental catch information provided here are covered in Section 4.2.2.1

Most trips in this category were north of Cape Mendocino. North of Cape Mendocino in 1998, $330 thousand of exvessel revenue was landed on 106 "leftover" limited entry trawl trips and in 2002 $492 thousand of exvessel revenue was landed on 158 "leftover" limited entry trawl trips and in 2002. Lingcod was the overfished species that most consistently appeared on these trips.

3.4.2.3 Other Trawl Strategies with Groundfish as the Predominant Catch

Any vessel using groundfish trawl gear is required to hold a limited entry permit. However, there are certain trawl gears used to target species other than groundfish are allowed to retain incidental groundfish catch. These are called open access trawl gears. These open access trawl fisheries are discussed in detail in Section 3.4.2.6. In this section we document that while nongroundfish species are the main target for these gears on some trips there are more groundfish taken than other nongroundfish target species. This occurred more frequently in 1998 than in 2002 and more frequently south of Cape Mendocino than north.

For purposes of this portion of the analysis, the criteria were maintained that groundfish comprise 50% or more of the weight of all species delivered and pink shrimp not comprise more than 100 pounds of the delivery. Trips meeting these criteria were assessed to determine a primary nongroundfish target species based on the weight of prawns, sea cucumber and California halibut delivered. Those trips that could not be assigned a nongroundfish target for one of these species were placed in the "other category." Pink shrimp trips for which greater than 50% of the weight was groundfish are covered in Section 3.4.2.6 as combination pink shrimp groundfish trips.

Open Access Groundfish Trawl (>50% of catch is groundfish and pink shrimp comprised less than 100 pounds of the landing)

	North of Cape Mendocino		South of Cape Mendocino						
	1998	2002	1998				2002		
	Other	Other	Prawn	CA Halibut	Sea Cucumber	Other	Prawn	CA Halibut	Other
Trips	43	135	38	284	2	129	2	25	29
Total Exvessel Revenue	173	510	85	96	1	28	1	7	29
Lingcod	48.8%	50.4%	28.9%	1.8%	-	7.8%	-	-	-
Whiting	-	-	-	-	-	-	-	-	-
Darkblotched RF	-	8.9%	-	-	-	-	-	-	3.4%
POP	32.6%	2.2%	-	-	-	-	-	-	-
Bocaccio RF	2.3%	-	39.5%	1.4%	-	5.4%	-	-	10.3%
Canary RF	37.2%	32.6%	-	-	-	-	-	-	-
Cowcod	-	-	2.6%	-	-	4.7%	-	-	-
Widow RF	32.6%	29.6%	2.6%	-	-	0.8%	-	-	3.4%
Yelloweye RF	-	-	-	0.4%	-	-	-	-	-

In the northern fisheries, lingcod, canary rockfish and widow rockfish were the overfished species encountered on the greatest number of open access trawl trips in which groundfish was the dominant catch. In southern fisheries, lingcod and bocaccio were the overfished species most frequently encountered.

3.4.2.4 Limited Entry Groundfish Fixed Gears (Longline and Fishpot Gear)

Trips for which vessels used longline or fishpot gear and held limited entry endorsements for the gear used were counted as groundfish trips if greater than 50% of the landing weight was groundfish (and, to be consistent with the trawl criteria, there was not more than 100 pounds of pink shrimp). Groundfish landed on these trips was assigned to one of five categories: whiting, sablefish, slope species, shelf species, or nearshore species. If there was more sablefish landed than any of the other four species groups, the trip was designated as a sablefish trip. Assignments were made in a similar fashion for the other four species groups. Sablefish trips were divided into slope, shelf and nearshore subcategories, depending on the depth associated with the most dominant nonsablefish groundfish species group in the landing. A fourth general sablefish category was provided for trips on which there was no incidental catch associated with a depth strata or for trips on which the weight catch associated with two dominant depth strata were identical. Pot and longline gears are known to have differences in their selectivity for target and incidentally caught species. While being somewhat distinct in their selectivity, they have generally been managed together with common trip limits and closure areas. Therefore, for purposes of summary they are grouped together with separations by depth strata. For future analyses, it may be appropriate and important to separate these gears in evaluating the specific management measures the council will recommend to achieve the rebuilding policies covered as part of this plan amendment. Such considerations may occur as part of the biannual management process or other regulatory or plan amendment processes. The frequency of fixed gear trips, total exvessel revenue generated on those trips and the frequency of occurrence of overfished species in the north of Cape Mendocino limited entry fixed gear landings are as follows:

North of Cape Mendocino	Limited Entry Fixed Gear						
	Sablefish				Other Groundfish Species		
	Slope	Shelf	Nearshore	No Strata	Slope	Shelf	Nearshore
1998							
Trips	436	182	6	600	7	313	215
Total Exvessel Revenue	1,567	711	3	1,488	6	295	120
Lingcod	0.9%	13.2%	66.7%	-	28.6%	67.7%	63.7%
Whiting	-	-	-	-	-	-	-
Darkblotched RF	-	-	-	-	-	-	-
POP	9.9%	15.4%	-	0.2%	57.1%	51.4%	8.4%
Bocaccio RF	-	0.5%	-	-	-	2.9%	0.5%
Canary RF	1.4%	26.4%	50.0%	0.2%	42.9%	93.6%	72.1%
Cowcod	-	-	-	-	-	-	-
Widow RF	-	3.3%	-	0.2%	14.3%	20.4%	2.8%
Yelloweye RF	-	0.5%	-	-	-	6.4%	9.3%
2002							
Trips	316	105	4	233	21	52	185
Total Exvessel Revenue	2,068	905	8	1,032	35	225	174
Lingcod	13.9%	58.1%	-	-	19.0%	36.5%	53.0%
Whiting	-	-	-	-	-	-	-
Darkblotched RF	3.5%	3.8%	-	-	-	-	-
POP	2.2%	2.9%	-	-	-	-	-
Bocaccio RF	-	-	-	-	-	-	-
Canary RF	0.3%	4.8%	-	-	-	1.9%	-
Cowcod	-	-	-	-	-	-	-
Widow RF	-	1.0%	-	-	-	1.9%	0.5%
Yelloweye RF	0.6%	-	-	-	-	-	-

The frequency of fixed gear trips, total exvessel revenue generated on those trips and the frequency of occurrence of overfished species in the south of Cape Mendocino limited entry fixed gear landings are as follows:

South of Cape Mendocino	Limited Entry Fixed Gear							
	Sablefish				Other Groundfish Species			
	Slope	Shelf	Nearshore	No Strata	Slope	Shelf	Nearshore	Whiting
1998								
Trips	690	27	8	223	830	312	169	7
Total Exvessel Revenue	669	24	3	98	649	353	161	2
Lingcod	0.7%	48.1%	25.0%	-	0.5%	46.8%	51.5%	-
Whiting	0.9%	-	-	1.8%	2.5%	-	-	100.0%
Darkblotched RF	-	-	-	-	-	-	-	-
POP	-	-	-	-	-	-	-	-
Bocaccio RF	0.1%	7.4%	-	-	0.4%	37.2%	-	-
Canary RF	0.1%	11.1%	-	-	0.1%	16.7%	20.1%	-
Cowcod	0.1%	-	-	-	0.1%	9.9%	-	-
Widow RF	0.1%	3.7%	-	-	1.0%	10.6%	0.6%	-
Yelloweye RF	0.3%	18.5%	-	-	-	13.8%	5.3%	-

South of Cape Mendocino	Limited Entry Fixed Gear							
	Sablefish				Other Groundfish Species			
	Slope	Shelf	Nearshore	No Strata	Slope	Shelf	Nearshore	Whiting
2002								
Trips	695	4	4	171	746	32	43	-
Total Exvessel Revenue	613	4	10	145	741	29	51	-
Lingcod	0.4%	25.0%	-	-	0.3%	34.4%	23.3%	-
Whiting	0.9%	-	25.0%	-	0.7%	-	-	-
Darkblotched RF	-	-	-	-	-	-	-	-
POP	-	-	-	-	-	-	-	-
Bocaccio RF	-	-	-	-	0.3%	31.3%	-	-
Canary RF	-	-	-	-	-	-	-	-
Cowcod	0.1%	-	-	-	-	-	-	-
Widow RF	-	-	-	-	-	3.1%	-	-
Yelloweye RF	-	-	-	-	-	-	-	-

3.4.2.5 Directed Open Access Gears

This section provides information on the directed open access sector. Unlike the limited entry sector, the open access fishery has unrestricted participation and is comprised of vessels targeting ("directed open access") or incidentally catching groundfish with a variety of gears. Incidental groundfish harvest is discussed in the following section. Directed fishing for groundfish with trawl gear is not allowed in the open access fishery, though in some cases the incidental landing of groundfish with open access trawl gear may exceed the catch of the targeted species (see Section 3.4.2.3). The number of unique vessels targeting groundfish in the open access fishery between 1995 and 1998 coastwide was 2,723 (SSC's Economic Subcommittee, 2000). Of these vessels, 1,231 participated in both the directed and incidental groundfish fisheries.

Trips which were not made using a limited entry permit were counted as directed groundfish trips if greater than 50% of the landing weight was groundfish (and, to be consistent with the criterial for limited entry groundfish, there was not more than 100 pounds of pink shrimp). Groundfish landed on these trips was assigned to one of five categories: whiting, sablefish, slope species, shelf species, or nearshore species. If there was more sablefish landed than any of the other four species groups, the trip was designated as a sablefish trip. Assignments were made in a similar fashion for the other four species groups. Sablefish trips were divided into slope, shelf and nearshore subcategories, depending on the depth associated with the most dominant nonsablefish groundfish species group in the landing. A fourth general sablefish category was provided for trips on which there was no incidental catch associated with a depth strata or for trips on which the weight catch associated with two dominant depth strata were identical. There are a number of nontrawl gears included in the open access fishery. These individual gears are known to have differences in their selectivity for target and incidentally caught species. While being somewhat distinct in their selectivity, they have generally been managed together with common trip limits and closure areas. Therefore purposes of summary they are grouped together here. For future analyses, it may be appropriate and important to separate these gears in evaluating the specific management measures the council will recommend to achieve the rebuilding policies covered as part of this plan amendment. Such considerations may occur as part of the biannual management process or another separate regulatory or plan amendment processes. The frequency of nontrawl open access groundfish trips, total exvessel revenue generated on those trips and the frequency of occurrence of overfished species in the north of Cape Mendocino nontrawl open access groundfish landings are as follows.

North of Cape Mendocino	Nontrawl Open Access Groundfish Fishery (>50% Trip Weight from Groundfish)							
	Sablefish				Other Groundfish			
	Slope	Shelf	Nearshore	No Strata	Slope	Shelf	Nearshore	Whiting
1998								
Trips	109	94	7	462	11	1,265	2,201	1
Total Exvessel Revenue	1,077	198	2	318	2	557	499	0
Lingcod	1.8%	17.0%	-	-	36.4%	52.3%	35.6%	-
Whiting	-	-	-	-	-	-	-	100.0%
Darkblotched RF	-	-	-	-	-	-	-	-
POP	2.8%	3.2%	-	-	54.5%	7.9%	0.3%	-
Bocaccio RF	-	-	-	-	-	2.4%	0.2%	-
Canary RF	1.8%	33.0%	14.3%	-	27.3%	71.1%	20.9%	-
Cowcod	-	-	-	-	-	-	-	-
Widow RF	-	2.1%	-	-	27.3%	24.5%	1.0%	-
Yelloweye RF	-	-	-	-	9.1%	6.1%	3.7%	-
2002								
Trips	216	128	7	535	2	381	4,229	0
Total Exvessel Revenue	1,100	312	9	650	1	96	1,501	-
Lingcod	6.9%	27.3%	14.3%	-	-	95.5%	35.3%	-
Whiting	-	-	-	-	-	-	-	-
Darkblotched RF	0.9%	-	-	-	50.0%	0.3%	0.0%	-
POP	-	-	-	-	-	-	0.0%	-
Bocaccio RF	-	-	-	-	-	-	-	-
Canary RF	0.5%	3.9%	-	-	-	1.3%	0.2%	-
Cowcod	-	-	-	-	-	-	-	-
Widow RF	-	0.8%	-	-	-	0.5%	0.2%	-
Yelloweye RF	0.5%	-	-	-	-	0.3%	0.0%	-

The frequency of nontrawl open access groundfish trips, total exvessel revenue generated on those trips and the frequency of occurrence of overfished species in the south of Cape Mendocino limited entry fixed gear landings are as follows.

South of Cape Mendocino	Nontrawl Open Access Groundfish Fishery (>50% Trip Weight from Groundfish)							
	Sablefish				Other Groundfish			
	Slope	Shelf	Nearshore	No Strata	Slope	Shelf	Nearshore	Whiting
1998								
Trips	58	22	1	522	166	2,441	6,201	0
Total Exvessel Revenue	14	10	1	138	86	1,655	2,560	-
Lingcod	-	9.1%	-	-	15.7%	24.4%	23.6%	-
Whiting	-	-	-	-	-	0.3%	-	-
Darkblotched RF	-	-	-	-	-	-	0.0%	-
POP	-	-	-	-	-	-	-	-
Bocaccio RF	1.7%	-	-	-	7.2%	27.3%	0.2%	-
Canary RF	-	4.5%	-	-	7.2%	10.0%	3.0%	-
Cowcod	-	-	-	-	3.6%	3.2%	0.0%	-
Widow RF	-	-	-	-	-	16.1%	0.0%	-
Yelloweye RF	-	9.1%	-	-	-	4.8%	0.3%	-

South of Cape Mendocino	Nontrawl Open Access Groundfish Fishery (>50% Trip Weight from Groundfish)							
	Sablefish				Other Groundfish			
	Slope	Shelf	Nearshore	No Strata	Slope	Shelf	Nearshore	Whiting
2002								
Trips	281	7	5	979	269	928	3,838	1
Total Exvessel Revenue	180	4	4	504	186	250	1,760	0
Lingcod	0.7%	57.1%	-	-	1.1%	32.0%	36.7%	-
Whiting	1.4%	-	-	0.1%	1.5%	-	-	100.0%
Darkblotched RF	0.4%	-	-	-	0.4%	0.5%	0.1%	-
POP	-	-	-	-	-	-	-	-
Bocaccio RF	0.4%	-	-	-	0.7%	15.3%	0.1%	-
Canary RF	-	-	-	-	-	0.3%	0.2%	-
Cowcod	-	-	-	-	-	-	-	-
Widow RF	-	-	-	-	-	2.3%	-	-
Yelloweye RF	-	-	-	-	-	-	0.1%	-

3.4.2.6 Incidental Open Access Gears

Many fishers catch groundfish incidentally when targeting other species, because of the kind of gear they use and the co-occurrence of target and groundfish species in a given area. While the incidental open access groundfish fishery is under federal management and does not have participation restrictions, some state and federally-managed fisheries that land groundfish in the open access fishery have implemented their own limited entry (restricted access) fisheries or enacted management provisions that have affected participation in groundfish fisheries. The commercial incidental open access groundfish fishery consists of vessels that do not necessarily depend on revenue from the fishery as a major source of income. The number of unique vessels landing groundfish as incidental catch between 1995 and 1998 coastwide was 2,024 (SSC's Economic Subcommittee, 2000). Of these vessels, 1,231 participated in both the directed and incidental groundfish fisheries.

In this analysis, incidental open access landings are identified using the inverse of the criteria outlined above to identify landings in the directed fishery, (i.e., if some groundfish was included in a landing, but the weight of the groundfish composed less than half of total weight for a landing, or there was more than 100 pounds of pink shrimp in the landing, the trip is considered a trip on which groundfish were incidentally caught). The trip is assigned to the incidental open access sector. Within the open access sector trips were assigned to a primary target species based on the nongroundfish species group contributing the most weight to the landing. The species groups included pink shrimp, spot prawn, ridgeback prawn, California halibut, Pacific halibut, Dungeness crab, salmon, sea cucumber, coastal pelagic species, California sheephead, highly migratory species, and the gillnet complex. For pink shrimp trips, a special category ("Pink-Shrimp/Groundfish Combination") was created for trips on which the weight of groundfish on the trip exceeded 50% but more than 100 pounds of pink shrimp were caught. A review of these fisheries follows, including their management, gear, regions fished, participation, and estimates of their incidental groundfish catch. Information on the bycatch of overfished species similar to that reviewed for the trawl fisheries is provided for each of the following fisheries in Tables 3.4-3 through 3.4-20.

California Halibut

The commercial California halibut fishery extends from Bodega Bay in northern California to San Diego in Southern California, and across the international border into Mexico. California halibut, a state-managed species, is targeted with hook-and-line, setnets and trawl gear, all of which intercept groundfish. Fishing with 4.5-inch minimum mesh size trawl nets is permitted in federal waters, but prohibited within state waters, except in the designated "California halibut trawl grounds," where a 7.5-inch minimum mesh size must be used. These areas are also closed seasonally. Historically, commercial halibut fishers have preferred setnets, because of these restrictions. Setnets with 8.5-inch mesh and maximum length of 9,000 feet are the main gear type used in Southern California. Setnets are prohibited in certain designated areas, including a Marine Resources Protection Zone (MRPZ), covering state waters (to 3 nm) south of Point Conception and waters around the Channel Islands to 70 fm, but extending seaward no more than one mile. In comparison to trawl and setnet landings, commercial hook-and-line catches are historically insignificant. Over the last decade they have ranged from 11% to 23% of total California halibut landings. Most of those landings were made in the San Francisco Bay area by salmon fishers mooching or trolling slowly over the ocean bottom (Kramer *et al.* 2001).

Dungeness Crab

The Dungeness crab fishery is divided between treaty sectors, covering catches by Indian tribes, and a non-treaty sector. The non-treaty crab fishery is managed by the states of Washington, Oregon, and California with inter-state coordination through the Pacific States Marine Fisheries Commission. This fishery is managed on the basis of simple "3-S" principles: sex, season, and size. Only male crabs may be retained in the commercial fishery (thus protecting the reproductive potential of the populations), the fishery has open and closed seasons, and a minimum size limit is imposed on commercial landings of male crabs (Hankin and Warner 2001). In Washington, the Dungeness crab fishery is managed under a limited entry system with two tiers of pot limits and a December 1 through September 15 season. In Oregon, 306 vessels made landings in 1999 during a season that generally starts on December 1. In California, distinct fisheries occur in Northern and Central California, with the northern fishery covering a larger area. California implemented a limited entry program in 1995 and as of March 2000, about 600 California residents and 70 non-residents had limited entry permits. Nonetheless, effort has increased with the entry of larger multipurpose vessels from other fisheries. Landings have not declined, but this effort increase has resulted in a "race for fish" with more than 80% of total landings made during the month of December (Hankin and Warner 2001).

Groundfish bycatch in the pot fishery is minimal, although, occasionally black rockfish or lingcod may be pulled up in a pot. Groundfish are caught incidentally in Dungeness crab pots off Washington, Oregon, and California, but can only be landed in Oregon and California ports. Coastwide, groundfish landed with Dungeness crabs have ranged between 5 mt in 1993 and 1998 to 17 mt in 1995. Overall, the percentage of groundfish landed with Dungeness crab is less than 1%. For example, in 2001, 6 mt of groundfish were landed out of a total of 8,274 mt of Dungeness crab, or 0.07%. Similarly, out of the over 800 vessels that participate in the Dungeness crab fishery coastwide, generally less than 100 of those vessels also land groundfish.

Gillnet Complex

The gillnet complex fishery occurs off California and comprises two gear types. Fishers use setnets to target California halibut (discussed above), white seabass, white croaker, swordfish, and sharks. Driftnets are used for California halibut, white croaker, and angel shark. Southeast Asian refugees (mainly Vietnamese), many of whom had fished with this gear in their home country, entered this fishery and began targeting white croaker resulting in a shift in fishing effort from Southern California to Central California. Most of the commercial catch is sold in the fresh fish market, although a small amount is used for live bait (Moore and Wild 2001). Currently, the only restriction on catches of white croaker off California is a small no-take zone off Palos Verdes peninsula. In the early 1990s, California's set gillnet fishery was subject to increasingly restrictive state regulations addressing high marine bird and mammal bycatch mortality. This forced the fleet into deeper water where shelf rockfish became their primary target. However, as open access rockfish limits became smaller, there was a shift from targeting shelf rockfish with setnets to the use of line gear in the more lucrative nearshore live-fish fishery. Thus, many fishers that were historically setnet fishers have changed their target strategy in response to increasing restrictions and changing market value. Table 3.4-22 summarizes catch and bycatch of rockfish species by depth strata for the gillnet fishery

PacFIN data shows that groundfish landed in the California gillnet complex as a whole have ranged from less than one mt in 1991 and 1992 to 54 mt in 1999 (out of a total of 1,223 mt landed in the gillnet complex). Participation in the gillnet complex fishery since 1993 has ranged between 99 vessels in 1993, to a high of 194 vessels in 1994, and was at 127 vessels in 2001. In 2001, 69 vessels also landed groundfish out of 127 total vessels in the gillnet complex fishery.

Pink Shrimp

The pink shrimp fishery is managed by the states of Washington, Oregon, and California. The Council has direct management authority only over incidental groundfish catch. In 1981, the three coastal states established uniform coastwide regulations for the pink shrimp fishery. The season runs from April 1 through

October 31. Pink shrimp may be taken for commercial purposes only by trawl nets or pots. Most of the pink shrimp catch is taken with trawl gear with minimum mesh size of 1 inches to 3/8 inches between knots. In some years the pink shrimp trawl fishery has accounted for a significant share of canary rockfish incidental catch. Many vessels that participate in the shrimp trawl fishery also have groundfish limited entry permits. When participating in the pink shrimp fishery, they must abide by the same rules as vessels that do not have limited entry permits. However, all groundfish landed by vessels with limited entry permits are included in the limited entry total. Table 3.4-23 summarizes logbook information on fishing effort by depth for the pink shrimp trawl fishery south of Cape Mendocino.

Vessels targeting pink shrimp also land groundfish species, including rockfish, lingcod, sablefish, thornyheads, and flatfish. Between 1990 and 2001, incidental landings of groundfish in the pink shrimp fishery have not exceeded 10% of the total pink shrimp landings coastwide. The highest percentage of landings was in 1993 at 8% (896 mt of groundfish) of the total landings with shrimp. The lowest incidental landings of groundfish were in 2000 and 2001, with groundfish only making up 2% (153 mt) and 1% (94 mt) of total pink shrimp landings, respectively. This recent reduction in incidental landings of groundfish in the pink shrimp fishery is due in part to lower groundfish landing limits, and to gear modifications. Efforts are underway to reduce the incidence of groundfish bycatch, by requiring bycatch reduction devices (BRDs, a.k.a. finfish excluders and described in the following section) and no-fishing buffer zones above the seafloor. In 2001, Washington and Oregon instituted mandatory BRDs in pink shrimp trawl nets, effective August 1, 2001, to reduce finfish take, including canary rockfish, an overfished species. Historically, about 71% of the canary rockfish landed annually by Pacific Coast shrimpers was landed in Oregon (ODFW 2002). Beginning in 2003, BRDs are required for all vessels landing shrimp in West Coast ports.

In Washington, 19 vessels participated in the pink shrimp fishery in 2001, 17 of those vessels also landed groundfish while participating in the shrimp fishery. Washington monitors landings from the pink shrimp fishery through state fishtickets. Prior to 1993, Washington monitored landings through a mandatory logbook program, as well as through fishticket. In Oregon, only 84 vessels landed shrimp in 2001 (74 double-rig; 10 single-rig) compared to 108 in 2000, 121 in 1999 and 109 vessels in 1998 (ODFW 2002). Oregon shrimpers are required to have a state permit to land shrimp and have historically been required to make annual shrimp landings to keep their permits. In 2001, the state removed the participation requirement and the exvessel value for shrimp was low – these two factors likely kept the number of participating shrimp vessels down. Despite lower landings in recent years, Oregon generally has the largest volume by weight of landings. In 1999, Oregon landed more pink shrimp than California, Washington, British Columbia, and Alaska combined. As part of Oregon's management of the fishery, enhanced logbooks record and monitor the fishery. In California, the pink shrimp fishery has been managed by the state since 1952. An average of 88 vessels participated per season from 1983 through 1999. A record high of 155 boats shrimped during the 1994 fishery, the first year of a moratorium on new shrimp permits (Collier and Hannah 2001).

The effectiveness of different BRDs to exclude groundfish species was tested in a 1995 study in waters off Oregon (Hannah *et al.* 1996). The BRDs found to be most effective in excluding groundfish from pink shrimp trawls were 3-5 in. soft panel and hard grate excluders. Three approaches were used to generate estimates of groundfish bycatch in the pink shrimp fishery (Table 3.4-24). For species that were broken out on fishtickets for a suitable time period, and that were generally landed whenever caught (prior to 2000 when significant restrictions were adopted to limit harvest of overfished rockfish in the north), such as canary rockfish, average 1995 through 1999 landings in Oregon were used to estimate projected annual take without BRDs. For species that have some discard due to size, like darkblotched rockfish, catch rates from the control net in ODFW's 1995 BRD study (Hannah *et al.* 1996) were used to calculate a catch per tow. This was then expanded, based on an average of 17 tows per trip and 1,206 trips per year. For estimated catch with BRDs, a single approach was used. Estimates of the percentage reduction in catch (percent exclusion) for the types of BRDs that are currently allowed in Oregon and Washington were applied to the take estimates that assume no BRD use. The percentage reduction values were calculated from data presented in Hannah *et al.* (1996). These estimates are for Oregon landings only. Historically, Oregon landings have accounted for about 50% of the coastwide pink shrimp effort north of Cape Mendocino, California.

Bycatch of large rockfish such as canary rockfish, Pacific ocean perch, and widow rockfish without BRDs was estimated from 1995 through 1999 average annual landings, a period when landings of these species were not constrained by rebuilding measures. Canary rockfish landings in Oregon during this period averaged 12.7 mt per year. Large rockfish exhibited the highest exclusion rates (98.5%) using BRDs during the 1995 study. Applying the BRD exclusion rate of 98.5% predicts canary rockfish landings during the same period with BRDs would be about 0.191 mt annually. Similar reductions in estimated bycatch of POP and widow rockfish in the Oregon pink shrimp fishery would be 0.31 mt and 4.03 mt annually during this period, respectively without BRDs. With BRDs, the estimated bycatch would have been 0.005 mt and 0.07 mt annually for POP and widow rockfish, respectively.

Because darkblotched rockfish are often of smaller size on the shrimp grounds, landings data were not used to estimate bycatch without BRDs. Therefore, expansions based on catches by the control net during the Hannah *et al.* (1996) BRD study were used to estimate darkblotched bycatch without BRDs. An average catch of 0.33 lbs per tow expands to an average projected bycatch of 3.1 mt annually based on an average of 17 tows per trip and 1,206 trips per year in Oregon. Applying the 1995 BRD study result showing a bycatch reduction of "small rockfish" of 65%, projects an average annual bycatch of 1.1 mt of darkblotched in the Oregon pink shrimp trawl fishery.

Lingcod bycatch without BRDs was difficult to estimate, because there are currently monthly and minimum size limits. Therefore, 1999-2000 landings data were used since they are approximately the same as current specifications. This approach yields an estimated 20.3 mt of lingcod bycatch annually in the Oregon pink shrimp fishery without BRDs. However, this ignores discard mortality which is currently estimated to be 50% of the lingcod bycatch not excluded from limited entry groundfish trawls. Assorted roundfish were excluded at about a 98% rate in the 1995 BRD study. Applying this rate would estimate an annual average lingcod bycatch of 0.41 mt in the Oregon pink shrimp fishery.

Results from the 1995 BRD study were used to estimate Pacific whiting bycatch; landings data were not used because whiting are generally discarded by pink shrimp fishermen. However, it is noted that whiting abundance on the Oregon pink shrimp grounds in 1995 was particularly high, so bycatch estimates derived from the coincident BRD study are probably high. The estimated bycatch of Pacific whiting adults without BRDs was estimated to be 3,294 mt in 1995. Whiting adults were excluded at an estimated 85% rate, which yields an estimated bycatch of 494 mt with the use of BRDs. Although juvenile whiting (≤33 cm) are rarely encountered off Oregon on the pink shrimp grounds, they were relatively abundant in 1995 when the BRD study was done (R. Hannah, pers. comm.). Estimated bycatch of juvenile whiting in Oregon in 1995 without BRDs was 1,581 mt. About 35% of juvenile whiting were excluded using BRDs yielding an estimated bycatch of 1,028 mt. Beyond the abnormal abundance of juvenile and adult whiting in 1995 off Oregon, recently built hard grate excluders are using a 1.25 in. bar which should increase the effectiveness of these BRDs to exclude whiting.

Yelloweye rockfish were not encountered in the 1995 BRD study off Oregon and are generally rare on the shrimp grounds (R. Hannah, pers. comm.). Based on results for canary and darkblotched rockfish it is estimated that adult yelloweye would be excluded at a 98.5% rate and juveniles at a 65% rate with current BRD configurations. However, the scarcity of the species on the shrimp grounds leads to the conclusion that the yelloweye bycatch would be 0.0 mt in Oregon with or without BRDs. Yelloweye are much more abundant in waters off Washington, but they are also rarely encountered in the pink shrimp fishery there. Therefore, the coastwide bycatch of yelloweye in pink shrimp fisheries is considered to be minimal with or without BRDs.

The other overfished groundfish species, bocaccio and cowcod south of Cape Mendocino, are not encountered in West Coast pink shrimp fisheries which occur north of Cape Mendocino.

Pacific Halibut

The Pacific halibut fishery is managed by the International Pacific Halibut Commission (IPHC) with implementing regulations set by Canada and the U.S. in their own waters. A license from the IPHC is required to participate in the commercial Pacific halibut fishery. The commercial sector off the Pacific Coast, IPHC Area 2A, has both a treaty and non-treaty sector. The directed commercial fishery in Area 2A is confined to south of Point Chehalis, Washington, Oregon, and California. In the non-treaty commercial sector, 85% of the harvest is allocated to the directed halibut fishery and 15% to the salmon troll fishery to cover incidental catch. When the Area 2A total allowable catch (TAC) is above 900,000 pounds, halibut may be retained in the limited entry primary sablefish fishery north of Point Chehalis, Washington (46°53'18" N latitude). In 2001, the TAC was above this level for the first time, and 56% (47,946 pounds) of the allocation was harvested. Area 2A licenses, issued for the directed commercial fishery, have decreased from 428 in 1997 to 320 in 2001.

Groundfish are caught in the Pacific halibut fishery coastwide. Rockfish and sablefish are commonly intercepted, as they are found in similar habitat to Pacific halibut and are easily caught with longline gear. Landings of halibut are monitored by state fishticket and through the mandatory logbooks required in the directed commercial halibut fishery. The amount of groundfish by weight landed coastwide between 1990 and 2001 with Pacific halibut has ranged from 6 mt in 1995 to 23 mt in 1997. In 1997, a high of 210 vessels participated in the Pacific halibut fishery coastwide, with participation concentrated off the Oregon coast north of Coos Bay. Of the coastwide participants in 1997, 168 of those vessels also landed groundfish in landings of Pacific halibut.

There is a strong correlation between directed line fisheries that target Pacific halibut (both commercial and recreational) and bycatch of yelloweye rockfish. Therefore, for 2003 management, the Council used the depth-based results of the IPHC halibut survey data to infer the depth-based yelloweye bycatch implications in this fishery. Approximately 99.1% of the yelloweye catch and 7.7% of the commercial-sized Pacific halibut catch in the IPHC survey occurred in waters shallower than 100 fm. Therefore, the Council recommended restricting the commercial halibut fishery to waters deeper than 100 fm, which is the regulation formally adopted by the IPHC. This restriction is estimated to incur a bycatch of about 0.5 mt of yelloweye rockfish in 2003. This depth-based restriction should greatly reduce the incidental bycatch of other overfished groundfish species on the shelf north of Cape Mendocino such as canary rockfish and lingcod.

Salmon Troll

The ocean commercial salmon fishery, both non-treaty and treaty, is under federal management with a suite of seasons and total allowable harvest. The Council manages fisheries in the EEZ while the states manage fisheries in their waters (zero nm to three nm). Harvest by tribal fishers is managed under tribal authority. All ocean commercial salmon fisheries off the West Coast states use troll gear. Chinook and coho are the principle target species with limited pink salmon landings in odd-years. However, commercial coho landings fell precipitously in the early 1990s and remain very low. Reductions in landings are mainly due to diminished opportunity as salmon populations declined. Poor ocean conditions, high harvest rates, and freshwater habitat degradation are contributing factors in this decline. Consequently, many natural salmon runs on the West Coast have been listed under the ESA. Because of these listings, the management regime is largely structured around so-called "no jeopardy standards" developed through the ESA-mandated consultation process. Ocean fisheries are managed based on zones which reflect the distribution of salmon stocks and are structured to allow and encourage capture of hatchery-produced stocks while depressed natural stocks are avoided. The Columbia River, on the Oregon/Washington border, the Klamath River in Southern Oregon, and the Sacramento River in Central California support the largest runs of returning salmon.

The salmon troll fishery has an incidental catch of Pacific halibut and groundfish, including yellowtail rockfish. The historical data show that trips where no halibut are landed have a higher range of groundfish landings (11-149 mt) in comparison to trips where halibut was landed (1-19 mt). However, looking at groundfish catch frequency, either by vessel or trips reveals that groundfish are caught more often by vessels or on trips catching halibut. Table 3.4-25 shows incidental catch of overfished rockfish species by the non-Indian salmon troll fisheries in 2000 through 2001. Small amounts of rockfish and other groundfish are taken as incidental catch in salmon troll fisheries. Although the gillnet/tangle net fishery does not technically occur in Council-managed waters, it may have some impact on groundfish that migrate through that area during part of their life cycle. To account for yellowtail rockfish landed incidentally while not promoting targeting on the species, a federal regulation was adopted in 2001 that allowed salmon trollers to land up to one pound of yellowtail per two pounds of salmon, not to exceed 300 pounds per month (north of Cape Mendocino). A similar regulation is in place for 2002.

Spot Prawn

Spot prawn are targeted with both trawl and pot gear. Although these fisheries are state-managed, for the purposes of managing incidentally-caught groundfish, the trawl fishery is categorized in the open access sector. However, the spot prawn trawl fishery is nearly phased out. California had the largest and oldest trawl fishery with about 54 vessels operating from Bodega Bay south to the U.S./Mexico border. (Most vessels operated out of Monterey, Morro Bay, Santa Barbara, and Ventura, although some Washington-based vessels participated in this fishery during the fall and winter.) Standard gear was a single-rig shrimp trawl with roller gear, varying in size from eight-inch disks to 28-inch tires. Despite the fact that spot prawn trawls are rare north of Cape Mendocino, Oregon plans to eliminate spot prawn trawls (2 active permits left) by 2004 and

Washington has already done so. Washington state phased out its trawl fishery by converting its trawl permits to pot/trap permits (there are currently 13 active trap permits). The trap fishery began in 1985 with a live prawn segment developing subsequently.

In California, area and season closures for the trawl fleet were instituted in 1984 to protect spot prawns during their peak egg-bearing months of November through January. In 1994, the trawl area and season closure was expanded to include the entire Southern California Bight. These closures, along with the development of ridgeback prawn, sea cucumber, and other fisheries, and also greater demand for fresh fish, have kept spot prawn trawl landings low and facilitated growth of the trap fishery. The fleet operates from Monterey Bay—where 6 boats are based—to Southern California , where a 30 to 40 boat fleet results in higher production. In both fishing areas traps are set at depths of 600 feet to 1,000 feet along submarine canyons or along shelf breaks. Between 1985 and 1991 trapping accounted for 75% of statewide landings; trawling accounted for the remaining 25% (Larson 2001). Landings continued to increase through 1998, when they reached a historic high of 780,000 pounds. Growth in participation and a subsequent drop in landings led to the development of a limited entry program Other recent regulations include closures, trap limits, and an Observer Program. Table 3.4-26 summarizes logbook information on fishing effort by depth for the spot prawn fishery trawl and trap fisheries.

Trap and trawl gears that target spot prawn exhibit differential bycatch rates; trawls are much more prone to catch overfished groundfish species (Table 3.4-27).

Ridgeback Prawn

Ridgeback prawns occur from Monterey, California to Cedros Island, Baja, California, at depths ranging from less than 145 feet to 525 feet. According to Sunada *et al.* (2001) this fishery occurs exclusively in California, centered in the Santa Barbara Channel and off Santa Monica Bay. In 1999, 32 boats participated in the ridgeback prawn fishery. Traditionally, a number of boats fished year-round for both ridgeback and spot prawns, targeting ridgeback prawns during the closed season for spot prawns and vice versa. Most boats typically use single-rig trawl gear. The ridgeback prawn fishery is managed by the State of California and is considered an "exempted" trawl gear in the federal open access groundfish fishery, entitling the fishery to groundfish trip limits.

Following a 1981 decline in landings, the California Fish and Game Commission adopted a June through September closure to protect spawning female and juvenile ridgeback prawns. An incidental take of 50 pounds of prawns or 15% by weight is allowed during the closed period. During the season, a maximum of 1,000 pounds of other finfish may be landed with ridgeback prawns, of which federal regulations require no more than 300 pounds per trip be groundfish. Any amount of sea cucumbers may be landed with ridgeback prawns as long as the vessel owner/operator possesses a sea cucumber permit. Other regulations include a prohibition on trawling within state waters, a minimum fishing depth of 25 fm, a minimum mesh size of 1.5 inches for single-walled codends or 3 inches for double-walled codends and a logbook requirement. Ridgeback prawn trawl logs have been required since 1986. Table 3.4-28 shows the depth distribution of effort in this fishery.

Sea Cucumber

Along the West Coast, sea cucumbers are harvested by diving or trawling. Only the trawl fishery for sea cucumbers lands an incidental catch of groundfish. Sea cucumbers are managed by the states. In Washington, the sea cucumber fishery only occurs inside Puget Sound and the Straight of Juan de Fuca. Most of the harvest is taken by diving, although the tribes can also trawl for sea cucumbers in these waters.

Two species of sea cucumbers are fished in California: the California sea cucumber, also known as the giant red sea cucumber, and the warty sea cucumber. The warty sea cucumber is fished almost exclusively by divers. The California sea cucumber is caught principally by trawling in Southern California, but is targeted by divers in Northern California. Sea cucumber fisheries have expanded worldwide and, on this coast, there is a dive fishery for warty sea cucumbers in Baja, California, Mexico, and dive fisheries for California sea cucumbers in Washington, Oregon, Alaska, and British Columbia, Canada (Rogers-Bennett and Ono 2001). California implemented a permit program in 1992. In 1997 the state established separate, limited entry permits for the dive and trawl sectors. Permit rules encourage transfer to the dive sector, and this has lead to growth in this sector, which now accounts for 80% of landings. In 2002 there were 113 sea cucumber dive permittees and 36 sea cucumber trawl permittees. Many commercial sea urchin and/or abalone divers also hold sea cucumber permits and began targeting sea cucumbers more heavily beginning in 1997. At up to $20 per pound wholesale for processed sea cucumbers, there is a strong incentive to participate in this fishery (also see Table 3.4-29 for effort and harvest information for this fishery by depth strata).

In Southern California, between 0 mt and 15 mt of groundfish have been landed with sea cucumbers, presumably in the trawl fishery. As many as 55 vessels have participated in the sea cucumber fishery in 1991. The largest number of vessels landing groundfish with sea cucumbers was in 1994, with 20 vessels landing groundfish out of 32 vessels participating in the sea cucumber fishery. Table 3.4-29 depicts the bycatch of overfished species by depth for this fishery.

Coastal Pelagic Species (CPS)

CPS are largely landed with round haul gear (purse seines and lampara nets). Vessels using round haul gear are responsible for 99% of total CPS landings and revenues per year. These fisheries are concentrated in California, but CPS fishing also occurs in Washington and Oregon. In Washington, the sardine fishery is managed under the Emerging Commercial Fishery provisions as a trial commercial fishery. The target of the trial fishery is sardines; however, anchovy, mackerel, and squid are also landed. The fishery is limited to vessels using purse seine gear. It is also prohibited inside of three miles and logbooks are required. Eleven of the 45 permits holders participated in the fishery in 2000, landing 4,791 mt of sardines (Robinson 2000). Three vessels accounted for 88% of the landings. Of these, two fished out of Ilwaco and one out of Westport. In Oregon, the sardine fishery is managed under the Development Fishery Program under annually-issued permits, which have ranged from 15 in 1999 and 2000 to 20 in 2001. Landings, almost all by purse seine vessels, have rapidly increased in Oregon: from 776 mt in 1999 to 12,798 mt in 2001. The number of vessels increased from three to 18 during this period (McCrae 2001; McCrae 2002). The Southern California round haul fleet is the most important sector of the CPS fishery in terms of landings. This fleet is primarily based in Los Angeles Harbor, along with fewer vessels in the Monterey and Ventura areas. The fishery harvests Pacific bonito, market squid, and tunas as well as CPS. The fleet consists of about 40 active purse seiners averaging 20 m in length. Approximately one-third of the this fleet are steel-hull boats built during the last 20 years, the remainder are wooden-hulled vessels built from 1930 to 1949, during the boom of the Pacific sardine fleet. The Council manages these fisheries under its CPS FMP. Because stock sizes of these species can radically change in response to ocean conditions, the FMP takes a flexible management approach. Pacific mackerel and Pacific sardine are actively managed through annual harvest guidelines based on periodic assessments. Northern anchovy, jack mackerel, and market squid are monitored through commercial catch data. If appropriate, one third of the harvest guideline is allocated to Washington, Oregon, and northern California (north of 35°40' N latitude) and two-thirds is allocated to Southern California (south of 35°40' N latitude). An open access CPS fishery is in place north of 39° N latitude and a limited entry fishery is in place south of 39° N latitude. The Council does not set harvest guidelines for anchovy, jack mackerel, or market squid (PFMC 1998). Table 3.4-30 summarizes log book data on groundfish catch and bycatch in the market squid fishery.

Highly Migratory Species (HMS)

Management of HMS is complex due to the multiple management jurisdictions, users, and gear types targeting these species. Adding to this complexity are oceanic regimes that play a major role in determining species availability and which species will be harvested off the U.S. West Coast in a given year. The states currently regulate the harvest of HMS but the Council has adopted an FMP for fisheries prosecuted in the West Coast EEZ or by vessels originating from West Coast ports fishing beyond the EEZ. There are five distinctive gear types used to harvest HMS commercially, with hook-and-line gear being the oldest and most common. Other gear types used to target HMS are driftnet, pelagic longline, purse seine, and harpoon. While hook-and-line can be used to take any HMS species, traditionally it has been used to harvest tunas. The principal target species in these fisheries include albacore and other tunas, swordfish and other billfish, several shark species, and dorado. Albacore is the most important species, in terms of landings and is commonly caught with troll gear. The majority of albacore are taken by troll and jig-and-bait gear (92% in 1999), with a small portion of fish landed by gillnet, drift longline, and other gear. These gears vary in the incidence of groundfish interception depending on the area fished, time of year, as well as gear type. Overall, nearly half of the total landings of albacore in millions of pounds coastwide were landed in California. Other gear includes pelagic longline, used to target swordfish, shark and tunas; drift gillnet gear for swordfish, tunas, and sharks off California and Oregon; purse seine gear for tuna off California and Oregon; and harpoon for swordfish off California and Oregon. Some vessels, especially longliners and purse seiners, fish outside of the U.S. EEZ, but may deliver to West Coast ports. Drift gillnet is most likely to intercept groundfish, including whiting, spiny dogfish, and yellowtail rockfish (Table 3.4-31 and 3.4-32 show the historical and geographical distribution of HMS harvests, vessels and effort).

3.4.3 Aggregate Commercial Catch and Recreational Effort for Baseline–Coastwide

Information on two fishing years provides a sense of the potential changes in harvest over the short-term and long-term under the rebuilding alternatives. The year 2002 is used as the most recent baseline year for comparison. Year 1998 is provided as a baseline for evaluating cumulative affects of past decisions (Chapter 5) and as pre-rebuilding-measure comparison point. Some of the Council interim rebuilding alternatives were implemented in 2002 and earlier.

1st Year in Which Interim Rebuilding Measures Were Implemented								
Darkblotched RF	POP	Bocaccio	Canary	Cowcod	Lingcod	Yelloweye RF	Widow RF	Pacific Whiting
2001	2000	2000	2000	2000	2000	2002	2001	2002

In 1999, measures were implemented for some species in anticipation that they would be found overfished and require rebuilding measures. Therefore 1998 is used as the comparison year for the "pre-rebuilding" fishery. However, it should be noted that for some species the Council had ongoing policies to restrict harvest in order to move biomass toward MSY levels. In particular, POP stands out as a species for which rebuilding policies had been in place since the early 1980s.

Table 3.4-33 shows groundfish total catch OYs and landings or catches (as indicated) for the nontribal commercial seafood, recreational and tribal commercial seafood fisheries. Additional information on the nontribal and tribal commercial seafood fisheries are provided in Section 3.4.4 and 3.4.7, respectively. Between 1998 and 2002, nontribal commercial groundfish landings decreased by 52% in weight and 27% in exvessel value.

The following is an excerpt of some of the recreational data provided in Table 3.4-48.

		Angler Trips (1,000's)		
Area		Charter	Private	Total
Washington Coast	Total	59	88	147
	Groundfish	12	10	23
Oregon	Total	70	140	211
	Groundfish	47	22	69
North/Central California[a/]	Total	221	901	1,122
	Groundfish	141	164	305
Southern California[b/]	Total	577	1,757	2,334
	Groundfish	204	252	456
California Total	Total	798	2,658	3,456
	Groundfish	345	416	761

Because groundfish are often caught on recreational trips targeted on other species (e.g., salmon or halibut) or as part of a generalized species target that includes groundfish along with many nongroundfish species (e.g., trips for which anglers report their target species as "anything I can catch") recreational effort associated with groundfish is difficult to estimate. For that reason, as an alternative indicator of a baseline for recreational fisheries, figures are provided to illustrate seasonal regulations (Figures 3.4.3-1 and 3.4.3-2). Additional information on the recreational fishery is provided in Section 3.4.6.

3.4.4 Primary Seafood Producers - Commercial Vessels

All along the West Coast, a majority of the vessels with limited entry trawl or fixed gear permits landing slope species also landed shelf species (Table 3.4-34). The bulk of these vessels were located from the Eureka port area north. However this is not the case for vessels operating in the open access groundfish fisheries. The bulk of these vessels were landing shelf species and nearshore species only, and landed most of their catch from the Brookings port area south. Table 3.4-34 shows the number of vessels in different fishery categories making landings by primary West Coast port areas during 2000-2001.

Coastwide a majority of vessels operating in limited entry trawl fisheries on the slope and shelf were at least 60 ft in length. Table 3.4-35 shows the number of vessels by length in different fisheries operating in West Coast INPFC areas. The vast majority of the larger vessels and limited entry trawlers were operating from the Eureka INPFC area North. Trawl vessels landing nearshore species, and the vast majority of vessels in the limited entry fixed gear and open access fisheries tended to be under 60 ft. Most of these smaller vessels were primarily operating from the Monterey INPFC area South.

While many limited entry vessels shown in Tables 3.4-34 and 3.4-35 appear to be landing both shelf and slope species, slope species are a fairly minor component of total revenue for most vessels except limited entry trawlers. In this category the share of revenue from slope species tends to increase with vessel size, so larger vessels tend to be more invested in slope fisheries than smaller ones. Table 3.4-36 shows the share of total exvessel revenue derived from landings of the designated species group by INPFC area for vessels. Smaller trawlers tend to rely on nearshore rockfish for a substantially greater portion of their revenue than did larger trawlers.

3.4.5 Seafood Distribution Chain

3.4.5.1 Buyers and Processors

The largest groundfish buyers on the coast generally buy year round and most make purchases from trawl vessels (year 2000 data is provided in Tables 3.4-37, 3.4-38, 3.4-39, 3.4-40, 3.4-41, and 3.4-42). The buyer/processor segment of the fishery is quite concentrated with approximately 5% of the buyers responsible for 80% of the purchases (derived from Tables 3.4-37 and 3.4-38).

Harvest data available for this descriptive analysis are from West Coast fish landing receipts (fishtickets). These receipts record buyer license numbers, but do not distinguish buyers from processors. Therefore, the analysis is restricted to examining buyers and processors together. There are some buyers that buy from more than one port and have facilities in each port, and others that do not have landing or processing facilities in every port where they buy. While these complexities exist, for the purpose of this analysis, a simplifying assumption has been made that each unique combination of buyer code and PacFIN port area represents a different buying unit (a different firm).

Table 3.4-43 shows the number of processors and buyers by primary port area buying different species groups from different categories of fishing vessel for November 2000 through October 2001. The table shows that a majority of the 70 buyers buying slope species from limited entry trawl vessels (excluding at-sea only purchases) were north of the Eureka port area. However most of the 78 total buyers purchasing slope species from limited entry fixed gear and open access vessels were located south of the Eureka port area.

A relatively large share, 38% (492), of the total number of West Coast buyers had less than $5,000 in gross exvessel purchases, and well over 50% of total buyers had gross purchases less than $20,000. Table 3.4-44 shows the size distribution of buyers as measured by exvessel value of purchases recorded on West Coast fishtickets.

Processors may buy fish caught from outside the area of their primary port of landings. For example, there are relatively few large processors with their primary buying locations in ports of the Columbia INPFC catch area (Table 3.4-44); however, many large processors buy fish caught in that area (Table 3.4-45). For groundfish caught in the Vancouver, Columbia, and Eureka INPFC areas, most buyers tend to be large, purchasing in excess of $1,000,000 of groundfish per year. In the Monterey and Conception INPFC areas, there is an increased frequency of middle size buyers for the groundfish limited entry fleet ($20,000 to $100,000), as compared to the northern areas; and for open access groundfish vessels the number of small buyers ($100,000 and under) increases substantially, as compared to the northern areas. Also of note is the large number of small buyers in the halibut, crab, salmon and HMS fisheries, particularly in the more southern areas.

For large buyers of trawl caught groundfish, nearshore species are relatively unimportant, comprising one percent or less of their total purchases (Table 3.4-46). Trawl-caught nearshore species stand out as being somewhat more important for medium size buyers in the Columbia and substantially more important in Monterey INPFC area (nearly 20% of all purchases for buyers purchasing between $100,000 and $300,000 of fish products).

For large buyers that buy groundfish caught by vessels other than trawlers, those nontrawl purchases compose 2% or less of their total purchases, with the exception of sablefish (Table 3.4-46). For most groundfish categories bought from nontrawl vessels by large processors, the purchases comprise less than one half of one percent of all their purchases. For small and medium size buyers, nontrawl vessels are a more important source of groundfish product than trawl vessels, and nearshore species are a more important component of their purchases than shelf and slope species (Table 3.4-46). As with large buyers, sablefish are the primary exception to this pattern.

3.4.5.2 Seafood Markets

Darkblotched rockfish, canary rockfish, Pacific ocean perch and lingcod are all valued for high quality fillets, a feature common to many West Coast rockfish species. Due to their relatively large size and high quality, these species have historically been important targets in their respective fisheries up and down the coast. Rockfish fillets compete generically in regional markets with similar products originating from other domestic fisheries as well as abroad. West Coast rockfish products tend to be marketed in the region rather than exported, although historically Japan was a major buyer, especially of Pacific ocean perch. Rockfish fillets are marketed generically as red snapper or Pacific snapper in regional markets.

Lingcod is known for its exceptional size, and is a popular item on the menus of regional seafood restaurants. Lingcod has also become an important component of the emerging high-value, live fish fishery supplying West Coast restaurants. Average prices for exvessel deliveries and "processed" live fish products are significantly higher than for fresh or frozen products caught using more traditional means.

3.4.6 Recreational Fishery - Commercial Charter and Private Vessel Sectors

Estimated recreational catch of rebuilding species by vessels operating in ocean areas during 1998 through 2002 is shown in Table 3.4-47. The table splits out catch by sub region (Southern California, Northern California, Oregon, and Washington), and by type of vessel (charter and private, including rentals). These estimates were generated using RecFin data gathered from MRFSS and other port sampling procedures. Note that catch estimates for 2002 in Table 3.4-47 are preliminary.

There is no recreational fishery where darkblotched rockfish is either targeted or taken incidentally. Also, no significant amounts of POP are caught recreationally. There are, however, significant recreational catch of several other rebuilding species (Table 3.4-47). For example, canary rockfish are harvested primarily in Northern California and Oregon, with smaller amounts taken in Southern California and Washington. The bulk of canary rockfish were taken by charter vessels in all years shown except for 2002.

Lingcod contribute the largest catches each year (Table 3.4-47). Lingcod is landed coast wide, but the majority of harvest occurs in Northern California and Oregon. Unlike canary rockfish, the bulk of lingcod were taken by private boats.

Other rebuilding species caught in the recreational fishery include bocaccio, cowcod, widow rockfish and yelloweye rockfish. In recent years most bocaccio harvest occurred in Southern California, although in 2000 Northern California had a slightly higher harvest than Southern California. The bulk of bocaccio were caught by charter boats. Cowcod are encountered almost exclusively in Southern California. Cowcod catch has diminished in recent years due to more restrictive management measures. Widow rockfish are caught primarily in Northern California, and occasionally in Oregon, but rarely in Southern California or Washington. Yelloweye rockfish are caught throughout Washington, Oregon, and Northern California, especially north of Cape Mendocino. Yelloweye rockfish are rarely caught in Southern California.

Table 3.4-48 shows estimated personal income generated in 2001 by the West Coast ocean recreational fishery. Income estimates were generated using the Fisheries Economic Assessment Model (see Section 3.4.8). The ocean recreational fishery accounted for $254 million in personal income and almost 10,000 jobs in 2001. Of this, groundfish trips accounted for $71 million and 2,800 jobs, respectively or about 28% of the total. The proportion of income associated with groundfish trips ranged from 17% in Washington to 45% in Oregon. The ratio of charter angler trips to private vessel participation was much greater in Northern and Southern California than in Washington and Oregon, probably reflecting differences in species opportunities, season length and weather along the coast.

3.4.7 Tribal Fishery

In 1994 the U.S. government formally recognized the four Washington coastal tribes (Makah, Quileute, Hoh, and Quinault) have treaty rights to fish for groundfish; and concluded, in general terms, they may take half of the harvestable surplus of groundfish available in the tribes' usual and accustomed (U&A) fishing areas (described at 60 CFR 660.324). West Coast treaty tribes have formal allocations for sablefish, black rockfish, and Pacific whiting. Members of the four coastal treaty tribes participate in commercial, ceremonial, and subsistence fisheries for groundfish off the Washington coast. Participants in the tribal commercial fisheries use similar gear to non-tribal fishers. Groundfish caught in the tribal commercial fishery pass through the same markets as non-tribal commercial groundfish catch.

There are several groundfish species taken in tribal fisheries for which the tribes have no formal allocations and some species for which no specific allocation has been determined. Rather than try to reserve specific allocations of these species, the tribes annually recommend trip limits for these species to the Council, who try to accommodate these fisheries. Tribal trip limits for groundfish species without tribal allocations are usually intended to constrain direct catch and incidental retention of overfished species in the tribal groundfish fisheries.

Twelve western Washington tribes possess and exercise treaty fishing rights to halibut, including the four tribes that possess treaty fishing rights to groundfish. Tribal allocations are divided into a tribal commercial component and the year-round ceremonial and subsistence component.

The bulk of tribal groundfish landings occur during the March-April halibut and sablefish fisheries. Most continental shelf species taken in the tribal groundfish fisheries are taken during the halibut fisheries, and most slope species are similarly taken during the tribal sablefish fisheries. Approximately one-third of the tribal sablefish allocation is taken during an open competition fishery, in which vessels from the sablefish tribes all have access to this portion of the overall tribal sablefish allocation. The open competition portion of the allocation tends to be taken during the same period as the major tribal commercial halibut fisheries in March and April. The remaining two-thirds of the tribal sablefish allocation is split between the tribes according to a mutually agreed-upon allocation scheme. Specific sablefish allocations are managed by the individual sablefish tribes, beginning in March and lasting into the autumn, depending on vessel participation management measures used. Participants in the halibut and sablefish fisheries tend to use hook-and-line gear, as required by the International Pacific Halibut Commission. By agreement the tribes also use snap gear for equity reasons in the fully competitive halibut and sablefish fisheries (i.e. someone participating in a fully competitive sablefish fishery who landed no halibut would not have to meet any IPHC requirements, but would still have to use snap line gear by tribal regulation).

In addition to these hook-and-line fisheries, the Makah tribe annually harvests a whiting allocation using mid-water trawl gear. Since 1996, a portion of the U.S. whiting OY has been allocated to the Pacific Coast treaty tribes. The tribal allocation is subtracted from the whiting OY before allocation to the nontribal sectors. Since 1999, the tribal allocation has been based on a sliding scale related to the U.S. whiting OY. To date, only the Makah tribe has fished on the tribal whiting allocation. Makah vessels fit with mid-water trawl gear have also been targeting widow rockfish and yellowtail rockfish in recent years.

Table 3.4-49 shows recorded landings of groundfish species by treaty tribes from 1995 to 2002. Since 1996, pacific whiting have comprised the vast bulk of tribal landings, even though in 2000 and 2001 whiting landings were relatively low due to reduced coastwide allocations. As shown in Table 3.4-50, in terms of exvessel revenue, sablefish landings provided well over half of total tribal groundfish revenue each year except 1998, 1999 and 2002.

Estimated groundfish bycatch in Makah trawl and troll fisheries in recent years is depicted in Table 3.4-51. Among the overfished species, the table shows some bycatch of widow rockfish and canary rockfish in midwater and bottom trawl, and lingcod bycatch in bottom trawl and salmon troll fisheries. Estimated bycatch in tribal longline fisheries in recent years is shown in Table 3.4-52. The table shows some bycatch of lingcod, canary rockfish and yelloweye rockfish in tribal halibut fisheries.

3.4.8 Communities

Table 3.4-53 shows the distribution of income among port groups resulting from West Coast fisheries in 1998. This year was chosen to represent the fishery before restrictions to protect and rebuild overfished groundfish species began to go into effect. Table 3.4-54 shows the distribution of exvessel revenue and income in the 2001 base period (used to model the 2003 Groundfish Annual Specs) as well as estimates of exvessel revenue and income in 2003. Table 3.4-55 shows estimated income and employment derived from groundfish, and groundfish-related income as a share of all fishing-related income for West Coast port areas. Table 3.4-56 displays additional socioeconomic information about the coastal counties, including unemployment rates, poverty rates, median household income, and racial composition of county residents.

In this section, total income impacts include direct, indirect, and induced effects, composed of the wages and salaries paid to primary producers, processors, and suppliers, and the additional income generated when those wages and salaries are spent in the local economy. Income impacts were generated using the Fisheries Economic Assessment Model (FEAM) (Jensen 1996). FEAM uses historical landings data, information on industry cost and margin structure (vessels and processors), and income multipliers generated by IMPLAN (MIG 2000) to produce estimates of local income impact. Income multipliers measure the income received by participants in the local economy, not gross sales or "turnover." These multipliers assume changes in the stock of durable assets are annualized, so the impact of purchasing or replacing vessels, gear, buildings, plant, etc. are amortized as a series of annual payments rather than treated as a lump sum purchase in any one year.

Table 3.4-53 shows that in 1998, about $139 million of a total $458 million West Coast fisheries-generated income was derived from groundfish harvesting and processing. Although more than 60% the total fisheries-related income was realized by California ports, the California total accounted for only about one third of total coastwide groundfish income. Ports particularly dependent on groundfish-related income were concentrated along the Oregon coast and Northern Washington coast.

Table 3.4-54 shows a similar pattern in 2001: about $157 million income from groundfish out of a total $635 million fisheries-related income coastwide. Many Oregon and Northern Washington port areas appeared even more invested in groundfish as a share of total fisheries-related income in 2001 than in 1998. The table also shows that in 2003, under the depth-based management regime adopted to rebuild overfished stocks, many West Coast port areas will see significant declines in total fisheries-related income. This is particularly true in the Oregon and Northern Washington ports due to their dependence on groundfish.

Table 3.4-55 splits the groundfish fishery into limited entry trawl and other gear components in order to examine relative dependence on groundfish-related income as a share of total regional income derived from commercial fishing. From the table we see that Astoria/Tillamook, Puget Sound, Newport, and Eureka are most dependent on limited entry trawling, deriving more than 40% of fishery-related income from this fishery. Coos Bay, Fort Bragg, Crescent City, Brookings, and central Washington coast are next, each deriving between 20% to 40% of fishery-related income from the limited entry trawl fishery. Of the ports with fleets engaged in non-trawl groundfish fisheries, only the Northwest Olympic Peninsula derives more than 40% of fishery-related income from non-trawl groundfish sources, and only Brookings derives between 20% to 40% of fishery-related income from non-trawl groundfish fisheries.

Table 3.4-56 shows a discernible pattern of counties with relatively high unemployment rates arrayed along the lower Washington coast, Columbia River, and southern Oregon coast. Monterrey and Del Norte were the only counties in California with unemployment rates among the highest ten counties. Four of the five counties with highest unemployment rates in 2001 were located in southwestern Washington.

Looking at poverty rates tells another story. Four of the five counties with the highest poverty rate in 1998 were located in California, three of the next five highest are in Oregon. Washington had two counties among the poorest ten.

Median income is a measure of relative household affluence and also an indicator of income distribution. It represents the income level of the household at the exact middle of the county income distribution. In 1998, Pacific County on the Washington coast had the lowest median income. Three of the next four poorest counties are along the Oregon coast (Curry, Coos, and Tillamook) and one is in California (Del Norte).

Table 3.4-56 includes information on the race of county households as reported by the 2000 Census. Counties with highest concentrations of minority populations are generally in California. Oregon counties are the least racially diverse of the group. Eight of 11 Oregon counties were at least 90% white. Only Hood River County on the Columbia River has a minority population above 10% (Hispanic or Latino). Three Oregon counties have among the 10 most concentrated Native American populations in the region (Wasco, Lincoln, and Coos). Only urban Multnomah County has an African American population concentration in the top 10.

In Washington, only five of the fifteen counties were more than 90% white. Four Washington counties had Native American populations in the top ten (Clallam, Grays Harbor, Klickitat, Whatcom), two had African American populations in the top ten (Pierce and King), and one (King) had an Asian population in the top ten.

California counties were the most racially diverse. None of the 19 California counties was more than 85% white. California counties had six of the top ten regional concentrations of African Americans (Alameda, Solano, Los Angeles, Contra Costa, San Francisco and San Diego), three of the top ten Native American (Del Norte, Humboldt and Mendocino), nine of the top ten Asian and nine of the top ten proportions of Hispanic or Latino households.

The highest proportion of African American households are found in the California counties of Solano, Alameda, and Los Angeles; and in Pierce County, Washington. Native Americans are most represented in Del Norte, Humboldt and Mendocino counties in Northern California, and Clallam and Grays Harbor in Washington. The highest concentrations of Asian households were reported in Bay Area counties of San Francisco, Alameda, San Mateo and Solano; and Orange and Los Angeles counties in Southern California. All of the five counties reporting at least 30% of households as Hispanic or Latino were in California, led by Monterey (46.8%) and Los Angeles (44.6%), and including Santa Barbara, Ventura, and Orange.

TABLE 3.4-1. Overview of domestic shoreside landings and at-sea deliveries (round weight mt) from West Coast (Washington, Oregon, California) ocean area fisheries (0-200 miles) north and south of Cape Mendocino and by state, 1981 through 2001 (includes commercial tribal fisheries, based on PacFIN data [August, 2002] and Council [1997]). (Page 1 of 1)

	All Groundfish							All Species						
	At-Sea Included		Not Including At Sea					At-Sea Included		Not Including At Sea				
Year	North of Cape Mendocino	South of Cape Mendocino	Washington	Oregon	California	Total	Total with At-Sea	North of Cape Mendocino	South of Cape Mendocino	Washington	Oregon	California	Total	Total with At-Sea
1981	151,004	25,592	23,290	37,315	42,434	103,039	176,596	200,657	334,063	33,937	66,554	360,779	461,270	534,827
1982	152,292	34,007	25,200	40,999	52,635	118,834	186,299	183,276	293,142	32,915	57,250	318,838	409,003	476,468
1983	143,709	26,973	22,912	35,103	40,567	98,583	170,683	164,636	222,109	30,740	44,898	239,115	314,752	386,852
1984	141,626	26,923	20,888	28,178	40,593	89,659	168,548	158,876	187,813	26,158	36,598	205,177	267,933	346,822
1985	96,178	26,312	19,166	28,967	42,665	90,798	122,490	125,107	142,474	27,921	43,062	165,272	236,255	267,947
1986	137,395	26,692	15,939	24,883	41,625	82,448	164,087	178,713	168,874	27,489	47,623	191,090	266,202	347,841
1987	174,325	23,519	20,097	30,531	41,219	91,847	197,844	220,706	178,523	31,820	58,994	202,778	293,591	399,588
1988	208,073	19,917	20,332	32,125	39,753	92,210	227,991	266,841	197,210	39,009	62,679	226,923	328,611	464,392
1989	279,717	23,202	20,012	36,836	42,492	99,341	302,919	340,343	194,791	36,795	72,104	222,864	331,763	535,341
1990	246,481	22,210	18,329	35,509	39,168	93,006	268,691	293,533	154,619	30,679	61,455	180,603	272,737	448,422
1991	283,082	19,989	16,941	49,750	35,786	102,477	303,071	314,390	146,533	24,777	66,239	169,497	260,513	461,107
1992	260,347	20,260	15,729	81,919	34,773	132,421	280,607	320,508	108,325	29,845	114,385	136,552	280,782	428,968
1993	191,730	16,205	17,018	71,211	28,066	116,295	207,935	241,100	123,751	34,261	92,938	146,135	273,334	364,974
1994	290,828	14,483	23,558	94,096	24,733	142,388	305,311	332,743	129,364	37,800	110,440	151,021	299,262	462,186
1995	219,667	17,339	18,455	91,644	28,531	138,630	237,006	255,753	176,863	32,695	107,495	194,086	334,276	432,652
1996	254,533	17,995	25,267	95,828	28,014	149,109	272,528	305,790	189,844	43,337	118,468	210,460	372,266	495,685
1997	270,417	16,675	19,106	95,875	29,333	144,314	287,093	313,325	201,296	30,163	116,860	224,838	371,862	514,655
1998	266,072	11,775	22,094	89,899	22,816	134,809	277,847	296,576	114,582	33,611	103,710	130,739	268,060	411,294
1999	260,219	8,707	21,496	92,089	14,863	128,448	268,926	296,771	204,567	32,007	112,253	216,505	360,765	501,575
2000	235,332	6,878	19,645	85,680	16,033	121,358	242,210	288,562	237,931	35,606	118,637	251,469	405,712	526,692
2001	196,620	5,627	24,197	66,450	11,403	102,051	202,247	263,965	192,980	49,532	104,343	202,565	356,440	457,100

NOTE: Includes at-sea whiting and tribal landings.

TABLE 3.4-2. Overview of domestic shoreside landings and at-sea deliveries (total exvessel revenue in thousands of inflation adjusted (2001) dollars) from West Coast (Washington, Oregon, California) ocean area fisheries (0-200 miles) north and south of Cape Mendocino and by state, 1981 through 2001 (includes commercial tribal fisheries, based on PacFIN data [August, 2002] and Council [1997]). (Page 1 of 1)

	All Groundfish							All Species						
	At-Sea Included		Not Including At Sea					At-Sea Included		Not Including At Sea				
Year	North of Cape Mendocino	South of Cape Mendocino	Washington	Oregon	California	Total	Total with At-Sea	North of Cape Mendocino	South of Cape Mendocino	Washington	Oregon	California	Total	Total with At-Sea
1981	75,626	24,386	16,035	25,399	37,155	78,589	100,011	215,873	452,754	49,998	97,998	499,245	647,241	668,663
1982	85,664	31,772	18,767	33,149	45,984	97,900	117,435	183,942	349,468	45,052	81,054	387,841	513,947	533,482
1983	77,313	25,477	17,826	29,014	35,729	82,569	102,790	147,235	276,037	44,130	58,487	300,658	403,275	423,496
1984	66,561	25,149	15,836	22,974	34,992	73,802	91,709	120,235	226,876	33,178	45,885	250,528	329,591	347,498
1985	62,840	26,553	18,418	25,283	38,843	82,543	89,393	137,596	155,079	40,774	62,109	184,509	287,392	294,242
1986	67,114	29,789	15,525	24,311	41,715	81,552	96,903	167,471	172,056	41,981	77,899	205,253	325,132	340,484
1987	93,205	28,013	23,372	34,028	43,188	100,588	121,217	229,400	194,315	57,483	116,430	231,353	405,266	425,895
1988	99,646	23,641	21,355	32,561	38,826	92,742	123,287	244,355	230,382	67,159	107,893	271,446	446,497	477,042
1989	102,508	26,097	17,806	33,058	39,394	90,259	128,604	215,951	174,185	55,233	93,831	203,716	352,780	391,125
1990	84,246	24,627	14,504	29,308	36,575	80,388	108,873	196,999	149,438	48,083	84,778	185,937	318,798	347,283
1991	92,211	23,042	17,165	36,317	33,173	86,655	115,253	160,120	142,743	36,899	70,817	166,875	274,590	303,188
1992	82,887	23,418	13,638	37,082	34,128	84,848	106,307	185,908	122,757	45,263	85,305	156,807	287,375	308,835
1993	63,629	18,653	12,703	33,726	27,628	74,057	82,283	154,518	117,228	47,670	67,711	148,335	263,716	271,941
1994	77,872	19,106	17,098	37,166	27,983	82,247	96,977	176,100	129,443	53,800	72,159	165,037	290,996	305,726
1995	84,812	26,736	19,802	42,119	38,256	100,178	111,548	187,465	153,091	65,391	84,816	179,090	329,297	340,667
1996	80,561	26,519	17,834	37,300	37,046	92,181	107,080	203,993	156,002	66,293	89,236	189,729	345,258	360,158
1997	84,585	24,158	17,520	36,291	34,307	88,118	108,743	171,485	155,349	47,956	72,903	185,470	306,328	326,957
1998	57,242	18,024	11,494	24,202	25,053	60,750	75,266	126,454	94,153	38,051	51,964	116,187	206,202	220,776
1999	61,107	15,426	12,949	28,828	22,065	63,842	76,533	154,332	130,203	48,636	69,921	153,337	271,894	284,585
2000	61,103	14,143	11,599	30,550	21,574	63,724	75,246	157,934	121,420	47,234	79,652	141,058	267,944	279,472
2001	50,659	11,025	10,809	23,392	16,664	50,866	61,684	138,307	91,850	48,123	66,860	104,493	219,477	230,303

NOTE: Includes at-sea whiting and tribal landings.

TABLE 3.4-3. Round weight by species and target fishery, 1998, north of Cape Mendocino (thousands of pounds).[a/b/] (Page 1 of 5)

North of Cape Mendocino	Limited Entry Trawl, Whiting	Limited Entry Trawl, Arrowtooth	Limited Entry Trawl, Petrale Sole	Limited Entry Trawl Flatfish	Limited Entry Trawl, Midwater	Limited Entry Trawl, DTS	Limited Entry Trawl, Pacific Ocean Perch	Limited Entry Trawl, Slope Rockfish	Limtied Entry Trawl, Yellowtail	Limited Entry Trawl, Canary	Limited Entry Trawl, Widow
Number of Trips	1,326.0	257.0	115.0	957.0	255.0	1,627.0	14.0	212.0	93.0	35.0	144.0
Total Pounds (thousands)	198,999.2	12,068.0	973.0	9,374.6	3,637.8	20,193.1	162.7	3,031.6	882.7	361.6	3,722.1
Lingcod	**0.6**	**51.3**	**7.6**	**75.7**	**23.1**	**125.6**	**1.0**	**24.8**	**12.7**	**5.9**	**20.6**
Whiting	**193,305.3**	**10.5**	**0.5**	**52.4**	**1.9**	**38.6**	-	**3.7**	-	**2.2**	**7.9**
Sablefish	63.1	352.9	29.3	296.8	87.4	2,393.4	6.4	150.6	49.8	13.6	157.4
Dover, Shelf	7.9	836.1	23.5	1,175.4	109.4	4,762.3	4.8	130.8	50.0	24.8	233.4
Dover, Slope	0.0	311.7	109.5	1,605.7	60.1	3,093.8	3.0	143.3	29.1	3.5	257.6
Petrale, Shelf	0.1	227.5	100.2	408.8	11.7	191.7	3.8	30.1	18.0	6.4	22.1
Petrale, Slope	-	116.4	409.9	593.5	12.8	190.0	0.9	75.6	21.9	0.3	43.0
Arrowtooth, Shelf	12.4	5,245.2	5.7	178.3	14.5	420.8	1.7	31.5	10.9	3.6	57.9
Arrowtooth, Slope	-	444.1	17.5	174.6	5.7	125.3	0.3	31.5	4.3	1.0	19.3
Pacific Sanddab	0.8	0.5	2.3	336.0	1.4	15.0	-	5.8	3.6	0.9	0.5
Rex Sole	0.0	73.9	18.4	281.6	11.6	486.1	0.5	48.1	9.8	0.9	44.3
Flatfish, Slope	-	-	-	-	-	-	-	-	-	-	-
Flatfish, Shelf	-	150.0	51.3	1,212.0	15.8	295.2	1.1	68.6	45.1	6.0	53.0
Flatfish, Nearshore	-	9.1	2.1	270.4	1.7	36.0	0.0	4.6	5.7	0.2	1.4
Flatfish, Other	-	16.6	-	13.9	0.2	-	-	1.0	-	-	-
Darkblotched Rockfish	**8.0**	-	-	-	-	-	-	-	-	-	-
Pacific Ocean Perch	**73.6**	**484.5**	**35.0**	273.7	**110.4**	533.3	**112.3**	**555.8**	**40.8**	**15.2**	**170.3**
Thornyheads	1.2	494.1	19.7	174.4	86.6	3,760.2	9.8	463.3	16.5	10.9	203.2
Rockfish, Slope	39.3	-	4.1	53.1	9.5	224.7	-	222.1	1.9	2.0	22.1
Bocaccio Rockfish	-	-	-	1.6	**0.3**	5.8	-	**4.8**	**0.1**	**0.0**	**7.0**
Canary Rockfish	**1.9**	**478.1**	**4.1**	147.9	**165.4**	222.7	**2.6**	**73.9**	**79.8**	**135.7**	**200.6**
Chilipepper Rockfish	0.0	-	-	-	0.2	0.0	-	-	-	-	1.1
Cowcod	-	-	-	0.0	-	-	-	-	-	-	-
Widow Rockfish	**811.6**	**872.5**	**14.1**	229.6	**2,098.9**	759.8	**8.1**	**282.9**	**41.8**	**53.8**	**1,466.4**
Yelloweye Rockfish	-	-	-	-	-	0.7	-	-	-	-	**0.1**
Yellowtail Rockfish	1,099.6	669.8	15.6	393.8	669.5	557.6	1.3	136.2	347.6	37.6	292.6
Rockfish, Shelf	2.8	-	3.0	7.3	1.4	34.4	-	28.8	0.6	0.1	7.4
Rockfish, Nearshore, Shallow	-	-	-	-	-	0.0	-	-	-	-	-
Rockfish, Nearshore, Deep	0.0	1.6	-	37.7	0.5	31.9	-	0.2	0.7	-	0.1
Rockfish, Other	37.3	608.2	41.2	355.4	93.9	638.7	3.4	230.8	32.1	16.7	275.0
Slope, Other Groundfish	0.0	25.3	0.1	20.9	11.3	475.1	0.8	158.1	0.5	1.1	63.3
Shelf, Other Groundfish	128.1	527.5	7.7	405.0	11.4	99.4	0.2	13.7	38.4	6.8	39.3
Nearshore, Other Groundfish	-	0.0	-	0.5	-	0.3	-	0.0	0.1	-	-
Other Groundfish	0.4	0.0	-	-	-	-	-	-	-	-	-
Pink Shrimp	-	-	-	-	-	-	-	-	0.0	-	-
Prawns	-	-	0.1	-	-	-	-	0.1	-	-	-
Pacific Halibut	-	-	-	-	-	-	-	-	-	-	-
California Halibut	-	-	-	2.4	-	2.1	-	0.9	0.4	-	0.1
Salmon	0.0	-	-	-	-	-	-	-	-	-	-
Sea Cucumber	-	-	-	-	-	-	-	-	-	-	-
Sea Urchins	-	-	-	-	-	-	-	-	-	-	-
California Sheephead	-	-	-	-	-	-	-	-	-	-	-
Gillnet Complex	-	-	-	-	-	-	-	-	-	-	-
Squid	5.6	0.2	0.8	1.0	0.1	0.8	-	0.6	0.0	0.0	0.0
CPS FMP	2,770.2	3.3	-	1.3	2.4	11.7	0.2	14.2	-	-	5.3
HMS FMP	0.3	-	-	0.3	-	0.1	-	0.2	-	-	-
Dungeness Crab	-	-	-	-	0.0	-	-	-	-	-	-
Other Crustaceans	-	-	0.2	-	-	-	-	-	-	-	-
All Other Species	629.0	57.0	49.6	593.5	18.8	659.9	0.4	94.8	20.2	12.5	49.8

TABLE 3.4-3. Round weight by species and target fishery, 1998, north of Cape Mendocino (thousands of pounds).[a/b/] (Page 2 of 5)

North of Cape Mendocino	Limited Entry Trawl, Other Rockfish	Limited Entry Trawl, Lingcod	Limited Entry Trawl, Left Over	Open Access Trawl, Other, >50% Groundfish	Limited Entry Fixed Gear Sablefish, Slope	Limited Entry Fixed Gear Sablefish, Shelf	Limited Entry Fixed Gear Sablefish, Nearshore	Limited Entry Fixed Gear Sablefish, No Strata	Limited Fixed Gear, Other Groundfish, Slope	Limited Entry Fixed Gear, Other Groundfish, Shelf	Limited Entry Fixed Gear, Other Groundfish, Nearshore
Number of Trips	165.0	2.0	106.0	43.0	436.0	182.0	6.0	600.0	7.0	313.0	215.0
Total Pounds (thousands)	3,238.7	0.5	1,240.9	500.4	1,369.2	645.4	2.7	1,369.7	5.6	363.8	118.0
Lingcod	**28.2**	**0.4**	**7.0**	**2.7**	**0.2**	**1.1**	**0.2**	-	**0.1**	**22.1**	**11.6**
Whiting	-	-	**194.5**	-	-	-	-	-	-	-	-
Sablefish	145.4	-	26.2	23.6	1,170.8	512.2	1.4	1,002.4	0.6	14.3	0.5
Dover, Shelf	221.9	-	14.5	52.3	1.4	1.3	-	0.0	0.0	0.0	-
Dover, Slope	176.5	-	18.6	35.1	0.2	0.0	-	-	0.1	0.0	-
Petrale, Shelf	26.6	0.0	24.1	6.5	0.2	0.2	-	-	-	0.0	0.0
Petrale, Slope	38.2	-	13.2	0.6	0.0	-	-	-	-	-	-
Arrowtooth, Shelf	63.9	-	12.9	56.3	0.1	0.9	-	0.0	-	0.6	-
Arrowtooth, Slope	24.6	-	5.5	2.4	-	0.0	-	-	-	-	-
Pacific Sanddab	4.9	-	4.3	0.1	-	-	-	-	-	-	-
Rex Sole	41.4	-	4.3	4.4	-	-	-	-	-	-	-
Flatfish, Slope	-	-	-	-	-	-	-	-	-	-	-
Flatfish, Shelf	47.2	-	21.4	4.5	-	-	-	-	-	-	-
Flatfish, Nearshore	1.4	-	3.5	2.5	-	0.0	-	-	-	0.0	0.0
Flatfish, Other	0.4	-	1.0	0.0	-	-	-	-	-	-	-
Darkblotched Rockfish	-	-	-	-	-	-	-	-	-	-	-
Pacific Ocean Perch	**242.6**	-	**30.7**	**19.7**	2.3	0.6	-	0.0	1.1	6.5	0.1
Thornyheads	184.5	-	18.1	19.9	35.3	0.9	-	0.0	0.9	0.6	-
Rockfish, Slope	44.0	-	4.7	0.1	0.0	-	-	-	-	0.2	0.0
Bocaccio Rockfish	**8.1**	-	**0.3**	**0.1**	-	0.0	-	-	-	1.7	0.0
Canary Rockfish	**269.5**	**0.0**	**25.0**	**17.6**	0.1	3.6	0.0	0.0	0.2	152.4	6.2
Chilipepper Rockfish	-	-	-	0.1	-	-	-	-	-	0.0	-
Cowcod	-	-	-	-	-	-	-	-	-	-	-
Widow Rockfish	**469.5**	-	**35.3**	**184.3**	-	0.2	-	0.0	0.0	10.3	0.0
Yelloweye Rockfish	**0.2**	-	-	-	-	0.0	-	-	-	3.7	1.2
Yellowtail Rockfish	352.9	0.1	69.2	40.8	0.3	2.2	-	0.0	0.1	72.3	1.3
Rockfish, Shelf	33.5	-	-	0.2	0.0	-	-	-	-	0.0	0.5
Rockfish, Nearshore, Shallow	-	-	-	-	-	-	-	-	-	0.7	1.2
Rockfish, Nearshore, Deep	63.7	-	0.0	-	-	0.2	0.4	-	-	7.0	50.0
Rockfish, Other	594.3	0.0	42.1	12.0	154.9	118.5	0.3	366.4	2.4	64.3	24.7
Slope, Other Groundfish	25.7	-	16.0	1.8	1.9	0.0	-	-	-	-	-
Shelf, Other Groundfish	40.0	-	586.4	9.6	0.2	1.9	-	-	-	1.0	0.2
Nearshore, Other Groundfish	-	-	-	-	-	0.0	0.4	0.0	-	3.1	19.6
Other Groundfish	-	-	-	-	-	-	-	-	-	-	-
Pink Shrimp	0.0	-	-	0.1	-	-	-	-	-	-	-
Prawns	0.1	-	-	-	-	-	-	-	-	-	-
Pacific Halibut	-	-	-	-	0.2	0.4	-	0.0	-	2.0	-
California Halibut	0.1	-	-	-	-	-	-	-	-	-	-
Salmon	-	-	-	-	-	-	-	-	-	-	-
Sea Cucumber	-	-	-	-	-	-	-	-	-	-	-
Sea Urchins	-	-	-	-	-	-	-	-	-	-	-
California Sheephead	-	-	-	-	-	-	-	-	-	-	-
Gillnet Complex	-	-	-	-	-	-	-	-	-	-	-
Squid	0.1	-	0.0	0.0	-	-	-	-	-	-	-
CPS FMP	-	-	3.1	-	-	-	-	-	-	-	-
HMS FMP	-	-	-	-	0.0	0.2	-	0.2	-	0.1	0.1
Dungeness Crab	-	-	-	-	-	-	-	-	-	-	-
Other Crustaceans	0.1	-	-	0.3	-	-	-	-	-	-	-
All Other Species	89.2	-	59.1	2.6	1.0	1.0	0.0	0.5	0.1	0.9	0.6

TABLE 3.4-3. Round weight by species and target fishery, 1998, north of Cape Mendocino (thousands of pounds). [a/b/] (Page 3 of 5)

North of Cape Mendocino	Open Access, Whiting	Open Access, Sablefish, Slope	Open Access, Sablefish, Shelf	Open Access, Sablefish, Nearshore	Open Access, Sablefish, No Strata	Open Access, Slope	Open Access, Shelf	Open Access, Nearshore	Other Groundfish (plurality, but <50%)	Groundfish/ Shrimp Combinations	Pink Shrimp
Number of Trips	1.0	109.0	94.0	7.0	462.0	11.0	1,265.0	2,201.0	179.0	11.0	1,105.0
Total Pounds (thousands)	0.5	850.9	152.0	1.9	306.9	3.7	813.3	567.6	318.6	33.8	9,642.0
Lingcod	-	**0.0**	**1.1**	-	-	**0.2**	**61.3**	**31.3**	**5.0**	**0.7**	**14.2**
Whiting	**0.5**	-	-	-	-	-	-	-	**60.4**	-	**4.1**
Sablefish	-	763.4	134.8	1.5	203.4	-	6.1	2.0	104.5	6.3	41.1
Dover, Shelf	-	0.3	0.4	-	0.0	-	0.0	0.0	-	2.1	72.1
Dover, Slope	-	0.1	0.0	-	-	-	0.0	-	-	0.1	5.6
Petrale, Shelf	-	-	-	-	-	-	0.0	0.0	0.0	0.2	11.2
Petrale, Slope	-	-	-	-	-	-	-	-	-	0.1	1.8
RWT1998N	-	0.0	0.0	-	-	-	-	-	-	0.1	5.8
Arrowtooth, Slope	-	-	-	-	-	-	-	-	-	-	0.5
Pacific Sanddab	-	-	-	-	-	-	-	-	0.0	-	1.0
Rex Sole	-	-	-	-	-	-	-	-	-	-	3.4
Flatfish, Slope	-	-	-	-	-	-	-	-	-	-	-
Flatfish, Shelf	-	0.0	-	-	-	-	-	-	0.1	0.1	4.5
Flatfish, Nearshore	-	0.0	-	-	-	-	0.0	0.2	0.4	-	0.0
Flatfish, Other	-	-	-	-	-	-	-	-	-	-	0.1
Darkblotched Rockfish	-	-	-	-	-	-	-	-	-	-	-
Pacific Ocean Perch	-	0.0	0.0	-	-	0.7	4.4	0.0	1.4	2.3	12.9
Thornyheads	-	7.9	0.4	-	0.0	0.0	0.0	-	0.0	0.0	3.9
Rockfish, Slope	-	0.0	-	-	-	0.9	1.5	1.2	0.3	0.7	5.4
Bocaccio Rockfish	-	-	-	-	-	-	1.2	0.1	1.3	-	0.0
Canary Rockfish	-	0.0	1.6	0.0	-	0.1	267.2	6.8	52.8	1.0	23.1
Chilipepper Rockfish	-	-	-	-	-	-	0.5	0.1	-	-	-
Cowcod	-	-	-	-	-	-	-	-	-	-	-
Widow Rockfish	-	-	0.0	-	-	0.1	80.4	2.8	7.5	0.9	9.7
Yelloweye Rockfish	-	-	-	-	-	0.0	3.5	2.2	0.1	-	-
Yellowtail Rockfish	-	0.1	0.8	-	-	0.1	260.4	5.7	40.5	6.6	289.3
Rockfish, Shelf	-	-	-	-	-	-	1.2	2.1	0.0	-	0.4
Rockfish, Nearshore, Shallow	-	-	-	-	-	-	0.8	7.4	0.0	-	-
Rockfish, Nearshore, Deep	-	-	0.0	0.3	-	0.0	21.9	390.2	16.1	-	0.1
Rockfish, Other	-	47.0	11.3	0.1	100.7	1.6	96.2	42.4	21.5	0.4	28.3
Slope, Other Groundfish	-	-	0.0	-	-	-	-	-	-	-	-
Shelf, Other Groundfish	-	0.1	1.1	-	0.0	-	0.9	0.0	0.2	-	2.1
Nearshore, Other Groundfish	-	-	-	0.0	-	0.0	2.2	71.5	3.2	-	-
Other Groundfish	-	-	-	-	-	-	-	-	-	-	-
Pink Shrimp	-	-	-	-	-	-	-	-	-	12.2	9,092.4
Prawns	-	-	-	-	-	-	-	-	-	-	-
Pacific Halibut	-	31.9	-	-	2.3	-	0.2	0.1	0.2	0.1	-
California Halibut	-	-	-	-	-	-	0.0	0.1	0.3	-	-
Salmon	-	-	-	-	0.0	-	2.2	0.1	1.7	-	-
Sea Cucumber	-	-	-	-	-	-	-	-	-	-	-
Sea Urchins	-	-	-	-	-	-	-	-	-	-	-
California Sheephead	-	-	-	-	-	-	-	0.1	-	-	-
Gillnet Complex	-	-	-	-	-	-	-	-	0.1	-	-
Squid	-	-	-	-	-	-	-	-	-	-	1.5
CPS FMP	-	-	-	-	-	-	-	-	-	-	1.8
HMS FMP	-	-	-	-	0.0	-	0.2	-	0.1	-	-
Dungeness Crab	-	-	0.0	-	-	-	-	0.0	0.1	-	-
Other Crustaceans	-	-	-	-	-	-	-	-	-	-	0.0
All Other Species	-	0.0	0.5	0.0	0.4	-	1.0	1.5	0.8	0.0	5.7

TABLE 3.4-3. Round weight by species and target fishery, 1998, north of Cape Mendocino (thousands of pounds).[a/b] (Page 4 of 5)

North of Cape Mendocino	Prawns	Pacific Halibut	California Halibut	Salmon	Sea Urchins	Gillnet Complex	Squid	CPS Plan Species	HMS Plan Species	Dungenes Crab	Other Crustaceans
Number of Trips	6.0	214.0	3.0	4,027.0	246.0	11.0	3.0	22.0	1,533.0	15,336.0	2,060.0
Total Pounds (thousands)	1.9	491.2	14.6	2,079.4	348.9	5.8	8.7	274.3	25,103.8	22,629.1	441.6
Lingcod	-	**3.1**	**0.0**	**6.8**	-	-	-	-	**0.0**	**0.3**	**2.9**
Whiting	-	-	-	-	-	-	-	-	-	-	-
Sablefish	-	45.5	-	1.0	-	-	-	-	0.5	-	1.7
Dover, Shelf	-	0.0	-	-	-	-	-	-	-	-	0.3
Dover, Slope	-	-	-	-	-	-	-	-	-	-	0.4
Petrale, Shelf	-	0.0	-	-	-	-	-	-	-	-	0.4
Petrale, Slope	-	-	-	-	-	-	-	-	-	-	0.2
Arrowtooth, Shelf	-	0.1	-	-	-	-	-	-	-	-	-
Arrowtooth, Slope	-	-	-	-	-	-	-	-	-	-	0.0
Pacific Sanddab	-	-	0.0	-	-	-	-	-	-	-	-
Rex Sole	-	-	-	-	-	-	-	-	-	-	0.1
Flatfish, Slope	-	-	-	-	-	-	-	-	-	-	-
Flatfish, Shelf	-	-	0.0	-	-	-	-	-	-	-	0.3
Flatfish, Nearshore	-	-	2.9	-	-	-	-	-	-	0.0	-
Flatfish, Other	-	-	-	-	-	-	-	-	-	-	-
Darkblotched Rockfish	-	-	-	-	-	-	-	-	-	-	-
Pacific Ocean Perch	-	0.0	-	0.3	-	-	-	-	0.1	-	2.1
Thornyheads	-	0.4	-	-	-	-	-	-	-	-	0.0
Rockfish, Slope	-	-	-	-	-	-	-	-	-	-	-
Bocaccio Rockfish	-	-	-	-	-	-	-	-	-	-	-
Canary Rockfish	-	0.6	0.0	4.8	-	-	-	-	0.1	0.0	2.1
Chilipepper Rockfish	-	-	-	-	-	-	-	-	-	-	-
Cowcod	-	-	-	-	-	-	-	-	-	-	-
Widow Rockfish	-	0.0	-	0.7	-	-	-	-	0.0	0.0	0.2
Yelloweye Rockfish	-	-	-	-	-	-	-	-	-	-	-
Yellowtail Rockfish	-	0.1	-	45.9	-	-	-	-	0.4	-	1.5
Rockfish, Shelf	-	-	-	-	-	-	-	-	-	-	-
Rockfish, Nearshore, Shallow	-	-	-	-	-	-	-	-	-	-	-
Rockfish, Nearshore, Deep	-	-	-	0.4	-	-	-	-	-	0.3	-
Rockfish, Other	-	7.5	2.3	26.7	0.0	-	-	-	0.6	0.2	5.1
Slope, Other Groundfish	-	-	-	-	-	-	-	-	-	-	-
Shelf, Other Groundfish	-	1.4	0.2	0.0	-	-	-	-	-	-	0.9
Nearshore, Other Groundfish	-	-	-	-	-	-	-	-	-	0.5	0.0
Other Groundfish	-	-	-	-	-	-	-	-	-	-	-
Pink Shrimp	-	-	-	-	-	-	-	-	-	-	0.5
Prawns	1.9	-	-	-	-	-	-	-	-	-	-
Pacific Halibut	-	431.8	-	15.2	-	-	-	-	0.2	-	-
California Halibut	-	-	8.8	-	-	-	-	-	-	-	-
Salmon	-	0.2	-	1,976.0	-	-	-	-	5.3	-	-
Sea Cucumber	-	-	-	-	-	-	-	-	-	-	-
Sea Urchins	-	-	-	-	348.8	-	-	-	-	0.1	-
California Sheephead	-	-	-	-	-	-	-	-	-	-	-
Gillnet Complex	-	-	-	-	-	5.8	-	-	0.5	-	-
Squid	-	-	-	-	-	-	8.7	-	-	-	-
CPS FMP	-	-	-	-	-	-	-	274.3	-	-	-
HMS FMP	-	0.2	-	1.3	-	0.0	-	-	25,090.5	-	-
Dungeness Crab	-	-	-	-	-	-	-	-	-	22,621.3	-
Other Crustaceans	-	-	-	-	0.0	-	-	-	-	1.0	422.3
All Other Species	-	0.1	0.3	0.2	0.1	0.0	-	-	5.7	5.2	0.4

TABLE 3.4-3. Round weight by species and target fishery, 1998, north of Cape Mendocino (thousands of pounds)[a/b/] (Page 5 of 5)

North of Cape Mendocino	Other Species	No Landing Weight or 2 Equal Weights	Total
Number of Trips	1,428.0	186.0	37,630.0
Total Pounds (thousands)	4,691.0	64.7	331,107.6
Lingcod	**7.0**	**0.2**	**556.7**
Whiting	**3.6**	**-**	**193,685.9**
Sablefish	3.9	-	7,813.5
Dover, Shelf	35.0	-	7,760.3
Dover, Slope	0.1	-	5,854.2
Petrale, Shelf	20.5	-	1,110.2
Petrale, Slope	5.0	-	1,523.5
Arrowtooth, Shelf	3.3	-	6,126.6
Arrowtooth, Slope	0.4	-	856.9
Pacific Sanddab	14.3	-	391.6
Rex Sole	4.9	-	1,033.9
Flatfish, Slope	-	-	0.0
Flatfish, Shelf	39.0	-	2,015.0
Flatfish, Nearshore	28.3	-	370.4
Flatfish, Other	0.0	-	33.3
Darkblotched Rockfish	-	-	**8.0**
Pacific Ocean Perch	0.0	-	**2,732.7**
Thornyheads	1.3	-	5,514.1
Rockfish, Slope	19.2	-	657.0
Bocaccio Rockfish	1.5	-	**33.9**
Canary Rockfish	4.3	0.2	**2,352.3**
Chilipepper Rockfish	-	-	1.9
Cowcod	-	-	**0.0**
Widow Rockfish	5.5	-	**7,447.0**
Yelloweye Rockfish	-	-	**11.8**
Yellowtail Rockfish	1.0	0.0	5,412.7
Rockfish, Shelf	0.9	-	124.4
Rockfish, Nearshore, Shallow	0.5	-	10.6
Rockfish, Nearshore, Deep	0.3	0.3	624.0
Rockfish, Other	23.7	63.2	4,191.7
Slope, Other Groundfish	0.0	-	801.9
Shelf, Other Groundfish	2.9	-	1,926.6
Nearshore, Other Groundfish	1.1	0.0	102.7
Other Groundfish	-	-	0.4
Pink Shrimp	-	-	9,105.3
Prawns	-	-	2.1
Pacific Halibut	0.2	0.0	484.9
California Halibut	13.2	-	28.5
Salmon	-	0.5	1,986.1
Sea Cucumber	-	-	0.0
Sea Urchins	-	0.0	349.0
California Sheephead	-	-	0.1
Gillnet Complex	-	-	6.3
Squid	-	-	19.6
CPS FMP	0.1	-	3,087.8
HMS FMP	-	-	25,093.7
Dungeness Crab	1.0	0.1	22,622.7
Other Crustaceans	0.3	0.1	424.4
All Other Species	4,448.7	0.1	6,811.5

a/ Includes shoreside whiting landings only.
b/ Zero vlaues indicate there was some landing, but less than 50 pounds.

TABLE 3.4-4. Round weight by species and target fishery, 1998, south of Cape Mendocino (thousands of pounds). [a/] (Page 1 of 5)

South of Cape Mendocino	Limited Entry Trawl, Petrale Sole	Limited Entry Trawl, Flatfish	Limited Entry Trawl, Midwater	Limited Entry Trawl, DTS	Limited Entry Trawl, Slope Rockfish	Limited Entry Trawl, Chillipepper	Limited Entry Trawl, Yellowtail	Limited Entry Trawl, Canary	Limited Entry Trawl, Widow	Limited Entry Trawl, Other Rockfish
Number of Trips	41.0	386.0	16.0	548.0	316.0	111.0	3.0	5.0	29.0	141.0
Total Pounds (thousands)	148.3	2,757.4	191	7,187.0	4,993.8	1,665.0	24.4	66.6	598.5	1,885.1
Lingcod	**0.7**	**13.8**	**1.7**	**23.0**	**13.2**	**9.6**	**0.5**	**1.0**	**3.6**	**13.1**
Whiting	-	-	-	**0.1**	**2.0**	-	-	-	-	-
Sablefish	6.9	39.0	2.0	670.1	126.9	27.7	0.2	0.4	18.0	33.5
Dover, Shelf	0.1	136.5	2.4	1,744.7	146.0	45.8	0.8	3.9	31.7	54.3
Dover, Slope	11.1	138.7	4.1	1,332.3	209.2	99.4	-	-	22.4	53.0
Petrale, Shelf	3.3	95.6	0.2	25.8	40.6	28.9	0.1	0.8	6.0	13.9
Petrale, Slope	80.3	85.8	2.0	40.1	86.0	38.0	-	-	0.8	16.9
Arrowtooth, Shelf	-	0.0	-	0.0	-	-	-	-	-	-
Arrowtooth, Slope	-	-	-	0.0	-	-	-	-	-	-
Pacific Sanddab	0.2	1,051.8	-	47.5	125.1	60.9	0.0	-	0.1	3.5
Rex Sole	5.2	84.0	0.3	127.8	101.7	34.7	-	0.0	1.9	12.7
Flatfish, Slope	-	-	-	-	-	-	-	-	-	-
Flatfish, Shelf	6.8	241.0	0.6	53.7	81.6	67.1	-	0.4	7.8	27.9
Flatfish, Nearshore	0.8	25.0	0.0	2.2	4.5	5.1	0.1	-	0.2	3.3
Flatfish, Other	0.0	6.6	0.0	0.6	1.7	2.9	0.1	-	-	0.1
Darkblotched Rockfish	-	-	-	-	**0.0**	-	-	-	-	-
Pacific Ocean Perch	-	-	-	-	-	-	-	-	-	-
Thornyheads	2.5	55.2	4.6	1,535.1	243.8	73.3	0.0	1.8	34.3	71.5
Rockfish, Slope	3.3	139.0	5.7	406.3	2,553.0	123.9	1.1	3.8	20.1	141.1
Bocaccio Rockfish	**0.5**	**15.7**	**1.8**	**24.2**	**17.4**	**20.1**	**0.8**	**1.3**	**4.8**	**17.4**
Canary Rockfish	**0.5**	**3.2**	**1.9**	**14.2**	**7.9**	**3.1**	**7.6**	**21.6**	**22.2**	**40.6**
Chilipepper Rockfish	0.8	126.8	2.8	198.4	240.4	794.5	-	0.3	16.5	19.5
Cowcod	-	-	0.1	**0.2**	**0.8**	**1.0**	-	-	**0.0**	**0.4**
Widow Rockfish	**0.2**	**57.0**	**137.0**	**132.5**	**139.1**	**96.0**	**0.2**	**9.1**	**251.0**	**158.1**
Yelloweye Rockfish	-	**0.0**	**0.0**	**0.2**	**0.2**	**0.3**	**0.1**	-	**0.2**	**2.0**
Yellowtail Rockfish	-	0.3	7.5	4.8	8.7	2.8	12.8	4.7	14.8	6.0
Rockfish, Shelf	0.5	63.4	5.3	62.0	107.1	19.3	0.0	-	11.9	255.2
Rockfish, Nearshore, Shallow	-	-	-	-	0.1	-	0.0	-	-	0.3
Rockfish, Nearshore, Deep	0.0	0.5	-	0.1	0.2	0.1	-	-	-	0.1
Rockfish, Other	15.9	135.6	9.5	247.4	412.1	8.2	-	15.8	124.3	894.0
Slope, Other Groundfish	1.2	36.4	0.4	338.8	113.6	5.0	-	1.1	4.3	11.8
Shelf, Other Groundfish	0.1	3.6	0.1	5.7	1.0	0.9	-	-	0.0	0.7
Nearshore, Other Groundfish	-	0.3	-	0.0	0.3	0.0	-	-	-	-
Other Groundfish	-	-	-	-	-	-	-	-	-	-
Pink Shrimp	-	-	-	-	-	-	-	-	-	-
Prawns	0.2	1.8	-	-	0.0	1.3	-	-	-	0.3
Pacific Halibut	-	-	-	-	-	-	-	-	-	-
California Halibut	0.5	37.6	0.0	15.6	9.7	8.9	0.2	-	-	7.6
Salmon	-	-	-	-	-	-	-	-	-	-
Sea Cucumber	-	-	-	-	-	-	-	-	-	-
Sea Urchins	-	-	-	-	-	-	-	-	-	-
California Sheephead	-	-	-	-	-	-	-	-	-	-
Gillnet Complex	-	-	-	-	-	-	-	-	-	-
Squid	-	0.1	-	-	0.1	-	-	-	-	0.8
CPS FMP	0.1	4.5	-	0.9	5.4	3.1	-	-	0.3	-
HMS FMP	-	-	-	-	-	-	-	-	-	-
Dungeness Crab	-	0.0	-	-	-	-	-	-	-	-
Other Crustaceans	-	-	-	-	-	-	-	-	-	-
All Other Species	6.8	158.6	1.2	132.5	194.5	83.0	0.0	0.7	1.5	25.3

TABLE 3.4-4. Round weight by species and target fishery, 1998, south of Cape Mendocino (thousands of pounds).[a/] (Page 2 of 5)

South of Cape Mendocino	Limited Entry Trawl, Lingcod	Limited Entry Trawl, Left Over	Open Access Trawl, Prawn, >50% Groundfish	Open Access Trawl, Halibut, >50% Groundfish	Open Access Trawl, Sea Cucumber, >50% Groundfish	Open Access Trawl, Other, >50% Groundfish	Limited Entry Fixed Gear, Whiting	Limited Entry Fixed Gear, Slope	Limited Entry Fixed Gear, Shelf	Limited Entry Fixed Gear Sablefish, Nearshore
Number of Trips	1.0	12.0	38.0	284.0	2.0	129.0	7.0	690.0	27.0	8.0
Total Pounds (thousands)	0.4	102.9	33.4	77.6	1.2	36.7	1.0	565.8	23.1	2.6
Lingcod	**0.1**	**0.6**	**0.7**	**0.1**	**-**	**0.4**	**-**	**0.2**	**0.7**	**0.0**
Whiting	**-**	**-**	**-**	**-**	**-**	**-**	**0.6**	**0.2**	**-**	**-**
Sablefish	-	4.6	0.0	1.4	-	1.9	0.2	454.2	15.7	1.7
Dover, Shelf	-	3.9	0.2	-	-	0.7	-	0.4	0.0	-
Dover, Slope	-	0.8	-	3.8	-	-	-	0.3	-	-
Petrale, Shelf	-	0.9	1.5	0.0	-	0.2	-	-	-	-
Petrale, Slope	-	1.2	0.5	0.1	0.0	1.6	-	-	-	-
Arrowtooth, Shelf	-	-	-	-	-	-	-	-	-	-
Arrowtooth, Slope	-	-	-	-	-	-	-	-	-	-
Pacific Sanddab	-	0.9	0.3	1.2	-	0.5	-	-	-	-
Rex Sole	-	0.9	-	0.5	-	0.2	-	-	-	-
Flatfish, Slope	-	-	-	-	-	-	-	-	-	-
Flatfish, Shelf	-	5.2	0.3	0.0	-	0.6	-	-	-	-
Flatfish, Nearshore	0.1	-	-	5.8	-	0.2	-	-	-	-
Flatfish, Other	-	-	0.1	19.1	0.5	3.2	-	0.0	-	-
Darkblotched Rockfish	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Pacific Ocean Perch	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Thornyheads	-	13.3	0.0	2.9	-	0.7	-	64.4	0.3	0.0
Rockfish, Slope	-	3.9	0.2	0.6	-	1.5	-	7.8	0.2	0.0
Bocaccio Rockfish	**-**	**1.0**	**3.2**	0.0	-	0.4	-	0.0	0.0	-
Canary Rockfish	**-**	**0.0**	**-**	-	-	-	-	0.0	0.5	-
Chilipepper Rockfish	-	1.5	8.9	-	-	5.4	-	-	0.1	-
Cowcod	**-**	**-**	**0.0**	-	-	0.4	-	0.0	-	-
Widow Rockfish	**-**	**0.2**	**0.1**	-	-	0.9	-	0.0	0.0	-
Yelloweye Rockfish	**-**	**-**	**-**	0.0	-	-	-	0.0	0.8	-
Yellowtail Rockfish	-	-	-	-	-	0.1	-	0.0	1.1	-
Rockfish, Shelf	-	-	2.3	0.2	0.0	7.3	0.1	0.2	1.6	0.0
Rockfish, Nearshore, Shallow	-	-	0.0	19.4	0.2	6.3	-	-	0.1	0.1
Rockfish, Nearshore, Deep	0.0	-	-	0.1	-	0.1	-	-	0.7	0.4
Rockfish, Other	-	15.1	3.0	0.8	-	1.4	0.1	7.8	0.9	0.0
Slope, Other Groundfish	-	40.4	-	0.7	-	-	-	27.7	-	-
Shelf, Other Groundfish	-	5.8	0.1	0.4	-	1.8	-	0.0	-	-
Nearshore, Other Groundfish	-	-	-	0.0	-	0.1	-	0.1	0.0	0.1
Other Groundfish	-	-	-	-	-	-	-	-	-	-
Pink Shrimp	-	-	-	-	-	-	-	-	-	-
Prawns	-	-	11.8	0.1	-	-	-	-	-	-
Pacific Halibut	-	-	-	-	-	-	-	-	-	-
California Halibut	0.2	-	-	15.7	0.0	-	-	-	-	-
Salmon	-	-	-	-	-	-	-	-	-	-
Sea Cucumber	-	-	-	-	0.4	-	-	-	-	-
Sea Urchins	-	-	-	-	-	-	-	-	-	-
California Sheephead	-	-	-	0.2	-	0.0	-	-	-	0.0
Gillnet Complex	-	-	-	-	-	-	-	-	-	-
Squid	-	-	-	0.0	-	-	-	-	-	-
CPS FMP	-	-	-	-	-	0.0	-	0.6	-	-
HMS FMP	-	-	-	-	-	-	-	0.5	0.1	-
Dungeness Crab	-	-	-	-	-	-	-	-	-	-
Other Crustaceans	-	-	0.0	0.2	-	0.0	-	0.0	0.0	0.0
All Other Species	-	2.6	-	4.4	0.0	1.0	-	1.2	0.1	0.2

TABLE 3.4-4. Round weight by species and target fishery, 1998, south of Cape Mendocino (thousands of pounds).[a/] (Page 3 of 5)

South of Cape Mendocino	Limited Entry Fixed Gear Sablefish, No Strata	Limited Entry Fixed Gear, Other Groundfish, Slope	Limited Entry Fixed Gear, Other Groundfish, Shelf	Limited Entry Fixed Gear, Other Groundfish, Nearshore	Open Access, Sablefish, Slope	Open Access, Sablefish, Shelf	Open Access, Sablefish, Nearshore	Open Access, Sablefish, No Strata	Open Access, Slope	Open Access, Shelf
Number of Trips	223.0	830.0	312.0	169.0	58.0	22.0	1.0	522.0	166.0	2,441.0
Total Pounds (thousands)	106	736	362	72	17	17	1	137	149	2,392
Lingcod	-	**0.3**	**14.2**	**3.2**	-	**0.1**	-	-	**1.1**	**54.6**
Whiting	**0.1**	**0.6**	-	-	-	-	-	-	-	**0.0**
Sablefish	104.9	138.5	7.8	1.2	12.7	4.7	0.3	129.4	13.3	11.2
Dover, Shelf	-	0.0	-	-	0.0	0.1	-	-	0.0	0.1
Dover, Slope	-	0.7	-	-	0.2	-	-	-	0.0	-
Petrale, Shelf	-	0.0	0.4	-	-	-	-	-	-	0.1
Petrale, Slope	-	-	0.5	-	-	-	-	-	-	0.8
Arrowtooth, Shelf	-	-	-	-	-	-	-	-	-	-
Arrowtooth, Slope	-	-	-	-	-	-	-	-	-	-
Pacific Sanddab	-	0.0	0.1	-	-	-	-	-	0.0	7.0
Rex Sole	-	-	0.0	-	-	-	-	-	-	-
Flatfish, Slope	-	-	-	-	-	-	-	-	-	-
Flatfish, Shelf	-	0.0	0.1	-	-	-	-	-	0.1	1.2
Flatfish, Nearshore	-	-	0.1	-	-	-	-	-	-	0.1
Flatfish, Other	-	0.0	2.0	0.0	0.0	-	-	0.0	0.0	0.9
Darkblotched Rockfish	-	-	-	-	-	-	-	-	-	-
Pacific Ocean Perch	-	-	-	-	-	-	-	-	-	-
Thornyheads	-	122.6	1.0	-	0.2	0.0	-	-	2.7	0.8
Rockfish, Slope	-	172.1	12.8	0.3	1.0	0.1	0.0	-	63.0	80.1
Bocaccio Rockfish	-	**0.2**	**14.7**	-	**0.0**	-	-	-	**5.2**	**125.2**
Canary Rockfish	-	**0.0**	**15.5**	**3.2**	-	**0.0**	-	-	**0.6**	**57.8**
Chilipepper Rockfish	-	0.1	23.8	-	-	0.1	-	-	2.5	584.0
Cowcod	-	0.0	3.3	-	-	-	-	-	0.4	17.0
Widow Rockfish	-	**0.5**	**12.8**	**0.0**	-	-	-	-	-	**268.1**
Yelloweye Rockfish	-	-	**7.7**	**0.6**	-	**0.0**	-	-	-	**13.3**
Yellowtail Rockfish	-	-	49.4	2.9	-	0.0	-	-	0.6	359.4
Rockfish, Shelf	-	3.7	118.2	5.1	0.1	0.2	-	0.0	4.3	461.5
Rockfish, Nearshore, Shallow	-	-	5.0	11.9	0.0	0.0	0.1	0.0	0.9	12.6
Rockfish, Nearshore, Deep	-	0.2	17.0	31.3	-	0.0	-	-	2.5	26.0
Rockfish, Other	0.9	2.9	37.6	0.6	0.2	11.7	-	6.5	14.1	204.0
Slope, Other Groundfish	-	287.2	0.8	-	2.1	0.0	-	-	36.4	0.1
Shelf, Other Groundfish	-	0.4	1.5	-	-	0.0	-	-	0.2	66.9
Nearshore, Other Groundfish	-	-	1.8	10.4	0.0	-	0.1	-	0.5	5.7
Other Groundfish	-	-	-	-	-	-	-	-	-	-
Pink Shrimp	-	-	-	-	-	-	-	-	-	-
Prawns	-	-	-	-	-	-	-	-	-	-
Pacific Halibut	-	-	3.7	-	-	-	-	-	-	-
California Halibut	-	-	0.2	0.0	-	-	-	-	0.0	0.6
Salmon	-	-	-	-	-	-	-	-	-	0.2
Sea Cucumber	-	-	-	-	-	-	-	-	-	-
Sea Urchins	-	-	-	-	-	-	-	-	-	-
California Sheephead	-	-	0.1	-	-	-	-	-	-	3.2
Gillnet Complex	-	-	-	-	-	-	-	-	-	8.5
Squid	-	-	-	-	-	-	-	-	-	-
CPS FMP	-	0.5	3.4	0.0	-	-	-	-	0.4	4.6
HMS FMP	-	1.4	0.4	-	-	-	-	-	0.1	4.0
Dungeness Crab	-	-	-	-	-	-	-	0.3	-	-
Other Crustaceans	0.0	0.0	0.1	0.2	-	-	-	-	0.0	0.7
All Other Species	0.1	3.4	6.5	0.5	0.3	0.1	-	0.3	0.2	11.8

TABLE 3.4-4. Round weight by species and target fishery, 1998, south of Cape Mendocino (thousands of pounds).[a/] (Page 4 of 5)

South of Cape Mendocino	Open Access, Nearshore	Other Groundfish (plurality, but <50%)	Groundfish/ Shrimp Combinations	Pink Shrimp	Prawns	Pacific Halibut	California Halibut	Salmon	Sea Cucumber	Sea Urchins
Number of Trips	6,201.0	333.0	1.0	70.0	3,132.0	3.0	3,194.0	7,526.0	947.0	7,981.0
Total Pounds (thousands)	1,001.4	186.8	0.7	472.7	1,335.0	2.7	924.9	2,098.6	776.3	10,432.3
Lingcod	**47.4**	**2.3**	**0.0**	**0.0**	**1.5**	**0.1**	**3.6**	**0.6**	-	**0.0**
Whiting	-	-	-	-	**0.1**	-	-	-	-	-
Sablefish	0.5	12.1	-	0.1	2.0	-	0.0	0.2	0.0	-
Dover, Shelf	0.0	-	-	-	0.1	-	0.1	-	0.0	-
Dover, Slope	-	-	-	-	0.6	-	-	-	-	-
Petrale, Shelf	-	0.4	-	0.0	8.6	0.0	1.1	0.0	-	-
Petrale, Slope	-	0.1	-	-	5.9	-	0.5	-	0.1	-
Arrowtooth, Shelf	-	-	-	-	-	-	0.1	-	-	-
Arrowtooth, Slope	-	-	-	-	-	-	1.5	-	-	-
Pacific Sanddab	0.1	11.8	-	-	0.1	-	2.6	0.0	0.2	-
Rex Sole	-	0.1	-	0.0	0.0	-	1.2	-	-	-
Flatfish, Slope	-	-	-	-	-	-	-	-	-	-
Flatfish, Shelf	-	0.6	-	0.0	0.9	-	7.8	-	-	-
Flatfish, Nearshore	0.2	0.6	-	-	-	-	81.6	-	-	-
Flatfish, Other	0.3	2.4	-	-	6.9	-	32.9	-	2.0	-
Darkblotched Rockfish	**0.2**	-	-	-	-	-	-	-	-	-
Pacific Ocean Perch	-	-	-	-	-	-	-	-	-	-
Thornyheads	0.2	1.6	-	-	0.8	-	0.1	0.0	-	-
Rockfish, Slope	15.0	12.5	0.2	0.0	3.9	-	0.0	0.0	0.0	-
Bocaccio Rockfish	**0.6**	**2.1**	-	**0.0**	**5.2**	-	**0.1**	**0.3**	**0.0**	-
Canary Rockfish	**9.2**	**0.4**	**0.0**	**0.2**	**0.1**	-	**0.0**	**0.1**	-	-
Chilipepper Rockfish	0.5	15.6	-	0.1	16.8	-	0.3	0.0	-	-
Cowcod	**0.2**	**0.6**	-	-	**1.2**	-	-	-	-	-
Widow Rockfish	**0.2**	**4.0**	-	**2.0**	-	-	**0.5**	**0.0**	-	-
Yelloweye Rockfish	**0.5**	**0.3**	-	-	**0.1**	-	-	**0.0**	-	-
Yellowtail Rockfish	8.7	3.1	-	0.3	0.0	-	0.1	0.5	0.0	-
Rockfish, Shelf	22.0	24.1	-	-	11.4	-	0.6	0.4	0.1	-
Rockfish, Nearshore, Shallow	291.5	10.1	-	-	0.9	-	5.5	0.0	2.1	0.0
Rockfish, Nearshore, Deep	189.2	0.9	-	-	-	-	0.9	0.1	-	-
Rockfish, Other	45.1	31.4	0.2	2.7	17.3	-	1.0	2.9	0.2	-
Slope, Other Groundfish	-	14.0	-	-	0.0	-	-	0.1	-	-
Shelf, Other Groundfish	1.2	4.4	-	-	0.2	-	4.0	-	-	-
Nearshore, Other Groundfish	343.3	14.2	-	-	-	-	3.5	0.0	-	-
Other Groundfish	-	-	-	-	-	-	-	-	-	-
Pink Shrimp	-	-	0.2	465.1	1.2	-	-	-	-	-
Prawns	1.7	0.5	-	2.0	1,226.5	-	0.4	-	0.1	-
Pacific Halibut	-	-	-	-	-	2.6	-	-	-	-
California Halibut	1.4	4.2	-	-	1.8	-	744.5	1.7	4.5	0.2
Salmon	0.0	0.1	-	-	-	-	0.1	2,087.5	-	-
Sea Cucumber	-	0.1	-	-	1.3	-	0.1	-	760.0	6.3
Sea Urchins	-	-	-	-	-	-	-	-	4.5	10,421.0
California Sheephead	8.5	0.9	-	-	3.1	-	0.5	-	0.1	1.7
Gillnet Complex	1.9	2.3	-	-	-	-	-	-	-	-
Squid	-	-	-	-	5.7	-	-	-	-	-
CPS FMP	2.2	0.6	-	-	0.3	-	0.1	0.2	-	-
HMS FMP	0.8	0.7	-	-	-	-	0.9	3.0	-	-
Dungeness Crab	-	0.0	-	-	0.4	-	0.2	0.0	-	-
Other Crustaceans	0.4	1.3	-	0.0	4.1	-	1.0	-	0.1	0.0
All Other Species	8.4	6.6	-	0.1	6.1	-	27.7	1.1	2.2	3.0

TABLE 3.4-4. Round weight by species and target fishery, 1998, south of Cape Mendocino (thousands of pounds)[a] (Page 5 of 5)

South of Cape Mendocino	California Sheephead	Gillnet Complex	Squid	CPS Plan Species	HMS Plan Species	Dungeness Crab	Other Crustaceans	Other Species	No Landing Weight or 2 Equal Weights	Total
Number of Trips	860.0	2,272.0	328.0	2,768.0	2,783.0	3,786.0	9,856.0	3,114.0	605.0	63,298.0
Total Pounds (thousands)	254.1	772.0	6,331.1	147,290.1	40,435.5	3,277.6	3,209.2	8,011.5	125.2	251,287.2
Lingcod	**0.7**	**1.0**	**-**	**0.0**	**0.0**	**0.5**	**0.1**	**0.5**	**0.3**	**215.1**
Whiting	**-**	**0.0**	**-**	**-**	**-**	**-**	**-**	**0.0**	**-**	**3.7**
Sablefish	-	0.3	-	1.1	-	-	0.0	0.9	0.0	1,845.7
Dover, Shelf	-	-	-	-	-	-	-	-	-	2,171.7
Dover, Slope	-	-	-	-	-	-	-	0.3	-	1,876.8
Petrale, Shelf	-	0.0	-	-	-	-	-	0.4	-	229.0
Petrale, Slope	-	0.0	-	-	-	-	-	0.6	-	361.8
Arrowtooth, Shelf	-	-	-	-	-	-	-	-	-	0.1
Arrowtooth, Slope	-	-	-	-	-	-	-	-	-	1.5
Pacific Sanddab	-	0.2	-	0.0	0.1	-	-	6.5	0.0	1,320.7
Rex Sole	-	-	-	0.0	-	-	-	0.3	0.0	371.5
Flatfish, Slope	-	-	-	-	-	-	-	-	-	0.0
Flatfish, Shelf	-	-	-	-	-	-	-	1.4	-	504.9
Flatfish, Nearshore	-	1.5	-	-	0.0	0.0	-	0.7	-	132.1
Flatfish, Other	0.0	1.0	0.0	0.0	-	-	0.0	3.6	0.5	87.6
Darkblotched Rockfish	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**0.2**
Pacific Ocean Perch	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**0.0**
Thornyheads	-	-	-	0.7	-	-	-	0.1	0.0	2,234.5
Rockfish, Slope	-	3.1	-	0.0	0.0	0.0	0.0	3.5	0.3	3,779.7
Bocaccio Rockfish	**0.0**	**0.7**	**-**	**0.0**	**0.0**	**-**	**0.0**	**0.4**	**0.1**	**263.5**
Canary Rockfish	**-**	**-**	**-**	**0.0**	**-**	**0.0**	**-**	**0.2**	**0.1**	**210.9**
Chilipepper Rockfish	-	0.6	-	-	0.0	-	-	2.5	-	2,062.7
Cowcod	**0.0**	**0.0**	**-**	**-**	**-**	**-**	**-**	**0.1**	**-**	**25.7**
Widow Rockfish	**-**	**0.0**	**-**	**-**	**-**	**-**	**-**	**0.0**	**-**	**1,269.6**
Yelloweye Rockfish	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**0.0**	**26.5**
Yellowtail Rockfish	-	-	-	0.0	0.0	0.0	-	0.0	0.0	488.6
Rockfish, Shelf	0.4	0.1	0.0	0.0	0.3	0.1	0.1	1.2	0.2	1,190.3
Rockfish, Nearshore, Shallow	1.7	1.8	-	1.9	0.2	-	0.6	6.0	0.2	379.7
Rockfish, Nearshore, Deep	0.0	0.0	-	0.1	0.1	-	0.0	0.5	0.3	271.3
Rockfish, Other	1.6	1.9	-	0.9	0.1	0.0	0.3	2.8	115.3	2,394.5
Slope, Other Groundfish	-	-	-	-	-	-	-	0.0	0.0	921.9
Shelf, Other Groundfish	-	22.3	-	0.5	2.5	-	0.7	2.5	0.1	127.5
Nearshore, Other Groundfish	2.7	12.4	-	0.0	0.9	0.0	1.0	2.5	0.3	400.1
Other Groundfish	-	-	-	-	-	-	-	-	-	0.0
Pink Shrimp	-	-	-	-	-	-	-	-	-	466.5
Prawns	3.2	-	0.7	-	-	0.0	3.4	1.0	0.8	1,255.7
Pacific Halibut	-	-	-	-	-	-	-	-	-	6.3
California Halibut	0.1	-	-	0.2	0.8	-	0.2	17.3	0.6	874.3
Salmon	-	-	-	0.0	2.4	-	-	0.0	1.0	2,091.4
Sea Cucumber	0.0	-	0.1	-	-	-	-	1.3	-	769.6
Sea Urchins	0.6	-	-	-	-	-	-	1.2	0.1	10,427.5
California Sheephead	234.7	1.3	-	0.0	0.1	-	5.1	3.0	0.1	262.5
Gillnet Complex	0.1	645.6	-	1.0	17.1	-	3.5	26.9	0.3	707.2
Squid	-	-	6,315.0	55.9	-	-	-	3.1	0.5	6,381.2
CPS FMP	-	3.0	9.3	147,172.5	0.9	-	0.1	22.8	1.1	147,236.9
HMS FMP	0.2	22.9	-	13.8	39,872.5	-	0.1	139.4	0.5	40,061.2
Dungeness Crab	-	0.3	-	-	0.0	3,261.2	13.9	-	-	3,276.3
Other Crustaceans	3.1	16.9	0.0	0.0	0.2	13.2	3,159.8	10.0	0.5	3,212.0
All Other Species	4.9	35.2	6.0	41.3	537.2	2.5	20.2	7,748.0	2.0	9,089.3

a/ Zero values indicate there was some landing, but less than 50 pounds

TABLE 3.4-5. Round weight by species and target fishery, 2000, north of Cape Mendocino (thousands of pounds).[a/b] (Page 1 of 4)

North of Cape Mendocino	Limited Entry Trawl, Whiting	Limited Entry Trawl, Arrowtooth	Limited Entry Trawl, Petrale Sole	Limited Entry Trawl, Flatfish	Limited Entry Trawl, Midwater	Limited Entry Trawl, DTS	Limited Entry Trawl, Slope Rockfish	Limited Entry Trawl, Yellowtail	Limited Entry Trawl, Canary	Limited Entry Trawl, Widow	Limited Entry Trawl, Other Rockfish
Number of Trips	1,054.0	241.0	251.0	753.0	581.0	1,399.0	32.0	5.0	1.0	3.0	1.0
Total Pounds (thousands)	190,694.8	10,823.0	2,509.6	8,376.3	12,848.2	20,477.0	240.2	13.2	0.0	75.0	1.9
Lingcod	**1.9**	**19.7**	**3.8**	**29.9**	**1.4**	**42.3**	**1.3**	**0.1**	-	-	-
Whiting	**189,076.3**	**10.3**	**0.5**	**0.9**	**29.4**	**1.7**	-	-	-	-	-
Sablefish	4.4	484.6	70.0	274.4	0.4	4,001.6	22.7	0.2	-	0.1	-
Dover, Shelf	7.0	784.0	51.4	1,143.3	1.0	4,214.3	5.2	-	-	-	-
Dover, Slope	-	1,423.2	233.1	2,130.9	-	4,891.3	18.2	1.1	-	11.2	-
Petrale, Shelf	2.6	396.6	260.2	431.2	0.1	143.1	0.9	-	-	-	-
Petrale, Slope	-	232.2	1,159.3	531.3	0.1	311.3	36.2	0.0	-	0.0	-
Arrowtooth, Shelf	8.8	5,026.8	25.1	298.8	0.6	494.5	4.0	2.2	-	-	-
Arrowtooth, Slope	-	676.4	44.5	244.4	-	326.2	3.2	0.7	-	1.7	-
Pacific Sanddab	0.1	14.8	10.3	352.5	-	27.1	0.1	-	-	-	-
Rex Sole	2.0	97.8	72.5	262.7	0.2	461.2	5.1	0.1	-	0.3	-
Flatfish, Slope	-	-	-	-	-	-	-	-	-	-	-
Flatfish, Shelf	2.1	264.9	97.3	708.5	0.3	153.3	3.4	0.9	-	-	-
Flatfish, Nearshore	0.0	10.1	2.0	130.9	0.0	19.5	-	-	-	-	-
Flatfish, Other	-	18.2	1.8	12.3	-	5.5	2.4	-	-	-	-
Darkblotched Rockfish	**3.6**	-	**3.9**	**3.1**	-	**7.7**	**1.2**	-	-	-	-
Pacific Ocean Perch	**0.5**	**55.9**	**5.8**	**29.7**	**6.7**	**188.0**	**11.1**	**0.0**	-	-	-
Thornyheads	5.4	209.0	54.4	138.7	0.2	3,061.2	40.1	0.1	-	0.3	-
Rockfish, Slope	37.1	120.8	53.7	135.4	15.0	662.0	45.1	0.0	-	0.1	-
Bocaccio Rockfish	**1.1**	-	**0.1**	**0.1**	**0.0**	**3.8**	**0.1**	-	-	-	-
Canary Rockfish	**2.4**	**7.7**	**1.4**	**16.9**	**12.7**	**11.6**	**11.4**	**0.0**	**0.0**	-	-
Chilipepper Rockfish	61.0	-	0.0	0.6	0.5	3.6	0.0	-	-	-	-
Cowcod	-	-	-	**0.0**	-	**0.0**	-	-	-	-	-
Widow Rockfish	**181.5**	**7.1**	**1.1**	**10.6**	**7,420.4**	**19.3**	**3.6**	**0.1**	-	**34.5**	**0.1**
Yelloweye Rockfish	-	-	-	-	-	**0.0**	-	-	-	-	-
Yellowtail Rockfish	415.0	170.4	17.0	58.8	5,295.5	26.0	1.8	5.9	-	1.0	-
Rockfish, Shelf	9.6	20.6	4.1	23.4	45.7	29.6	1.2	0.0	-	25.2	1.8
Rockfish, Nearshore, Shallow	-	-	-	-	-	-	-	-	-	-	-
Rockfish, Nearshore, Deep	0.1	0.4	0.4	1.5	8.1	1.0	0.0	-	-	-	-
Rockfish, Other	0.3	0.0	0.5	0.9	0.6	0.3	0.0	-	-	-	-
Slope, Other Groundfish	0.0	7.3	0.9	2.6	-	351.7	4.7	-	-	-	-
Shelf, Other Groundfish	77.1	398.9	23.6	282.0	1.6	38.6	0.9	1.6	-	-	-
Nearshore, Other Groundfish	-	0.1	-	0.9	-	-	-	-	-	-	-
Other Groundfish	0.1	-	-	-	-	-	-	-	-	-	-
Pink Shrimp	-	-	-	0.0	-	-	-	-	-	-	-
Prawns	-	-	-	-	-	-	-	-	-	-	-
Pacific Halibut	1.6	-	-	-	-	-	-	-	-	-	-
California Halibut	-	-	0.4	0.1	-	0.2	-	-	-	-	-
Salmon	11.7	-	-	-	-	-	-	-	-	-	-
Sea Cucumber	-	-	-	-	-	-	-	-	-	-	-
Sea Urchins	-	-	-	-	-	-	-	-	-	-	-
California Sheephead	-	-	-	-	-	-	-	-	-	-	-
Gillnet Complex	-	-	-	-	-	-	-	-	-	-	-
Squid	13.1	-	0.0	0.0	-	0.6	-	-	-	-	-
CPS FMP	549.5	-	0.0	0.4	5.6	0.0	-	-	-	-	-
HMS FMP	1.6	-	-	-	0.5	0.0	-	-	-	-	-
Dungeness Crab	0.0	-	0.0	0.1	-	-	-	-	-	-	-
Other Crustaceans	-	-	-	-	-	0.1	-	-	-	-	-
All Other Species	217.2	365.2	310.5	1,118.8	1.5	978.7	16.5	0.2	-	0.6	-

TABLE 3.4-5. Round weight by species and target fishery, 2000, north of Cape Mendocino (thousands of pounds).[a/b/] (Page 2 of 4)

North of Cape Mendocino	Limited Entry Trawl, Lingcod	Limited Entry Trawl, Leftover	Open Access Trawl, Other, >50% Groundfish	Limited Entry Fixed Gear Sablefish, Slope	Limited Entry Fixed Gear Sablefish, Shelf	Limited Entry Fixed Gear Sablefish, Nearshore	Limited Entry Fixed Gear Sablefish, No Strata	Limited Entry Fixed Gear, Other Groundfish, Slope	Limited Entry Fixed Gear, Other Groundfish, Shelf	Limited Entry Fixed Gear, Other Groundfish, Nearshore	Open Access, Sablefish, Slope
Number of Trips	1.0	84.0	28.0	514.0	183.0	12.0	528.0	41.0	164.0	233.0	246.0
Total Pounds (thousands)	8.8	683.5	327.4	2,307.7	565.6	21.1	1,407.6	57.7	785.0	89.8	852.2
Lingcod	**8.6**	**1.2**	**0.0**	**1.6**	**4.0**	**0.0**	**-**	**0.1**	**13.1**	**7.1**	**0.7**
Whiting	-	**130.2**	-	-	-	-	-	-	-	-	-
Sablefish	-	3.4	21.8	2,194.7	531.3	18.5	1,403.5	9.9	21.1	1.8	764.7
Dover, Shelf	0.1	8.9	19.4	2.7	1.9	-	0.0	0.0	0.0	0.0	0.9
Dover, Slope	-	0.2	103.9	0.3	0.0	-	-	0.0	0.0	-	0.5
Petrale, Shelf	0.0	11.9	-	0.0	0.2	-	-	-	0.5	-	-
Petrale, Slope	-	1.5	12.9	-	-	-	-	-	0.1	-	-
Arrowtooth, Shelf	-	5.5	0.6	1.4	2.3	-	-	-	-	-	0.0
Arrowtooth, Slope	-	1.2	11.1	0.1	0.2	-	-	-	0.2	-	-
Pacific Sanddab	-	0.5	-	-	-	-	-	-	-	-	-
Rex Sole	-	1.2	3.2	-	-	-	-	-	-	-	-
Flatfish, Slope	-	-	-	-	-	-	-	-	-	-	-
Flatfish, Shelf	-	15.7	1.0	-	0.0	-	-	-	-	-	-
Flatfish, Nearshore	-	1.5	-	-	-	-	-	-	-	0.0	-
Flatfish, Other	-	0.1	-	-	-	-	-	-	-	-	-
Darkblotched Rockfish	**-**	**-**	**0.0**	**-**	**-**	**-**	**-**	**0.0**	**-**	**-**	**-**
POP	**-**	**0.2**	**0.5**	**-**	**0.0**	**-**	**-**	**-**	**1.2**	**-**	**0.0**
Thornyheads	-	1.0	19.2	23.3	1.9	0.1	0.0	2.0	0.7	0.1	7.8
Rockfish, Slope	-	1.6	1.9	68.1	2.7	0.1	0.0	43.4	3.2	0.3	25.0
Bocaccio Rockfish	**-**	**0.1**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Canary Rockfish	**-**	**0.4**	**0.4**	**0.2**	**1.3**	**0.2**	**-**	**0.2**	**6.6**	**3.0**	**0.0**
Chilipepper Rockfish	-	0.0	-	-	0.1	-	-	-	-	-	-
Cowcod	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Widow Rockfish	**-**	**0.8**	**12.8**	**0.0**	**0.0**	**0.0**	**-**	**-**	**4.8**	**0.1**	**-**
Yelloweye Rockfish	**-**	**-**	**-**	**0.0**	**-**	**0.0**	**-**	**0.0**	**0.9**	**0.2**	**-**
Yellowtail Rockfish	-	12.5	103.0	0.0	0.2	0.1	-	0.0	4.8	0.4	0.0
Rockfish, Shelf	-	0.4	3.2	0.6	5.5	0.2	0.0	0.6	17.9	8.1	0.6
Rockfish, Nearshore, Shallow	-	-	-	-	-	-	-	0.0	0.1	0.5	-
Rockfish, Nearshore, Deep	-	-	-	0.0	0.7	1.5	-	0.3	6.8	47.4	-
Rockfish, Other	-	0.0	0.0	10.5	3.0	0.0	3.3	-	8.8	0.0	17.0
Slope, Other Groundfish	-	6.3	0.4	0.0	-	-	-	-	-	-	-
Shelf, Other Groundfish	-	447.6	2.8	0.7	7.4	-	-	0.9	685.6	0.1	0.2
Nearshore, Other Groundfish	-	-	-	-	0.2	0.3	-	0.2	1.7	19.0	-
Other Groundfish	-	0.1	-	-	0.2	-	-	-	-	-	-
Pink Shrimp	-	-	-	-	-	-	-	-	-	-	-
Prawns	-	-	-	-	-	-	-	-	-	-	-
Pacific Halibut	-	-	-	0.6	0.2	-	0.4	-	-	-	34.0
California Halibut	-	-	-	-	-	-	-	-	-	-	-
Salmon	-	0.0	-	-	-	-	-	-	-	-	-
Sea Cucumber	-	-	-	-	-	-	-	-	-	-	-
Sea Urchins	-	-	-	-	-	-	-	-	-	-	-
California Sheephead	-	-	-	-	-	-	-	-	-	-	-
Gillnet Complex	-	-	-	-	-	-	-	-	-	-	-
Squid	-	0.0	-	-	-	-	-	-	-	-	-
CPS FMP	-	-	-	-	-	-	-	-	-	-	-
HMS FMP	-	-	-	0.1	0.0	-	0.0	-	-	-	-
Dungeness Crab	-	-	-	-	-	-	-	-	-	0.0	-
Other Crustaceans	-	-	-	-	-	-	-	-	-	0.2	-
All Other Species	-	29.6	9.4	2.9	2.3	0.0	0.2	0.0	6.8	1.5	0.6

TABLE 3.4-5. Round weight by species and target fishery, 2000, north of Cape Mendocino (thousands of pounds).[a/b] (Page 3 of 4)

North of Cape Mendocino	Open Access, Sablefish, Shelf	Open Access, Sablefish, Nearshore	Open Access, Sablefish, No Strata	Open Access, Slope	Open Access, Shelf	Open Access, Nearshore	Other Groundfish (plurality, but <50%)	Groundfish/ Shrimp Combinations	Pink Shrimp	Prawns	Pacific Halibut
Number of Trips	100.0	1.0	534.0	7.0	433.0	3,112.0	225.0	3.0	1,647.0	1.0	270.0
Total Pounds (thousands)	320.6	0.3	795.6	0.3	77.0	476.2	340.5	2.2	32,501.8	0.4	470.1
Lingcod	**1.7**	-	-	-	**30.8**	**22.7**	**2.3**	-	**33.4**	-	**5.8**
Whiting	-	-	-	-	-	-	**0.0**	-	-	-	-
Sablefish	293.1	0.2	768.9	0.0	3.9	0.2	307.6	0.5	129.0	-	49.4
Dover, Shelf	0.7	-	0.0	-	0.0	-	0.0	-	100.6	-	0.0
Dover, Slope	0.0	-	-	-	-	-	-	-	0.1	-	0.0
Petrale, Shelf	0.0	-	-	-	-	-	0.0	0.0	9.7	-	0.1
Petrale, Slope	-	-	-	-	-	-	0.0	-	0.0	-	-
Arrowtooth, Shelf	0.2	-	-	-	-	0.0	0.0	-	33.7	-	0.2
Arrowtooth, Slope	0.4	-	0.0	-	-	-	-	-	-	-	-
Pacific Sanddab	-	-	-	-	0.0	-	-	0.0	0.1	-	-
Rex Sole	-	-	-	-	0.0	-	0.3	-	4.3	-	-
Flatfish, Slope	-	-	-	-	-	-	-	-	-	-	-
Flatfish, Shelf	-	-	-	-	0.0	-	-	0.0	4.1	-	-
Flatfish, Nearshore	-	-	-	-	0.0	0.0	-	-	0.0	-	-
Flatfish, Other	-	-	-	-	-	0.0	-	-	-	-	-
Darkblotched Rockfish	-	-	-	-	-	-	-	-	-	-	-
POP	-	-	-	-	-	**0.0**	-	-	**0.6**	-	-
Thornyheads	0.9	-	0.0	0.1	0.0	-	0.2	-	0.2	-	1.1
Rockfish, Slope	0.4	-	0.0	0.2	0.1	0.3	2.1	-	18.0	-	0.2
Bocaccio Rockfish	-	-	-	-	**0.0**	-	-	-	**0.0**	-	-
Canary Rockfish	**0.2**	-	-	-	**2.4**	**4.0**	**1.1**	-	**25.0**	-	**0.4**
Chilipepper Rockfish	-	-	-	-	-	-	-	0.0	-	-	-
Cowcod	-	-	-	-	-	-	-	-	-	-	-
Widow Rockfish	**0.0**	-	-	-	**6.4**	**0.3**	**1.4**	**0.2**	**5.4**	-	**0.0**
Yelloweye Rockfish	-	-	-	-	**0.5**	**1.8**	**0.0**	-	-	-	-
Yellowtail Rockfish	0.2	-	-	-	5.2	1.8	3.1	0.4	216.1	-	0.4
Rockfish, Shelf	0.9	-	-	-	4.1	10.0	1.9	-	3.2	-	0.6
Rockfish, Nearshore, Shallow	-	-	-	-	0.3	5.5	0.0	-	-	-	-
Rockfish, Nearshore, Deep	0.1	-	-	-	7.9	318.5	13.1	-	0.2	-	0.0
Rockfish, Other	7.1	-	11.4	-	1.4	0.3	0.0	0.1	3.5	-	5.6
Slope, Other Groundfish	-	-	-	-	-	-	-	-	-	-	-
Shelf, Other Groundfish	3.6	-	0.0	-	7.5	0.0	0.1	-	3.3	-	0.8
Nearshore, Other Groundfish	-	0.0	-	-	2.5	108.7	5.5	-	-	-	0.0
Other Groundfish	-	-	-	-	-	-	-	-	-	-	-
Pink Shrimp	-	-	-	-	-	-	-	0.9	31,905.8	-	-
Prawns	-	-	-	-	-	-	-	-	-	0.4	-
Pacific Halibut	10.4	-	14.8	-	1.0	0.1	0.3	-	-	-	403.9
California Halibut	-	-	-	-	-	-	-	-	-	-	-
Salmon	-	-	-	-	2.7	0.3	0.6	-	-	-	1.5
Sea Cucumber	-	-	-	-	-	-	-	-	-	-	-
Sea Urchins	-	-	-	-	0.0	-	-	-	-	-	-
California Sheephead	-	-	-	-	-	-	-	-	-	-	-
Gillnet Complex	-	-	-	-	-	-	-	-	-	-	-
Squid	-	-	-	-	-	-	-	-	0.0	-	-
CPS FMP	-	-	-	-	-	-	-	0.0	-	-	-
HMS FMP	0.1	-	-	-	-	0.1	-	-	0.3	-	-
Dungeness Crab	-	-	-	-	0.0	0.2	-	-	-	-	-
Other Crustaceans	-	-	-	-	0.0	0.0	0.6	-	0.0	-	-
All Other Species	0.5	-	0.5	-	0.2	1.4	0.3	-	5.1	-	0.1

TABLE 3.4-5. Round weight by species and target fishery, 2000, north of Cape Mendocino (thousands of pounds)[a/b/] (Page 4 of 4)

North of Cape Mendocino	Salmon	Sea Cucumber	Sea Urchins	Gillnet Complex	CPS Plan Species	HMS Plan Species	Dungeness Crab	Other Crustaceans	Other Species	No Landing Weight or 2 Equal Weights	Total
Number of Trips	4,915.0	2.0	400.0	12.0	484.0	1,508.0	17,771.0	1,424.0	1,899.0	28.0	41,131.0
Total Pounds (thousands)	2,388.1	0.3	986.7	3.3	31,962.8	16,491.6	26,975.4	431.4	7,071.0	3.2	374,464.4
Lingcod	**18.6**	-	-	-	-	**0.0**	**0.1**	**0.3**	**2.5**	**0.2**	**255.0**
Whiting	-	-	-	-	-	-	-	-	**0.1**	-	**189,249.4**
Sablefish	0.3	-	-	-	-	-	-	0.0	2.4	0.0	11,384.4
Dover, Shelf	-	-	-	-	-	-	-	-	34.0	-	6,375.5
Dover, Slope	-	-	-	-	-	-	-	-	4.5	-	8,818.7
Petrale, Shelf	-	-	-	-	-	-	-	-	71.4	-	1,328.5
Petrale, Slope	-	-	-	-	-	-	-	-	22.5	-	2,307.5
Arrowtooth, Shelf	-	-	-	-	-	-	-	-	1.3	-	5,906.1
Arrowtooth, Slope	-	-	-	-	-	-	-	-	4.9	-	1,315.1
Pacific Sanddab	-	-	-	-	-	-	-	-	16.5	-	422.1
Rex Sole	-	-	-	-	-	-	-	-	5.4	-	916.1
Flatfish, Slope	-	-	-	-	-	-	-	-	-	-	0.0
Flatfish, Shelf	-	-	-	-	-	-	-	-	47.7	-	1,299.2
Flatfish, Nearshore	-	-	-	-	0.0	-	-	-	4.6	-	168.6
Flatfish, Other	-	-	-	-	-	-	-	-	0.0	-	40.4
Darkblotched Rockfish	-	-	-	-	-	-	-	-	**0.2**	-	**19.8**
POP	-	-	-	-	-	-	-	-	**0.3**	-	**300.5**
Thornyheads	-	-	-	-	-	-	-	-	0.7	-	3,568.9
Rockfish, Slope	0.2	-	-	-	-	-	-	-	4.8	0.0	1,241.6
Bocaccio Rockfish	-	-	-	-	-	-	-	-	-	-	**5.3**
Canary Rockfish	**3.6**	-	-	-	-	-	**0.1**	**0.0**	**0.8**	**0.0**	**113.9**
Chilipepper Rockfish	-	-	-	-	-	-	-	-	0.3	-	66.0
Cowcod	-	-	-	-	-	-	-	-	**0.0**	-	**0.1**
Widow Rockfish	**0.2**	-	-	-	-	**0.1**	-	-	**0.8**	-	**7,711.7**
Yelloweye Rockfish	**0.1**	-	-	-	-	-	**0.0**	-	-	**0.0**	**3.7**
Yellowtail Rockfish	11.5	-	-	-	-	-	0.0	-	1.2	0.0	6,352.6
Rockfish, Shelf	1.7	-	-	-	-	-	0.1	0.0	1.4	0.0	222.2
Rockfish, Nearshore, Shallow	0.0	-	-	-	-	-	0.0	0.0	0.1	0.0	6.5
Rockfish, Nearshore, Deep	3.5	-	-	-	-	-	0.6	0.6	0.2	0.1	413.0
Rockfish, Other	4.1	-	-	-	-	-	-	-	0.0	2.4	81.3
Slope, Other Groundfish	-	-	-	-	-	-	-	-	-	-	373.9
Shelf, Other Groundfish	-	-	-	-	0.0	-	-	-	2.3	-	1,987.1
Nearshore, Other Groundfish	0.0	-	-	-	-	-	1.7	0.0	0.8	0.1	141.9
Other Groundfish	-	-	-	-	-	-	-	-	-	-	0.3
Pink Shrimp	-	-	-	-	-	-	-	-	-	-	31,906.7
Prawns	-	-	-	-	-	-	-	-	-	-	0.4
Pacific Halibut	24.9	-	-	-	-	-	-	-	0.1	-	492.2
California Halibut	-	-	-	-	-	-	-	-	0.1	-	0.8
Salmon	2,317.6	-	-	-	0.1	3.5	-	-	0.0	0.1	2,338.0
Sea Cucumber	-	0.3	-	-	-	-	-	-	-	-	0.3
Sea Urchins	-	-	986.7	-	-	-	0.2	-	0.1	0.0	987.1
California Sheephead	-	-	-	-	-	-	-	-	-	-	0.0
Gillnet Complex	-	-	-	3.3	-	0.4	-	-	-	-	3.7
Squid	-	-	-	-	-	-	-	-	-	-	13.7
CPS FMP	-	-	-	-	31,953.0	-	-	-	-	-	32,508.6
HMS FMP	1.7	-	-	-	0.2	16,487.3	-	-	0.2	-	16,492.2
Dungeness Crab	-	-	-	-	-	-	26,966.0	0.3	0.0	-	26,966.6
Other Crustaceans	-	-	0.0	-	-	-	2.4	430.0	0.2	0.0	433.6
All Other Species	0.0	-	0.0	-	9.5	0.2	4.2	0.2	6,838.6	0.1	9,923.6

a/ Inclues shoreside whiting landings only.
b/ Zero values indicate there was some landing, but less than 50 pounds.

TABLE 3.4-6. Round weight by species and target fishery, 2000, south of Cape Mendocino (thousands of pounds).[a/] (Page 1 of 5)

South of Cape Mendocino	Limited Entry Trawl, Petrale Sole	Limited Entry Trawl, Flatfish	Limited Entry Trawl, Midwater	Limited Entry Trawl, DTS	Entry Trawl, Slope Rockfish	Limited Entry Trawl, Chilipepper	Limited Entry Trawl, Widow	Limited Entry Trawl, Other Rockfish	Limited Entry Trawl, Lingcod	Limited Entry Trawl, Leftover	Open Access Trawl, Prawn, >50% Groundfish
Number of Trips	57.0	558.0	27.0	509.0	32.0	152.0	4.0	20.0	3.0	4.0	11.0
Total Pounds (thousands)	299.1	3,005.4	638.9	6,646.4	324.6	735.9	48.1	106.6	1.6	13.3	2.6
Lingcod	**0.5**	**6.7**	**0.0**	**10.4**	-	**5.0**	-	**0.0**	**1.0**	**0.3**	-
Whiting	-	-	**0.3**	**1.6**	**0.0**	-	-	-	-	**0.5**	-
Sablefish	8.3	55.0	0.7	806.2	32.5	16.2	1.0	1.5	0.1	1.6	-
Dover, Shelf	1.9	128.8	3.8	1,390.7	5.8	14.1	4.1	-	-	-	-
Dover, Slope	29.0	452.1	-	2,015.9	44.8	13.4	-	0.4	-	0.0	-
Petrale, Shelf	20.1	80.5	-	35.1	0.2	21.7	0.5	1.5	0.1	0.3	0.5
Petrale, Slope	145.2	93.1	-	51.5	18.8	28.6	0.0	5.6	-	0.9	0.3
Arrowtooth, Shelf	-	0.2	-	0.1	-	-	-	-	-	-	-
Arrowtooth, Slope	0.1	-	-	0.2	0.1	-	-	-	-	-	-
Pacific Sanddab	3.9	1,448.3	-	28.5	0.4	37.7	1.4	0.5	0.1	-	-
Rex Sole	8.9	69.3	-	182.0	10.2	10.2	-	0.1	-	0.0	-
Flatfish, Slope	-	-	-	-	-	-	-	-	-	-	-
Flatfish, Shelf	33.8	206.1	1.3	85.9	7.9	49.3	0.7	2.1	0.1	0.0	0.0
Flatfish, Nearshore	1.2	60.9	-	1.7	0.0	5.4	-	0.5	-	-	-
Flatfish, Other	0.2	5.0	-	0.5	-	1.4	-	0.1	-	-	0.3
Darkblotched Rockfish	**0.4**	**0.3**	-	**0.3**	**0.4**	-	-	-	-	-	-
Pacific Ocean Perch	-	-	-	-	-	-	-	-	-	-	-
Thornyheads	3.9	33.6	0.4	1,279.7	30.0	9.3	2.0	1.3	-	0.6	-
Rockfish, Slope	12.1	36.5	0.0	233.7	120.5	13.7	2.0	2.5	-	0.2	0.0
Bocaccio Rockfish	**0.9**	**12.2**	**0.6**	**6.1**	**0.5**	**11.3**	**0.2**	**0.4**	**0.1**	**0.1**	**0.0**
Canary Rockfish	**0.1**	**1.7**	-	**1.6**	**0.2**	**1.1**	**0.0**	**0.1**	-	-	-
Chilipepper Rockfish	6.9	138.3	54.4	146.2	17.3	404.9	9.0	5.7	0.1	0.1	0.2
Cowcod	**0.0**	**0.1**	-	**0.2**	**0.0**	**0.0**	-	-	-	**0.0**	**0.0**
Widow Rockfish	**0.1**	**7.1**	**528.1**	**11.8**	**2.1**	**48.6**	**26.4**	**1.1**	-	-	**0.1**
Yelloweye Rockfish	-	**0.0**	**0.2**	**0.0**	-	-	-	-	-	-	-
Yellowtail Rockfish	0.1	0.8	48.4	0.1	-	0.5	0.1	0.6	-	-	-
Rockfish, Shelf	2.1	22.7	0.6	62.0	12.0	5.9	0.3	71.4	-	3.1	0.4
Rockfish, Nearshore, Shallow	-	-	-	-	-	-	-	-	-	0.1	-
Rockfish, Nearshore, Deep	0.0	1.2	-	1.1	0.0	0.6	-	0.0	-	-	-
Rockfish, Other	0.0	3.5	-	5.1	2.3	0.7	0.0	8.4	-	-	-
Slope, Other Groundfish	-	9.7	-	105.2	7.5	1.2	-	-	-	5.2	-
Shelf, Other Groundfish	0.1	6.7	-	1.5	-	1.3	-	0.0	-	0.1	-
Nearshore, Other Groundfish	-	0.2	-	-	-	0.0	-	-	-	-	-
Other Groundfish	-	-	-	-	-	-	-	-	-	-	-
Pink Shrimp	-	-	-	-	-	0.0	-	-	-	-	-
Prawns	-	0.1	-	0.1	-	0.3	-	-	-	-	0.7
Pacific Halibut	-	-	-	-	-	-	-	-	-	-	-
California Halibut	1.9	39.2	-	3.3	0.3	5.3	-	1.5	-	0.1	0.0
Salmon	-	-	-	-	-	-	-	-	-	-	-
Sea Cucumber	-	-	-	-	-	-	-	-	-	-	-
Sea Urchins	-	-	-	-	-	-	-	-	-	-	-
California Sheephead	-	-	-	-	-	-	-	-	-	-	-
Gillnet Complex	-	-	-	-	-	-	-	-	-	-	-
Squid	-	-	-	0.1	-	-	-	-	-	-	-
CPS FMP	-	0.0	-	0.6	-	0.5	0.0	-	-	-	-
HMS FMP	-	0.7	-	0.1	-	0.1	-	-	-	-	-
Dungeness Crab	-	-	-	-	-	-	-	-	-	-	-
Other Crustaceans	-	0.1	-	0.1	-	0.0	-	-	-	-	0.0
All Other Species	17.2	84.7	0.3	177.6	10.8	27.4	0.4	1.2	-	-	-

TABLE 3.4-6. Round weight by species and target fishery, 2000, south of Cape Mendocino (thousands of pounds).[a/] (Page 2 of 5)

South of Cape Mendocino	Open Access Trawl, Halibut, >50% Groundfish	Open Access Trawl, Sea Cucumber, >50% Groundfish	Open Access Trawl, Other, >50% Groundfish	Limited Entry Fixed Gear Sablefish, Slope	Limited Entry Fixed Gear Sablefish, Shelf	Limited Entry Fixed Gear Sablefish, Nearshore	Limited Entry Fixed Gear Sablefish, No Strata	Limited Entry Fixed Gear, Other Groundfish, Slope	Limited Entry Fixed Gear, Other Groundfish, Shelf	Limited Entry Fixed Gear, Other Groundfish, Nearshore	Open Access, Sablefish, Slope
Number of Trips	45.0	6.0	80.0	785.0	17.0	2.0	150.0	584.0	117.0	138.0	236.0
Total Pounds (thousands)	7.4	1.6	75.2	862.2	16.6	2.7	76.4	313.0	76.5	50.1	77.4
Lingcod	-	-	**0.0**	**0.0**	**0.3**	-	-	**0.8**	**3.1**	**2.9**	**0.0**
Whiting	-	-	-	**0.0**	-	-	-	-	**0.0**	-	**0.2**
Sablefish	-	-	10.5	751.8	12.3	2.0	76.0	61.9	3.3	-	57.1
Dover, Shelf	-	-	8.8	0.2	0.0	-	-	0.0	-	-	0.3
Dover, Slope	-	-	2.2	0.1	-	-	-	0.0	0.0	-	0.0
Petrale, Shelf	-	-	1.1	-	-	-	-	-	0.1	-	-
Petrale, Slope	0.2	-	14.1	-	-	-	-	-	-	-	-
Arrowtooth, Shelf	-	-	-	-	-	-	-	-	-	-	-
Arrowtooth, Slope	-	-	-	-	-	-	-	-	-	-	-
Pacific Sanddab	0.3	-	10.9	-	-	-	-	0.0	0.0	-	-
Rex Sole	-	-	1.3	-	-	-	-	0.1	0.0	0.0	0.0
Flatfish, Slope	-	-	-	-	-	-	-	-	-	-	-
Flatfish, Shelf	0.2	-	4.8	-	-	-	-	-	-	-	-
Flatfish, Nearshore	2.3	-	0.4	-	0.0	-	-	-	0.0	0.0	0.0
Flatfish, Other	1.0	0.1	0.7	0.0	0.0	-	-	0.1	0.1	0.1	0.0
Darkblotched Rockfish	-	-	-	**0.1**	-	-	-	**2.3**	**1.2**	-	**0.0**
Pacific Ocean Perch	-	-	-	-	-	-	-	-	**0.3**	-	-
Thornyheads	-	-	3.7	68.4	0.5	-	-	120.4	0.5	0.0	8.1
Rockfish, Slope	0.0	-	1.2	28.0	0.1	-	-	65.6	2.3	0.4	5.2
Bocaccio Rockfish	-	-	**0.2**	-	**0.1**	-	-	**0.1**	**4.7**	**0.1**	-
Canary Rockfish	-	-	**0.0**	**0.0**	**0.0**	**0.0**	-	**0.1**	**2.2**	**1.7**	-
Chilipepper Rockfish	0.1	-	5.4	0.1	0.1	-	-	0.4	15.6	-	0.1
Cowcod	-	-	**0.0**	**0.0**	**0.0**	-	-	-	**0.2**	-	-
Widow Rockfish	-	-	**0.7**	**0.0**	**0.3**	-	-	**0.1**	**4.9**	**0.0**	-
Yelloweye Rockfish	-	-	-	-	**0.1**	-	-	**0.2**	**1.5**	**0.2**	-
Yellowtail Rockfish	-	-	0.1	0.0	0.0	-	-	0.0	3.2	0.5	-
Rockfish, Shelf	-	0.0	1.2	0.6	1.7	0.1	-	4.0	23.4	4.9	0.2
Rockfish, Nearshore, Shallow	0.4	1.0	1.3	0.0	0.2	-	-	0.5	0.4	5.6	0.1
Rockfish, Nearshore, Deep	-	-	0.3	0.1	0.3	0.6	-	1.2	4.7	26.7	0.2
Rockfish, Other	0.1	0.0	0.9	0.1	-	-	0.1	1.0	0.8	-	0.7
Slope, Other Groundfish	-	-	0.2	9.5	-	-	-	46.7	-	-	4.1
Shelf, Other Groundfish	0.0	-	2.9	-	-	-	-	-	1.6	-	0.0
Nearshore, Other Groundfish	0.0	-	-	-	0.1	-	-	0.4	0.5	6.5	0.3
Other Groundfish	-	-	-	-	-	-	-	-	-	-	-
Pink Shrimp	-	-	0.0	-	-	-	-	-	-	-	-
Prawns	-	-	-	-	-	-	-	-	-	-	-
Pacific Halibut	-	-	-	-	-	-	-	-	-	-	-
California Halibut	2.6	-	-	0.1	-	-	0.0	-	0.2	-	0.0
Salmon	-	-	-	-	-	-	-	-	-	-	-
Sea Cucumber	-	0.5	-	-	-	-	-	-	-	-	-
Sea Urchins	-	-	-	-	-	-	-	-	-	-	-
California Sheephead	-	-	0.0	0.0	0.2	-	-	-	0.4	-	0.5
Gillnet Complex	-	-	-	-	-	-	-	-	-	-	-
Squid	-	-	-	-	-	-	-	0.4	-	-	-
CPS FMP	-	-	-	-	-	-	-	-	0.3	-	-
HMS FMP	-	-	0.0	0.8	-	-	-	0.4	0.2	-	-
Dungeness Crab	-	-	-	-	-	-	-	-	-	-	-
Other Crustaceans	0.1	-	0.0	-	-	-	-	-	-	0.3	-
All Other Species	0.1	0.0	2.5	2.3	0.5	0.0	0.3	6.4	0.8	0.3	0.2

TABLE 3.4-6. Round weight by species and target fishery, 2000, south of Cape Mendocino (thousands of pounds).[a/] (Page 3 of 5)

South of Cape Mendocino	Open Access, Sablefish, Shelf	Open Access, Sablefish, Nearshore	Open Access, Sablefish, No Strata	Open Access, Slope	Open Access, Shelf	Open Access, Nearshore	Other Groundfish (plurality, but <50%)	Groundfish/ Shrimp Combinations	Pink Shrimp	Prawns	California Halibut
Number of Trips	18.0	18.0	1,393.0	345.0	1,291.0	6,530.0	158.0	1.0	41.0	3,043.0	2,943.0
Total Pounds (thousands)	9.0	11.6	473.6	233.4	322.1	644.2	40.9	3.3	377.7	2,057.1	514.5
Lingcod	**0.0**	**0.1**	-	**0.0**	**15.1**	**15.1**	**0.2**	-	**0.0**	**0.7**	**0.3**
Whiting	-	-	-	**0.1**	-	-	-	-	-	**0.0**	-
Sablefish	5.6	6.1	472.2	33.3	4.1	0.5	7.9	0.1	0.1	1.2	0.1
Dover, Shelf	-	-	0.0	0.1	0.1	-	0.0	-	-	0.1	0.0
Dover, Slope	-	-	-	0.1	-	-	0.0	1.2	-	0.1	0.0
Petrale, Shelf	-	-	-	-	0.1	0.0	0.0	-	0.0	3.6	0.6
Petrale, Slope	-	-	-	-	0.0	-	0.1	0.7	0.1	4.1	1.0
Arrowtooth, Shelf	-	-	-	-	-	-	-	-	-	-	0.2
Arrowtooth, Slope	-	-	-	0.0	-	-	-	-	-	-	-
Pacific Sanddab	0.0	-	-	-	12.0	0.1	0.8	-	-	1.1	1.1
Rex Sole	-	-	-	-	0.0	-	-	-	-	0.1	0.3
Flatfish, Slope	-	-	-	-	-	-	-	-	-	-	-
Flatfish, Shelf	-	-	-	-	0.1	0.0	0.0	-	0.1	0.8	5.1
Flatfish, Nearshore	-	-	-	-	0.1	0.8	3.3	-	-	0.0	54.4
Flatfish, Other	-	-	0.0	0.2	0.5	1.9	1.1	-	0.1	9.5	15.8
Darkblotched Rockfish	-	-	-	**0.4**	-	**0.0**	-	-	-	-	**0.0**
Pacific Ocean Perch	-	-	-	-	**0.1**	-	-	-	-	-	-
Thornyheads	0.1	0.6	0.0	60.6	0.1	0.3	1.5	1.0	-	-	-
Rockfish, Slope	0.3	-	-	7.0	1.1	0.6	1.7	0.0	-	0.2	0.1
Bocaccio Rockfish	**0.0**	-	-	**0.0**	**10.3**	**0.1**	**0.0**	-	-	**0.2**	**0.1**
Canary Rockfish	**0.0**	**0.1**	-	**0.0**	**3.4**	**1.2**	**0.1**	-	**0.0**	**0.1**	**0.0**
Chilipepper Rockfish	1.4	-	-	0.0	104.2	0.2	2.6	-	0.1	3.7	0.6
Cowcod	-	-	-	**0.0**	**0.7**	**0.0**	-	-	-	**0.2**	-
Widow Rockfish	**0.1**	-	-	-	**26.5**	**0.3**	**0.1**	-	**0.0**	**0.1**	-
Yelloweye Rockfish	-	-	-	**0.0**	**1.1**	**0.2**	-	-	-	-	-
Yellowtail Rockfish	0.0	-	-	0.0	8.2	0.9	0.0	-	-	-	0.2
Rockfish, Shelf	0.5	0.5	-	1.2	33.0	15.9	3.1	0.0	0.0	3.7	0.3
Rockfish, Nearshore, Shallow	0.0	0.7	-	0.1	2.6	204.5	2.2	-	-	2.4	5.4
Rockfish, Nearshore, Deep	0.1	0.5	-	0.1	3.7	106.0	0.1	-	-	0.1	1.5
Rockfish, Other	0.3	0.8	0.2	0.6	4.3	5.2	0.0	-	0.0	3.2	0.2
Slope, Other Groundfish	-	-	-	128.7	0.5	-	1.5	-	-	-	-
Shelf, Other Groundfish	-	-	-	-	66.0	0.7	2.0	-	-	0.2	1.6
Nearshore, Other Groundfish	0.0	1.2	-	0.1	2.4	272.0	3.6	-	-	0.0	1.1
Other Groundfish	-	-	-	-	-	-	-	-	-	-	-
Pink Shrimp	-	-	-	-	-	-	-	0.2	375.3	0.1	-
Prawns	-	-	-	-	-	0.4	0.2	-	1.7	1,998.1	0.0
Pacific Halibut	-	-	-	-	-	-	-	-	-	-	-
California Halibut	-	-	-	0.0	1.6	1.5	3.3	-	-	3.3	402.1
Salmon	-	-	-	-	0.0	0.4	0.0	-	-	-	0.1
Sea Cucumber	-	-	-	-	-	-	-	-	-	4.4	0.1
Sea Urchins	-	-	-	-	-	-	-	-	-	-	-
California Sheephead	0.1	0.6	0.0	0.5	1.8	6.7	0.2	-	-	2.6	0.1
Gillnet Complex	-	-	-	-	11.6	2.4	1.8	-	-	-	-
Squid	-	-	-	-	0.0	-	0.0	-	0.0	1.6	0.0
CPS FMP	-	-	-	-	0.6	0.3	0.1	-	-	0.0	0.1
HMS FMP	-	-	-	0.2	2.5	0.4	0.4	-	-	-	0.3
Dungeness Crab	0.0	-	0.4	-	0.0	0.1	0.1	-	-	-	-
Other Crustaceans	-	-	-	0.1	0.3	1.9	0.3	-	0.1	5.2	3.3
All Other Species	0.3	0.5	0.6	0.3	3.5	3.8	2.5	-	0.1	6.3	18.4

TABLE 3.4-6. Round weight by species and target fishery, 2000, south of Cape Mendocino (thousands of pounds).[a/] (Page 4 of 5)

South of Cape Mendocino	Salmon	Sea Cucumber	Sea Urchins	California Sheephead	Gillnet Complex	Squid	CPS Plan Species	HMS Plan Species	Dungeness Crab	Other Crustaceans	Other Species
Number of Trips	9,904.0	679.0	10,408.0	687.0	3,581.0	4,365.0	3,301.0	2,240.0	2,442.0	9,253.0	3,961.0
Total Pounds (thousands)	5,842.3	648.8	15,183.6	169.3	974.2	261,922.6	195,642.3	15,383.3	1,717.2	2,864.4	9,315.3
Lingcod	**0.8**	-	-	**0.1**	-	-	**0.0**	-	-	**0.0**	**0.1**
Whiting	**0.0**	-	-	-	**0.0**	-	-	**0.0**	-	-	-
Sablefish	0.0	-	-	0.1	0.0	-	0.0	0.4	0.3	0.0	0.8
Dover, Shelf	-	-	-	-	0.0	-	-	-	-	-	0.0
Dover, Slope	-	-	-	-	0.0	-	-	-	-	-	0.0
Petrale, Shelf	0.0	-	-	-	0.1	-	-	0.0	-	0.0	0.9
Petrale, Slope	-	-	-	-	0.0	-	-	-	-	0.1	1.1
Arrowtooth, Shelf	-	-	-	-	-	-	-	-	-	-	0.1
Arrowtooth, Slope	-	-	-	-	-	-	-	-	-	-	-
Pacific Sanddab	-	-	-	-	0.0	-	0.0	0.0	-	-	1.1
Rex Sole	-	-	-	-	0.0	-	-	0.0	-	-	0.0
Flatfish, Slope	-	-	-	-	-	-	-	-	-	-	-
Flatfish, Shelf	-	-	-	-	0.1	-	-	-	-	-	0.6
Flatfish, Nearshore	-	-	-	0.0	2.7	-	-	0.0	-	-	1.5
Flatfish, Other	-	0.3	-	0.0	2.4	0.0	0.0	0.1	0.0	0.3	1.3
Darkblotched Rockfish	-	-	-	-	-	-	-	-	-	**0.0**	-
Pacific Ocean Perch	-	-	-	-	-	-	-	-	-	-	-
Thornyheads	-	-	-	-	-	-	-	0.0	-	0.0	0.3
Rockfish, Slope	0.1	-	-	-	-	-	-	0.0	-	-	0.6
Bocaccio Rockfish	**0.5**	-	-	**0.0**	-	-	**0.0**	**0.1**	-	**0.0**	**0.5**
Canary Rockfish	**0.3**	-	-	**0.0**	-	-	**0.0**	**0.0**	-	-	**0.0**
Chilipepper Rockfish	0.6	-	-	-	-	-	0.0	0.2	-	0.1	2.0
Cowcod	-	-	-	**0.0**	-	-	-	-	-	-	**0.0**
Widow Rockfish	**0.0**	-	-	**0.0**	-	-	-	-	-	-	-
Yelloweye Rockfish	-	-	-	-	-	-	-	**0.0**	-	-	**0.0**
Yellowtail Rockfish	1.3	-	-	0.0	0.0	-	0.0	0.3	-	-	-
Rockfish, Shelf	1.3	0.1	0.0	0.4	0.0	-	0.1	0.4	0.0	0.2	0.9
Rockfish, Nearshore, Shallow	0.0	0.8	0.1	1.2	2.8	-	0.1	0.1	-	0.9	1.3
Rockfish, Nearshore, Deep	0.8	-	0.0	0.1	0.1	-	0.1	0.2	0.0	0.2	0.4
Rockfish, Other	1.0	0.0	-	0.7	1.0	-	0.0	0.1	-	0.1	0.5
Slope, Other Groundfish	-	-	-	-	0.2	-	-	-	-	-	-
Shelf, Other Groundfish	-	-	0.8	0.1	27.8	-	0.1	4.0	0.0	0.1	1.8
Nearshore, Other Groundfish	-	-	0.0	5.2	10.7	-	0.0	0.3	0.0	0.7	1.1
Other Groundfish	-	-	-	-	-	-	-	-	-	-	-
Pink Shrimp	-	-	-	-	-	-	-	-	-	-	-
Prawns	-	0.3	-	0.9	-	-	-	-	-	3.2	0.2
Pacific Halibut	-	-	-	-	-	-	-	-	-	-	-
California Halibut	2.4	0.4	0.0	0.2	-	0.0	0.2	0.2	-	0.8	8.5
Salmon	5,831.9	-	-	-	-	-	0.0	0.5	-	0.2	0.0
Sea Cucumber	-	621.0	16.4	-	-	-	-	-	-	-	0.2
Sea Urchins	-	24.6	15,163.1	-	-	-	-	-	-	0.3	3.2
California Sheephead	-	0.5	0.1	150.4	1.3	-	0.1	0.1	-	6.3	1.3
Gillnet Complex	-	-	-	0.5	844.1	-	1.9	19.7	0.1	1.1	16.2
Squid	-	-	-	-	-	261,111.9	1,017.5	-	-	0.0	0.0
CPS FMP	0.6	-	-	-	4.2	808.6	194,477.5	1.3	-	0.1	4.6
HMS FMP	0.6	-	0.1	0.0	35.4	-	58.8	15,136.1	-	0.0	30.2
Dungeness Crab	-	-	-	-	0.4	-	-	-	1,715.2	4.1	0.0
Other Crustaceans	-	0.0	0.9	4.9	5.3	0.0	0.0	6.4	1.4	2,816.8	6.6
All Other Species	0.1	0.7	2.0	4.4	35.6	2.1	85.8	212.7	0.1	28.7	9,227.0

TABLE 3.4-6. Round weight by species and target fishery, 2000, south of Cape Mendocino (thousands of pounds (Page 5 of 5)

South of Cape Mendocino	No Landing Weight or 2 Equal Weights	Total
Number of Trips	242.0	70,381.0
Total Pounds (thousands)	16.0	527,748.3
Lingcod	**0.2**	**63.8**
Whiting	**0.0**	**2.7**
Sablefish	0.6	2,431.5
Dover, Shelf	0.3	1,559.2
Dover, Slope	-	2,559.4
Petrale, Shelf	-	166.8
Petrale, Slope	-	365.6
Arrowtooth, Shelf	-	0.6
Arrowtooth, Slope	-	0.3
Pacific Sanddab	-	1,548.3
Rex Sole	-	282.6
Flatfish, Slope	-	0.0
Flatfish, Shelf	-	399.2
Flatfish, Nearshore	0.5	135.8
Flatfish, Other	1.9	45.1
Darkblotched Rockfish	**-**	**5.3**
Pacific Ocean Perch	**-**	**0.3**
Thornyheads	0.2	1,627.1
Rockfish, Slope	0.0	535.8
Bocaccio Rockfish	**0.0**	**49.2**
Canary Rockfish	**-**	**14.2**
Chilipepper Rockfish	0.0	920.7
Cowcod	**-**	**1.6**
Widow Rockfish	**0.0**	**658.6**
Yelloweye Rockfish	**-**	**3.6**
Yellowtail Rockfish	0.0	65.3
Rockfish, Shelf	0.1	278.3
Rockfish, Nearshore, Shallow	0.5	235.0
Rockfish, Nearshore, Deep	0.1	151.0
Rockfish, Other	5.7	47.6
Slope, Other Groundfish	-	320.2
Shelf, Other Groundfish	0.2	119.7
Nearshore, Other Groundfish	0.3	306.7
Other Groundfish	-	0.0
Pink Shrimp	-	375.7
Prawns	0.2	2,006.3
Pacific Halibut	-	0.0
California Halibut	1.3	480.5
Salmon	0.0	5,833.3
Sea Cucumber	-	642.5
Sea Urchins	0.5	15,191.7
California Sheephead	0.1	173.8
Gillnet Complex	0.7	900.1
Squid	0.0	262,131.6
CPS FMP	0.3	195,299.7
HMS FMP	0.2	15,267.3
Dungeness Crab	0.2	1,720.5
Other Crustaceans	0.8	2,854.9
All Other Species	1.2	9,969.3

a/ Zero values indicate there was some landing, but less than 50 pounds.

TABLE 3.4-7. Round weight by species and target fishery, 2002, north of Cape Mendocino (thousands of pounds).[a/b] (Page 1 of 4)

North of Cape Mendocino	Limited Entry Trawl, Whiting	Limited Entry Trawl, Arrowtooth	Limited Entry Trawl, Petrale Sole	Limited Entry Trawl, Flatfish	Limited Entry Trawl, Midwater	Limited Entry Trawl, DTS	Limited Entry Trawl, Slope Rockfish	Limited Entry Trawl, Yellowtail	Limited Entry Trawl, Canary	Entry Trawl, Other Rockfish	Limited Entry Trawl, Lingcod
Number of Trips	632.0	184.0	229.0	1,275.0	63.0	1,020.0	19.0	10.0	1.0	1.0	8.0
Total Pounds (thousands)	101,000.7	7,481.1	2,481.4	11,007.1	1,316.9	11,554.5	163.0	20.5	0.2	4.0	4.6
Lingcod	**0.5**	**31.4**	**13.4**	**93.2**	**0.1**	**35.6**	**0.8**	**0.3**	**-**	**1.0**	**2.2**
Whiting	**100,219.7**	**-**	**0.6**	**54.7**	**0.2**	**7.9**	**-**	**-**	**-**	**-**	**-**
Sablefish	290.9	168.9	60.7	334.9	0.0	1,652.6	13.6	0.1	-	-	0.0
Dover, Shelf	0.0	488.9	62.3	1,676.4	-	1,716.9	0.3	-	-	-	0.0
Dover, Slope	-	473.7	274.4	1,725.7	0.0	2,966.8	9.4	0.0	-	-	-
Petrale, Shelf	0.1	412.7	300.4	627.7	-	75.0	0.6	0.1	-	0.1	0.5
Petrale, Slope	-	92.4	1,025.5	557.2	-	235.4	18.0	0.2	-	-	0.0
Arrowtooth, Shelf	1.0	3,184.7	11.2	257.2	3.6	77.0	0.2	0.1	-	-	0.0
Arrowtooth, Slope	-	630.7	35.7	201.4	-	156.1	8.6	-	-	-	-
Pacific Sanddab	0.1	15.7	46.6	943.4	-	53.0	4.8	-	-	-	0.5
Rex Sole	0.0	83.8	80.1	519.7	0.0	351.0	8.7	0.1	-	-	0.1
Flatfish, Slope	-	-	-	-	-	-	-	-	-	-	-
Flatfish, Shelf	0.0	227.2	142.9	1,620.7	0.2	201.0	11.4	2.7	-	0.4	0.7
Flatfish, Nearshore	0.0	10.5	15.8	360.0	-	19.6	0.2	0.0	-	-	-
Flatfish, Other	-	6.7	0.4	11.0	-	6.1	-	-	-	-	-
Darkblotched Rockfish	**0.0**	**11.2**	**21.8**	**33.9**	**0.3**	**70.4**	**3.3**	**-**	**0.0**	**-**	**0.1**
Pacific Ocean Perch	**0.5**	**95.4**	**17.8**	**65.5**	**0.0**	**133.5**	**7.4**	**0.0**	**0.0**	**-**	**-**
Thornyheads	0.1	132.7	49.9	136.1	-	3,141.6	60.2	-	0.0	-	0.0
Rockfish, Slope	0.3	47.1	12.9	52.2	0.7	85.9	4.1	-	0.0	-	0.0
Bocaccio Rockfish	**0.0**	**-**	**-**	**0.3**	**-**	**0.0**	**0.1**	**-**	**-**	**-**	**-**
Canary Rockfish	**1.0**	**27.1**	**4.9**	**34.6**	**2.5**	**11.4**	**0.5**	**0.6**	**0.1**	**0.6**	**-**
Chilipepper Rockfish	1.2	-	-	3.6	0.0	2.6	0.0	-	-	1.1	-
Cowcod	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Widow Rockfish	**11.7**	**41.4**	**1.3**	**5.0**	**493.3**	**2.7**	**0.1**	**-**	**-**	**-**	**0.0**
Yelloweye Rockfish	**-**	**0.0**	**0.1**	**0.5**	**-**	**0.2**	**-**	**-**	**-**	**-**	**-**
Yellowtail Rockfish	91.4	347.6	28.9	275.1	798.9	40.1	0.7	7.4	-	0.9	-
Rockfish, Shelf	0.5	37.9	2.6	20.6	13.5	9.2	0.7	0.1	0.0	-	-
Rockfish, Nearshore, Shallow	-	-	-	-	-	-	-	-	-	-	-
Rockfish, Nearshore, Deep	-	0.4	0.1	3.3	-	1.1	-	-	-	-	0.3
Rockfish, Other	-	-	-	-	-	0.1	-	-	-	-	-
Slope, Other Groundfish	-	1.2	3.4	6.5	-	238.0	6.0	-	-	-	-
Shelf, Other Groundfish	26.0	711.0	34.2	583.7	2.6	24.8	0.1	6.4	-	-	-
Nearshore, Other Groundfish	-	-	-	0.8	-	-	-	-	-	-	-
Other Groundfish	-	-	-	-	-	-	-	-	-	-	-
Pink Shrimp	-	-	-	-	-	-	-	-	-	-	-
Prawns	-	-	-	-	-	-	-	-	-	-	-
Pacific Halibut	0.2	-	-	-	-	-	-	-	-	-	-
California Halibut	-	-	-	0.3	-	-	-	-	-	-	0.0
Salmon	5.8	-	-	-	-	-	-	-	-	-	-
Sea Cucumber	-	-	-	-	-	-	-	-	-	-	-
Sea Urchins	-	-	-	-	-	-	-	-	-	-	-
California Sheephead	-	-	-	-	-	-	-	-	-	-	-
Gillnet Complex	-	-	-	-	-	-	-	-	-	-	-
Squid	0.4	0.1	-	0.0	0.0	0.1	0.1	-	-	-	-
CPS FMP	15.7	-	-	-	-	-	-	-	-	-	-
HMS FMP	0.4	-	0.0	-	-	-	-	-	-	-	-
Dungeness Crab	0.0	-	-	-	-	-	-	-	-	-	-
Other Crustaceans	-	-	0.0	0.1	-	2.1	-	-	-	-	-
All Other Species	333.1	200.5	233.4	801.8	0.9	236.7	3.2	2.2	-	-	0.0

TABLE 3.4-7. Round weight by species and target fishery, 2002, north of Cape Mendocino (thousands of pounds).[a/b] (Page 2 of 4)

North of Cape Mendocino	Limited Entry Trawl, Leftover	Access Trawl, Other, >50% Groundfish	Limited Entry Fixed Gear Sablefish, Slope	Limited Entry Fixed Gear Sablefish, Shelf	Limited Entry Fixed Gear Sablefish, Nearshore	Limited Entry Fixed Gear Sablefish, No Strata	Limited Entry Fixed Gear, Other Groundfish, Slope	Limited Entry Fixed Gear, Other Groundfish, Shelf	Limited Entry Fixed Gear, Other Groundfish, Nearshore	Open Access, Sablefish, Slope	Open Access, Sablefish, Shelf
Number of Trips	158.0	135.0	316.0	105.0	4.0	233.0	21.0	52.0	185.0	216.0	128.0
Total Pounds (thousands)	1,403.0	1,033.4	1,199.9	513.6	8.2	578.4	43.2	924.2	82.3	699.2	201.1
Lingcod	**6.9**	**10.8**	**2.1**	**6.4**	-	-	**0.9**	**2.0**	**6.4**	**0.3**	**3.6**
Whiting	**80.9**	-	-	-	-	-	-	-	-	-	-
Sablefish	26.8	25.2	1,087.3	445.6	5.6	565.7	8.5	24.3	0.3	614.7	184.6
Dover, Shelf	9.7	32.8	1.2	1.2	0.0	0.0	0.0	0.0	-	0.3	0.4
Dover, Slope	7.3	2.1	0.4	0.0	-	-	0.0	0.0	-	0.7	0.1
Petrale, Shelf	26.8	43.5	0.3	0.8	-	0.0	-	0.3	-	0.0	-
Petrale, Slope	13.1	1.8	-	0.0	-	-	-	0.2	-	0.0	-
Arrowtooth, Shelf	5.5	7.1	2.3	6.3	-	-	0.1	2.2	-	0.0	0.4
Arrowtooth, Slope	1.8	-	0.3	0.1	-	-	-	0.2	-	0.0	-
Pacific Sanddab	2.7	19.5	-	-	-	-	-	-	-	-	-
Rex Sole	4.2	7.1	-	-	-	-	-	-	-	-	-
Flatfish, Slope	-	-	-	-	-	-	-	-	-	-	-
Flatfish, Shelf	62.0	87.4	-	-	-	-	-	-	-	-	-
Flatfish, Nearshore	4.0	9.5	-	0.4	-	-	-	-	0.0	-	-
Flatfish, Other	0.2	8.4	-	-	-	-	-	-	-	-	-
Darkblotched Rockfish	**0.3**	**3.3**	**0.3**	**0.1**	-	-	-	-	-	**0.0**	-
Pacific Ocean Perch	**1.1**	**0.5**	**0.4**	**0.0**	-	-	-	-	-	-	-
Thornyheads	2.0	2.0	13.7	1.4	0.0	0.0	1.6	0.5	0.1	5.0	0.8
Rockfish, Slope	0.4	2.7	53.7	3.6	0.0	-	30.9	0.6	0.1	25.0	0.6
Bocaccio Rockfish	-	-	-	-	-	-	-	-	-	-	-
Canary Rockfish	**1.9**	**5.1**	**0.0**	**0.6**	-	-	-	**2.9**	-	**0.0**	**0.4**
Chilipepper Rockfish	-	-	-	-	-	-	-	-	-	-	-
Cowcod	-	-	-	-	-	-	-	-	-	-	-
Widow Rockfish	**0.0**	**28.0**	-	**0.0**	-	-	-	**0.0**	**0.0**	-	**0.0**
Yelloweye Rockfish	-	-	**0.0**	-	-	-	-	-	-	**0.0**	-
Yellowtail Rockfish	22.1	564.0	0.2	0.6	-	-	0.0	0.3	0.1	0.1	1.1
Rockfish, Shelf	0.7	18.4	0.8	3.0	0.0	-	0.2	0.8	2.4	0.3	0.5
Rockfish, Nearshore, Shallow	-	-	-	-	-	-	0.0	0.1	1.5	-	-
Rockfish, Nearshore, Deep	0.0	0.3	-	0.1	2.5	-	0.9	0.6	47.9	-	0.0
Rockfish, Other	-	-	-	-	-	-	-	-	-	-	-
Slope, Other Groundfish	7.3	1.5	0.1	-	-	-	-	-	-	-	-
Shelf, Other Groundfish	1,083.1	127.7	0.6	14.8	-	-	-	875.7	0.0	0.1	1.9
Nearshore, Other Groundfish	-	-	-	-	0.0	-	-	0.0	21.8	-	-
Other Groundfish	-	-	-	-	-	-	-	-	-	-	-
Pink Shrimp	-	-	-	-	-	-	-	-	-	-	-
Prawns	-	-	-	-	-	-	-	-	-	-	-
Pacific Halibut	-	-	30.5	23.2	-	8.7	0.0	1.0	-	52.2	6.6
California Halibut	-	-	-	-	-	-	-	-	-	-	-
Salmon	-	-	-	-	-	-	-	-	-	-	-
Sea Cucumber	-	-	-	-	-	-	-	-	-	-	-
Sea Urchins	-	-	-	-	-	-	-	-	0.0	-	-
California Sheephead	-	-	-	-	-	-	-	-	-	-	-
Gillnet Complex	-	-	-	-	-	-	-	-	-	-	-
Squid	-	-	-	-	-	-	-	-	-	-	-
CPS FMP	-	-	-	-	-	-	-	-	-	-	-
HMS FMP	-	-	-	0.3	-	-	-	-	-	-	-
Dungeness Crab	-	-	-	-	-	0.0	-	-	1.1	-	-
Other Crustaceans	-	-	-	-	-	1.8	-	0.0	-	-	-
All Other Species	32.1	24.7	5.6	5.0	-	2.2	-	12.3	0.7	0.4	0.2

TABLE 3.4-7. Round weight by species and target fishery, 2002, north of Cape Mendocino (thousands of pounds).[a/b/] (Page 3 of 4)

North of Cape Mendocino	Open Access, Sablefish, Nearshore	Open Access, Sablefish, No Strata	Open Access, Slope	Open Access, Shelf	Open Access, Nearshore	Other Groundfish (plurality, but <50%)	Pink Shrimp	Prawns	Pacific Halibut	California Halibut	Salmon
Number of Trips	7.0	535.0	2.0	381.0	4,229.0	336.0	1,963.0	1.0	379.0	115.0	8,390.0
Total Pounds (thousands)	5.1	406.0	1.1	75.7	751.8	428.9	54,994.6	0.5	856.8	7.4	5,861.7
Lingcod	**0.2**	-	-	**40.2**	**55.5**	**5.3**	**13.7**	-	**8.5**	**0.0**	**8.6**
Whiting	-	-	-	-	-	-	-	-	-	-	-
Sablefish	3.4	393.9	0.1	2.6	2.6	362.2	29.4	-	89.2	-	1.6
Dover, Shelf	-	0.0	-	0.1	0.0	0.1	21.7	-	0.1	-	-
Dover, Slope	-	-	-	-	-	0.1	0.7	-	0.0	-	-
Petrale, Shelf	-	-	-	0.2	-	-	2.9	-	0.0	-	0.0
Petrale, Slope	-	-	-	0.0	-	-	0.3	-	-	-	-
Arrowtooth, Shelf	-	-	-	-	-	0.4	1.5	-	0.6	-	-
Arrowtooth, Slope	-	-	-	-	-	-	0.0	-	-	-	-
Pacific Sanddab	-	-	-	0.1	0.0	-	0.1	-	-	-	-
Rex Sole	-	-	-	0.1	-	-	2.6	-	-	-	-
Flatfish, Slope	-	-	-	-	-	-	-	-	-	-	-
Flatfish, Shelf	-	-	-	1.1	-	-	2.5	-	-	-	-
Flatfish, Nearshore	-	-	-	-	0.0	-	0.2	-	-	-	-
Flatfish, Other	-	-	-	-	0.0	-	0.0	-	-	-	-
Darkblotched Rockfish	-	-	**0.0**	**0.0**	**0.0**	**0.0**	**1.3**	-	-	-	-
Pacific Ocean Perch	-	-	-	-	**0.0**	-	**0.1**	-	**0.0**	-	-
Thornyheads	-	-	0.8	0.0	0.1	2.1	0.0	-	3.9	-	-
Rockfish, Slope	-	0.0	-	0.7	0.6	10.5	0.5	-	6.3	-	1.5
Bocaccio Rockfish	-	-	-	-	-	-	**0.0**	-	-	-	-
Canary Rockfish	-	-	-	**0.6**	**0.1**	**0.0**	**2.7**	-	**0.2**	-	**1.0**
Chilipepper Rockfish	-	-	-	-	-	-	-	-	-	-	-
Cowcod	-	-	-	-	-	-	-	-	-	-	-
Widow Rockfish	-	-	-	**0.1**	**0.3**	**0.0**	**0.4**	-	-	-	**0.0**
Yelloweye Rockfish	-	-	-	**0.0**	**0.0**	-	**0.0**	-	**0.4**	-	-
Yellowtail Rockfish	-	-	-	2.0	2.7	0.1	55.8	-	0.2	-	13.3
Rockfish, Shelf	0.3	-	-	0.8	8.0	0.7	0.6	-	1.2	-	4.9
Rockfish, Nearshore, Shallow	0.1	-	-	0.3	3.4	-	-	-	-	-	-
Rockfish, Nearshore, Deep	1.0	-	0.0	8.1	483.6	19.9	-	-	0.0	0.0	1.0
Rockfish, Other	-	-	-	-	-	-	-	-	-	-	-
Slope, Other Groundfish	-	-	-	-	0.0	0.9	-	-	-	-	-
Shelf, Other Groundfish	-	-	-	14.4	-	0.0	0.2	-	0.3	-	0.1
Nearshore, Other Groundfish	-	-	-	2.3	193.3	19.3	-	-	-	0.1	0.0
Other Groundfish	-	-	-	-	-	-	-	-	-	-	-
Pink Shrimp	-	-	-	-	-	-	54,855.0	-	-	-	-
Prawns	-	-	-	-	-	-	-	0.4	-	-	-
Pacific Halibut	-	11.5	0.1	1.2	-	4.0	-	-	744.9	-	43.2
California Halibut	-	-	-	-	0.0	-	-	-	-	7.3	0.1
Salmon	-	-	-	0.7	0.1	0.5	-	-	0.3	-	5,783.1
Sea Cucumber	-	-	-	-	-	-	-	-	-	-	-
Sea Urchins	-	-	-	-	-	-	-	-	-	-	-
California Sheephead	-	-	-	-	-	-	-	-	-	-	-
Gillnet Complex	-	-	-	-	-	-	-	-	-	-	-
Squid	-	-	-	-	-	-	-	-	-	-	-
CPS FMP	-	-	-	-	-	-	-	-	-	-	0.0
HMS FMP	-	0.1	-	-	0.0	-	0.0	-	-	-	3.2
Dungeness Crab	-	0.3	-	-	0.1	-	-	-	-	-	-
Other Crustaceans	-	-	-	-	0.3	-	-	-	-	-	-
All Other Species	-	0.2	-	0.2	1.0	2.8	2.2	0.1	0.6	-	0.1

TABLE 3.4-7. Round weight by species and target fishery, 2002, north of Cape Mendocino (thousands of pounds).[a/b/] (Page 4 of 4)

North of Cape Mendocino	Sea Urchins	Gillnet Complex	Squid	CPS Plan Species	HMS Plan Species	Dungenes Crab	Other Crustaceans	Other Species	No landing Weight or 2 Equal Weights	Total
Number of Trips	342.0	1.0	2.0	1,139.0	1,490.0	13,725.0	1,636.0	3,880.0	8.0	43,556.0
Total Pounds (thousands)	822.7	1.2	4.6	87,051.3	18,553.5	29,660.4	389.4	13,131.0	1.4	354,725.4
Lingcod	-	-	-	-	-	**0.0**	-	**2.5**	**0.3**	**353**
Whiting	-	-	-	-	-	-	-	**403.3**	-	**100,767**
Sablefish	-	-	-	-	-	0.7	-	2.8	-	6,399
Dover, Shelf	-	-	-	-	-	-	-	3.1	-	4,016
Dover, Slope	-	-	-	-	-	-	-	7.5	-	5,469
Petrale, Shelf	-	-	-	-	-	-	-	3.3	-	1,495
Petrale, Slope	-	-	-	-	-	0.0	-	28.0	-	1,972
Arrowtooth, Shelf	-	-	-	-	-	-	-	0.1	-	3,562
Arrowtooth, Slope	-	-	-	-	-	-	-	0.1	-	1,035
Pacific Sanddab	-	-	-	-	-	-	-	6.0	-	1,093
Rex Sole	-	-	-	-	-	-	-	3.1	-	1,061
Flatfish, Slope	-	-	-	-	-	-	-	-	-	0
Flatfish, Shelf	-	-	0.0	-	-	-	-	16.5	-	2,377
Flatfish, Nearshore	-	-	0.6	-	-	0.0	-	4.2	-	425
Flatfish, Other	-	-	-	-	-	-	-	0.0	-	33
Darkblotched Rockfish	-	-	-	-	-	-	-	**0.5**	-	**147**
Pacific Ocean Perch	-	-	-	-	-	-	-	**0.0**	-	**322**
Thornyheads	-	-	-	-	-	-	-	1.7	-	3,556
Rockfish, Slope	-	-	-	-	-	-	-	0.4	-	342
Bocaccio Rockfish	-	-	-	-	-	-	-	-	-	**0**
Canary Rockfish	-	-	-	-	-	-	-	**0.5**	-	**99**
Chilipepper Rockfish	-	-	-	-	-	-	-	-	-	9
Cowcod	-	-	-	-	-	-	-	-	-	**0**
Widow Rockfish	-	-	-	-	-	-	-	**0.2**	-	**585**
Yelloweye Rockfish	-	-	-	-	-	-	-	-	-	**1**
Yellowtail Rockfish	-	-	-	-	-	-	-	2.2	-	2,256
Rockfish, Shelf	-	-	-	-	-	0.0	-	0.1	0.0	129
Rockfish, Nearshore, Shallow	-	-	-	-	-	-	-	-	-	5
Rockfish, Nearshore, Deep	-	-	-	-	-	0.7	-	0.2	0.2	572
Rockfish, Other	-	-	-	-	-	-	-	-	-	0
Slope, Other Groundfish	-	-	-	-	-	-	-	-	-	265
Shelf, Other Groundfish	-	-	-	-	-	-	-	44.7	-	3,552
Nearshore, Other Groundfish	-	-	-	-	0.0	0.6	-	0.4	0.1	239
Other Groundfish	-	-	-	-	-	-	-	-	-	0
Pink Shrimp	-	-	-	-	-	-	-	-	-	54,855
Prawns	-	-	-	-	-	-	-	-	-	0
Pacific Halibut	-	-	-	-	-	-	-	-	-	927
California Halibut	-	-	-	-	-	-	-	0.0	-	8
Salmon	-	-	-	0.0	2.3	-	-	-	-	5,793
Sea Cucumber	-	-	-	-	-	-	-	-	-	0
Sea Urchins	822.5	-	-	-	-	0.4	0.0	0.0	-	823
California Sheephead	-	-	-	-	-	-	-	-	-	0
Gillnet Complex	-	1.2	-	-	0.0	-	-	-	-	1
Squid	-	-	3.9	-	-	-	-	-	-	5
CPS FMP	-	-	-	86,702.8	-	-	-	0.6	-	86,719
HMS FMP	-	-	-	-	18,550.3	-	-	0.0	-	18,554
Dungeness Crab	-	-	-	-	-	29,647.3	1.8	2.5	0.3	29,653
Other Crustaceans	-	-	-	-	0.0	3.9	385.3	3.1	0.1	397
All Other Species	0.2	-	0.1	348.4	0.7	6.8	2.3	12,593.3	0.3	14,854

a/ Includes shoreside whiting landings only.
b/ Zero values indicate there was some landing, but less than 50 pounds.

TABLE 3.4-8. Round weight by species and target fishery, 2002, south of Cape Mendocino (thousands of pounds).[a/] (Page 1 of 5)

South of Cape Mendocino	Limited Entry Trawl, Petrale Sole	Limited Entry Trawl, Flatfish	Limited Entry Trawl, Midwater	Limited Entry Trawl, DTS	Entry Trawl, Slope Rockfish	Limited Entry Trawl, Chilipepper	Limited Entry Trawl, Widow	Entry Trawl, Other Rockfish	Limited Entry Trawl, Lingcod	Limited Entry Trawl, Leftover	Open Access Trawl, Prawn, >50% Groundfish
Number of Trips	53.0	369.0	2.0	625.0	53.0	54.0	1.0	28.0	6.0	3.0	2.0
Total Pounds (thousands)	347.6	1,982.3	2.1	7,425.2	501.3	243.8	5.8	359.4	3.0	39.9	0.5
Lingcod	**3.4**	**9.4**	**-**	**13.4**	**0.5**	**4.1**	**-**	**0.3**	**1.8**	**0.4**	**-**
Whiting	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**0.0**	**-**	**-**	**-**
Sablefish	8.8	63.7	0.2	756.1	12.6	6.6	0.7	2.3	0.0	0.0	-
Dover, Shelf	0.0	257.7	-	2,417.7	0.2	-	-	10.4	-	-	-
Dover, Slope	17.7	275.7	-	1,335.5	42.8	15.2	-	2.3	-	0.3	-
Petrale, Shelf	1.0	29.6	-	33.3	1.2	2.0	0.1	0.8	-	-	0.3
Petrale, Slope	204.0	119.2	0.1	52.0	24.7	8.5	-	4.9	0.1	0.7	-
Arrowtooth, Shelf	-	0.4	-	0.6	-	-	-	-	-	-	-
Arrowtooth, Slope	-	0.0	-	0.0	-	-	-	-	-	-	-
Pacific Sanddab	3.5	729.2	-	5.8	1.0	2.0	-	-	-	0.4	-
Rex Sole	18.2	59.8	-	148.6	21.9	4.7	-	0.3	-	-	-
Flatfish, Slope	-	-	-	-	-	-	-	-	-	-	-
Flatfish, Shelf	26.8	108.0	-	55.6	16.1	8.7	1.0	1.2	-	0.4	-
Flatfish, Nearshore	5.1	69.1	-	1.9	-	0.5	-	0.1	-	-	-
Flatfish, Other	-	0.2	-	0.5	-	-	-	0.0	-	-	0.0
Darkblotched Rockfish	**0.0**	**0.7**	**-**	**7.4**	**18.0**	**0.4**	**-**	**-**	**-**	**-**	**-**
Pacific Ocean Perch	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Thornyheads	4.6	33.3	-	2,076.9	38.0	6.1	-	7.3	-	1.3	-
Rockfish, Slope	22.1	59.4	0.0	171.6	266.7	5.1	0.9	17.7	0.0	0.0	-
Bocaccio Rockfish	**5.1**	**10.5**	**-**	**13.9**	**0.1**	**4.7**	**-**	**2.9**	**0.7**	**0.1**	**-**
Canary Rockfish	**0.2**	**1.6**	**-**	**3.3**	**0.1**	**1.5**	**0.0**	**0.0**	**-**	**0.0**	**-**
Chilipepper Rockfish	12.9	57.5	0.1	83.8	7.9	164.3	0.2	2.7	0.1	-	-
Cowcod	**-**	**0.1**	**-**	**0.0**	**-**	**0.0**	**-**	**-**	**-**	**-**	**-**
Widow Rockfish	**0.2**	**2.4**	**1.7**	**2.8**	**0.9**	**2.0**	**2.8**	**1.3**	**-**	**0.3**	**-**
Yelloweye Rockfish	**0.0**	**0.0**	**-**	**0.0**	**0.0**	**-**	**-**	**-**	**-**	**-**	**-**
Yellowtail Rockfish	0.0	2.0	-	0.7	-	-	-	-	-	-	-
Rockfish, Shelf	2.2	19.8	-	85.5	35.6	0.9	0.0	286.6	0.1	0.5	-
Rockfish, Nearshore, Shallow	-	0.1	-	0.0	-	-	-	-	-	-	-
Rockfish, Nearshore, Deep	-	2.7	-	0.0	-	0.2	-	-	-	-	-
Rockfish, Other	4.2	2.1	-	1.4	7.8	0.0	-	15.5	-	-	0.1
Slope, Other Groundfish	0.1	3.6	-	119.5	4.2	0.4	-	-	-	3.5	-
Shelf, Other Groundfish	-	0.3	-	4.0	-	0.1	-	-	0.0	31.5	-
Nearshore, Other Groundfish	0.0	0.1	-	1.9	-	-	-	0.5	-	-	-
Other Groundfish	-	-	-	-	-	-	-	-	-	-	-
Pink Shrimp	-	-	-	-	-	-	-	-	-	-	-
Prawns	-	-	-	0.0	-	-	-	-	0.2	-	0.1
Pacific Halibut	-	-	-	-	-	-	-	-	-	-	-
California Halibut	4.3	41.1	-	7.9	-	0.7	-	0.6	-	0.2	-
Salmon	-	-	-	-	-	-	-	-	-	-	-
Sea Cucumber	-	-	-	-	-	-	-	-	-	-	-
Sea Urchins	-	-	-	-	-	-	-	-	-	-	-
California Sheephead	-	-	-	-	-	-	-	-	-	-	-
Gillnet Complex	-	-	-	-	-	-	-	-	-	-	-
Squid	-	0.0	-	0.0	-	-	-	-	-	-	-
CPS FMP	-	-	-	-	-	-	-	-	-	-	-
HMS FMP	-	0.0	-	0.4	-	-	-	-	-	-	-
Dungeness Crab	-	-	-	-	-	-	-	-	-	-	-
Other Crustaceans	-	0.1	-	0.0	-	-	-	-	-	-	-
All Other Species	2.9	22.9	-	23.0	1.2	5.1	0.1	1.7	0.0	0.2	-

TABLE 3.4-8. Round weight by species and target fishery, 2002, south of Cape Mendocino (thousands of pounds).[a/] (Page 2 of 5)

South of Cape Mendocino	Access Trawl, Halibut, >50% Groundfish	Open Access Trawl, Other, >50% Groundfish	Limited Entry Fixed Gear Sablefish, Slope	Limited Entry Fixed Gear Sablefish, Shelf	Limited Entry Fixed Gear Sablefish, Nearshore	Limited Entry Fixed Gear Sablefish, No Strata	Limited Entry Fixed Gear, Other Groundfish, Slope	Limited Entry Fixed Gear, Other Groundfish, Shelf	Limited Entry Fixed Gear, Other Groundfish, Nearshore	Open Access, Whiting	Open Access, Sablefish, Slope
Number of Trips	25.0	29.0	695.0	4.0	4.0	171.0	746.0	32.0	43.0	1.0	281.0
Total Pounds (thousands)	3.8	21.7	415.7	2.6	4.3	115.5	450.4	14.9	16.9	0.1	146.3
Lingcod	-	-	**0.0**	**0.1**	-	-	**0.1**	**3.1**	**0.5**	-	**0.1**
Whiting	-	-	**0.3**	-	**0.0**	-	**0.1**	-	-	**0.1**	**0.2**
Sablefish	-	10.4	315.7	1.6	2.1	114.9	106.7	1.2	-	-	115.0
Dover, Shelf	-	2.9	0.1	-	0.0	-	0.0	-	-	-	0.1
Dover, Slope	-	-	0.1	-	-	-	0.1	-	-	-	0.0
Petrale, Shelf	0.2	0.9	-	-	-	-	-	-	-	-	0.1
Petrale, Slope	-	0.3	-	-	-	-	-	-	-	-	0.1
Arrowtooth, Shelf	-	-	-	-	-	-	-	-	-	-	-
Arrowtooth, Slope	-	-	-	-	-	-	-	-	-	-	-
Pacific Sanddab	0.4	-	-	-	0.0	-	-	-	-	-	0.1
Rex Sole	-	0.6	-	-	-	-	-	-	-	-	-
Flatfish, Slope	-	-	-	-	-	-	-	-	-	-	-
Flatfish, Shelf	-	0.1	-	-	-	-	-	-	-	-	-
Flatfish, Nearshore	0.7	0.1	0.0	-	-	-	-	-	-	-	-
Flatfish, Other	0.7	-	0.0	-	0.0	-	0.1	0.0	-	-	-
Darkblotched Rockfish	-	**0.0**	-	-	-	-	-	-	-	-	**0.0**
Pacific Ocean Perch	-	-	-	-	-	-	-	-	-	-	-
Thornyheads	-	3.6	61.3	0.1	0.4	-	172.7	0.5	0.1	0.0	7.0
Rockfish, Slope	-	0.3	19.3	0.1	0.1	-	52.5	0.0	-	0.0	11.7
Bocaccio Rockfish	-	**0.1**	-	-	-	-	**0.1**	**0.4**	-	-	**0.1**
Canary Rockfish	-	-	-	-	-	-	-	-	-	-	-
Chilipepper Rockfish	-	0.1	-	0.1	-	-	0.2	0.7	-	-	0.1
Cowcod	-	-	**0.0**	-	-	-	-	-	-	-	-
Widow Rockfish	-	**0.0**	-	-	-	-	-	**0.0**	-	-	-
Yelloweye Rockfish	-	-	-	-	-	-	-	-	-	-	-
Yellowtail Rockfish	-	-	-	-	0.0	-	-	0.1	-	-	-
Rockfish, Shelf	0.0	0.0	0.0	0.4	0.2	-	1.1	5.5	3.0	-	0.0
Rockfish, Nearshore, Shallow	0.4	0.1	-	-	-	-	0.2	0.3	3.8	-	0.0
Rockfish, Nearshore, Deep	-	0.5	-	-	1.2	-	0.0	1.1	7.6	-	0.0
Rockfish, Other	0.0	0.3	3.4	0.2	0.0	-	0.3	0.3	-	-	0.0
Slope, Other Groundfish	-	1.1	11.1	-	-	-	111.8	-	-	-	11.3
Shelf, Other Groundfish	-	-	-	-	-	-	-	0.3	0.0	-	-
Nearshore, Other Groundfish	-	0.0	-	-	0.2	-	0.3	0.4	1.9	-	-
Other Groundfish	-	-	-	-	-	-	-	-	-	-	-
Pink Shrimp	-	-	-	-	-	-	-	-	-	-	-
Prawns	-	-	-	-	-	-	-	-	-	-	0.0
Pacific Halibut	-	-	-	-	-	0.3	-	-	-	-	-
California Halibut	1.3	-	-	-	-	0.0	0.0	0.0	-	-	-
Salmon	-	-	-	-	-	-	-	-	-	-	-
Sea Cucumber	-	-	-	-	-	-	-	-	-	-	-
Sea Urchins	-	-	-	-	-	-	-	-	-	-	-
California Sheephead	-	-	-	-	-	-	0.2	0.4	-	-	-
Gillnet Complex	-	-	-	-	-	-	-	-	-	-	-
Squid	-	-	-	-	-	-	-	-	-	-	-
CPS FMP	-	-	-	-	-	-	-	-	-	-	-
HMS FMP	-	-	0.9	0.1	-	-	0.8	-	-	-	0.3
Dungeness Crab	-	-	0.1	-	-	-	-	-	-	-	-
Other Crustaceans	0.1	-	0.2	-	-	-	0.0	-	-	-	0.1
All Other Species	0.1	0.1	3.0	-	0.2	0.3	3.0	0.5	0.0	-	0.1

TABLE 3.4-8. Round weight by species and target fishery, 2002, south of Cape Mendocino (thousands of pounds).[a/] (Page 3 of 5)

South of Cape Mendocino	Open Access, Sablefish, Shelf	Open Access, Sablefish, Nearshore	Open Access, Sablefish, No Strata	Open Access, Slope	Open Access, Shelf	Open Access, Nearshore	Other Groundfish (plurality, but <50%)	Pink Shrimp	Prawns	California Halibut	Salmon
Number of Trips	7.0	5.0	979.0	269.0	928.0	3,838.0	180.0	57.0	2,083.0	4,326.0	8,117.0
Total Pounds (thousands)	2.9	1.7	354.5	217.2	169.8	413.5	120.2	865.2	900.3	688.9	5,313.3
Lingcod	**0.7**	-	-	**0.1**	**21.6**	**34.1**	**0.8**	-	**0.0**	**1.7**	**1.0**
Whiting	-	-	**0.0**	**0.0**	-	-	-	-	-	-	-
Sablefish	2.1	1.3	350.6	43.4	5.3	0.1	30.8	-	1.6	0.0	0.2
Dover, Shelf	-	-	0.0	0.0	-	0.0	10.5	-	-	0.0	-
Dover, Slope	-	-	-	-	-	-	-	-	0.0	0.0	-
Petrale, Shelf	0.0	-	-	-	0.3	0.0	0.1	0.2	0.9	0.4	-
Petrale, Slope	-	-	-	-	0.1	0.0	0.9	0.0	1.6	0.8	-
Arrowtooth, Shelf	-	-	-	-	-	-	-	-	-	0.3	-
Arrowtooth, Slope	-	-	-	-	-	-	-	-	-	0.3	-
Pacific Sanddab	-	-	-	-	12.5	0.0	1.8	-	0.1	0.9	-
Rex Sole	-	-	-	-	-	-	-	-	0.4	0.4	-
Flatfish, Slope	-	-	-	-	-	-	-	-	-	-	-
Flatfish, Shelf	-	-	-	-	-	-	1.8	-	1.4	1.9	-
Flatfish, Nearshore	-	-	-	-	0.0	0.2	7.5	-	-	66.3	0.0
Flatfish, Other	-	-	0.1	-	0.0	0.6	0.4	-	5.3	9.4	0.0
Darkblotched Rockfish	-	-	-	**0.0**	**0.1**	**0.0**	-	-	-	-	-
Pacific Ocean Perch	-	-	-	-	-	-	-	-	-	-	-
Thornyheads	-	-	0.0	8.6	0.2	0.0	5.8	-	0.0	0.1	-
Rockfish, Slope	-	-	-	93.0	2.1	0.4	18.3	-	0.1	0.2	0.2
Bocaccio Rockfish	-	-	-	**0.1**	**5.8**	**0.0**	**0.9**	-	**0.1**	**0.1**	**0.0**
Canary Rockfish	-	-	-	-	**0.0**	**0.1**	**0.0**	-	**0.1**	-	-
Chilipepper Rockfish	-	-	-	-	7.0	0.1	0.0	0.1	0.1	0.1	0.0
Cowcod	-	-	-	-	-	-	-	-	-	-	-
Widow Rockfish	-	-	-	-	**0.6**	-	-	-	-	**0.3**	-
Yelloweye Rockfish	-	-	-	-	-	**0.1**	-	-	-	-	-
Yellowtail Rockfish	0.1	-	-	-	0.7	0.2	0.0	-	-	0.0	0.2
Rockfish, Shelf	0.0	0.0	-	0.0	45.2	11.7	7.1	-	0.5	0.2	0.0
Rockfish, Nearshore, Shallow	-	0.0	-	-	4.0	154.2	0.5	-	0.9	2.8	0.0
Rockfish, Nearshore, Deep	-	0.1	-	-	3.6	83.8	0.7	-	0.0	0.5	1.1
Rockfish, Other	-	-	0.0	0.1	0.9	0.7	0.3	-	1.0	0.0	0.1
Slope, Other Groundfish	0.0	-	-	70.7	0.1	-	9.3	-	-	-	-
Shelf, Other Groundfish	-	-	-	-	40.3	0.4	3.5	-	0.1	1.0	-
Nearshore, Other Groundfish	-	0.0	-	-	1.2	118.8	0.7	-	0.0	1.4	0.0
Other Groundfish	-	-	-	-	-	-	-	-	-	-	-
Pink Shrimp	-	-	-	-	-	-	-	864.8	1.7	0.2	-
Prawns	-	0.0	0.2	-	-	0.1	-	0.1	848.9	0.6	-
Pacific Halibut	-	-	-	-	-	-	-	-	-	-	-
California Halibut	-	-	-	-	0.7	0.7	7.6	-	3.3	577.4	1.4
Salmon	-	-	0.8	-	0.1	-	0.1	-	-	0.3	5,304.8
Sea Cucumber	-	-	-	-	-	-	-	-	6.5	0.7	-
Sea Urchins	-	-	-	-	-	-	-	-	-	-	-
California Sheephead	-	0.2	0.3	0.6	1.1	3.7	0.8	-	1.8	0.1	-
Gillnet Complex	-	-	0.0	-	9.1	0.8	2.6	-	-	-	-
Squid	-	-	0.2	-	-	-	-	-	1.1	0.0	-
CPS FMP	-	-	-	-	0.0	0.0	0.2	-	-	0.0	0.0
HMS FMP	-	-	-	-	5.5	0.0	0.7	-	-	0.4	0.7
Dungeness Crab	-	-	0.7	-	0.0	0.1	1.1	-	0.2	0.6	0.4
Other Crustaceans	-	-	1.4	-	0.2	0.7	0.4	-	6.6	2.5	-
All Other Species	0.0	-	0.2	0.5	1.5	2.0	5.1	-	15.8	16.7	3.1

TABLE 3.4-8. Round weight by species and target fishery, 2002, south of Cape Mendocino (thousands of pounds).[a/] (Page 4 of 5)

South of Cape Mendocino	Sea Cucumber	Sea Urchins	California Sheephead	Gillnet Complex	Squid	CPS Plan Species	HMS Plan Species	Dungeness Crab	Other Crustaceans
Number of Trips	1,177.0	9,719.0	387.0	2,767.0	2,857.0	2,969.0	1,966.0	3,249.0	8,526.0
Total Pounds (thousands)	926.1	13,475.7	109.6	839.8	158,856.2	148,004.5	8,965.5	3,733.9	2,732.1
Lingcod	**0.0**	**0.1**	**0.3**	**0.2**	-	**0.0**	**0.2**	-	**0.1**
Whiting	-	-	-	**0.1**	-	-	-	-	-
Sablefish	-	-	0.3	-	-	-	0.1	0.8	4.0
Dover, Shelf	0.0	-	-	0.0	-	-	-	-	-
Dover, Slope	-	-	-	-	-	-	-	-	-
Petrale, Shelf	-	-	-	-	-	-	-	-	0.1
Petrale, Slope	-	-	-	0.0	-	-	-	-	-
Arrowtooth, Shelf	-	-	-	-	-	-	-	-	-
Arrowtooth, Slope	-	-	-	-	-	-	-	-	-
Pacific Sanddab	-	-	-	0.0	-	0.1	-	0.0	0.0
Rex Sole	0.0	-	-	-	-	-	-	-	-
Flatfish, Slope	-	-	-	-	-	-	-	-	-
Flatfish, Shelf	-	-	-	0.1	-	-	-	-	-
Flatfish, Nearshore	-	-	-	0.7	-	-	0.0	0.0	-
Flatfish, Other	0.8	-	-	2.2	-	0.0	0.0	0.0	0.6
Darkblotched Rockfish	-	-	-	-	-	-	-	-	-
Pacific Ocean Perch	-	-	-	-	-	-	-	-	-
Thornyheads	-	-	-	-	-	-	0.2	-	0.2
Rockfish, Slope	-	-	0.0	0.1	-	-	0.3	-	0.2
Bocaccio Rockfish	-	-	**0.0**	**0.0**	-	**0.0**	-	-	**0.0**
Canary Rockfish	-	-	-	-	-	-	-	-	-
Chilipepper Rockfish	-	-	0.0	-	-	-	-	-	-
Cowcod	-	-	-	-	-	-	-	-	-
Widow Rockfish	-	-	-	**0.0**	-	-	-	-	-
Yelloweye Rockfish	-	-	-	-	-	-	-	-	-
Yellowtail Rockfish	-	-	-	-	-	-	-	-	0.0
Rockfish, Shelf	0.0	-	0.4	0.0	0.0	-	-	0.0	0.1
Rockfish, Nearshore, Shallow	0.4	0.4	1.2	1.5	0.0	-	0.0	0.0	0.5
Rockfish, Nearshore, Deep	0.0	0.0	0.2	-	0.0	-	0.0	0.0	0.1
Rockfish, Other	0.1	-	0.4	0.3	-	0.0	-	0.0	0.4
Slope, Other Groundfish	-	-	-	-	-	-	-	-	-
Shelf, Other Groundfish	-	-	0.1	16.5	-	0.1	5.7	0.0	0.5
Nearshore, Other Groundfish	0.0	0.0	1.7	10.1	-	0.0	0.3	0.1	0.4
Other Groundfish	-	-	-	-	-	-	-	-	-
Pink Shrimp	-	-	-	-	-	-	-	-	-
Prawns	2.7	-	0.2	-	-	-	-	-	3.2
Pacific Halibut	-	-	-	-	-	-	-	-	-
California Halibut	4.5	0.2	0.1	-	-	0.0	0.5	-	3.0
Salmon	-	-	-	-	-	-	0.9	-	-
Sea Cucumber	908.8	14.9	0.0	-	-	-	-	-	0.2
Sea Urchins	6.4	13,459.5	-	-	-	-	-	-	-
California Sheephead	0.0	0.3	101.2	1.2	0.1	-	-	-	2.3
Gillnet Complex	-	-	-	729.5	-	0.4	22.3	0.2	3.0
Squid	0.1	-	0.0	-	158,044.2	1,364.3	0.3	-	-
CPS FMP	-	-	-	1.3	811.9	146,609.2	1.0	-	0.1
HMS FMP	-	-	0.1	36.0	-	7.9	8,852.4	-	0.4
Dungeness Crab	-	-	-	1.8	-	-	-	3,723.4	6.3
Other Crustaceans	0.4	-	2.1	17.8	-	0.2	0.1	6.3	2,685.6
All Other Species	1.7	0.2	1.5	20.3	0.0	22.4	81.2	3.1	21.1

TABLE 3.4-8. Round weight by species and target fishery, 2002, south of Cape Mendocino (thousands of pounds)[a]. (Page 5 of 5)

South of Cape Mendocino	Other Species	No Landing Weight or 2 Equal Weights	Total
Number of Trips	3,651.0	143.0	61,427.0
Total Pounds (thousands)	7,816.2	12.4	366,622.7
Lingcod	**0.2**	**0.4**	**99**
Whiting	**-**	**-**	**1**
Sablefish	0.4	0.0	1,960
Dover, Shelf	-	-	2,700
Dover, Slope	-	-	1,690
Petrale, Shelf	-	0.1	71
Petrale, Slope	0.0	0.0	418
Arrowtooth, Shelf	-	0.0	1
Arrowtooth, Slope	-	0.0	0
Pacific Sanddab	1.4	0.2	759
Rex Sole	-	-	255
Flatfish, Slope	-	-	0
Flatfish, Shelf	0.1	-	223
Flatfish, Nearshore	0.3	0.2	153
Flatfish, Other	0.6	2.9	25
Darkblotched Rockfish	**-**	**-**	**27**
Pacific Ocean Perch	**-**	**-**	**0**
Thornyheads	-	-	2,428
Rockfish, Slope	0.1	0.0	742
Bocaccio Rockfish	**0.0**	**0.0**	**46**
Canary Rockfish	**-**	**-**	**7**
Chilipepper Rockfish	-	0.0	338
Cowcod	**-**	**-**	**0**
Widow Rockfish	**-**	**-**	**15**
Yelloweye Rockfish	**-**	**-**	**0**
Yellowtail Rockfish	-	0.0	4
Rockfish, Shelf	0.8	0.0	508
Rockfish, Nearshore, Shallow	0.8	0.6	173
Rockfish, Nearshore, Deep	0.2	0.1	104
Rockfish, Other	0.1	1.4	42
Slope, Other Groundfish	-	-	347
Shelf, Other Groundfish	0.4	-	105
Nearshore, Other Groundfish	1.4	0.1	141
Other Groundfish	-	-	0
Pink Shrimp	-	-	867
Prawns	0.4	0.1	857
Pacific Halibut	-	-	0
California Halibut	12.6	1.5	670
Salmon	0.5	-	5,307
Sea Cucumber	0.6	-	932
Sea Urchins	-	-	13,466
California Sheephead	0.7	0.2	115
Gillnet Complex	4.6	0.2	773
Squid	20.8	-	159,431
CPS FMP	11.2	1.7	147,437
HMS FMP	18.1	0.1	8,925
Dungeness Crab	0.5	0.1	3,735
Other Crustaceans	7.7	0.3	2,733
All Other Species	7,731.9	2.2	7,995

a/ Zeros values indicate there was some landing, but less than 50 pounds.

TABLE 3.4-9. Exvessel revenue by species and target fishery, 1998, north of Cape Mendocino (thousands of dollars, not adjusted for inflation).[a] (Page 1 of 5)

North of Cape Mendocino	Limited Entry Trawl, Whiting	Limited Entry Trawl, Arrowtooth	Entry Trawl, Petrale Sole	Limited Entry Trawl, Flatfish	Limited Entry Trawl, Midwater	Limited Entry Trawl, DTS	Limited Entry Trawl, Pacific Ocean Perch	Entry Trawl, Slope Rockfish	Limited Entry Trawl, Yellowtail	Limited Entry Trawl, Canary	Limited Entry Trawl, Widow
Number of Trips	1,326	257	115	957	255	1,627	14	212	93	35	144
Total Revenue	5,399.6	3,574.0	630.5	4,000.5	1,462.0	10,067.1	67.3	1,325.8	399.1	159.4	1,583.4
Lingcod	**0.3**	**30.4**	**4.9**	**44.1**	**13.4**	**76.0**	**0.6**	**15.3**	**7.4**	**3.4**	**12.5**
Whiting	**4,748.0**	**0.6**	**-**	**2.6**	**0.0**	**1.9**	**-**	**0.2**	**-**	**0.2**	**0.4**
Sablefish	24.3	456.6	31.3	335.6	96.9	2,681.5	8.1	180.3	54.8	16.5	186.6
Dover, Shelf	2.8	289.1	8.0	410.6	38.3	1,649.1	1.5	45.5	17.3	8.8	81.7
Dover, Slope	0.0	109.6	35.7	550.7	20.0	1,046.2	1.0	48.7	9.9	1.3	87.0
Petrale, Shelf	0.1	220.3	81.7	371.5	10.7	177.6	3.6	28.4	16.6	5.9	20.1
Petrale, Slope	-	110.8	373.3	561.2	12.1	176.8	1.0	65.8	21.7	0.3	40.7
Arrowtooth, Shelf	1.2	531.6	0.6	18.6	1.5	42.7	0.1	3.2	1.2	0.4	6.0
Arrowtooth, Slope	-	47.5	1.9	18.9	0.6	13.5	0.0	3.4	0.5	0.1	1.9
Pacific Sanddab	-	0.1	0.7	68.3	0.4	4.4	-	1.5	1.0	0.2	0.2
Rex Sole	0.0	23.7	6.0	94.0	3.9	168.9	0.2	16.6	3.2	0.3	15.1
Flatfish, Slope	-	-	-	-	-	-	-	-	-	-	-
Flatfish, Shelf	-	53.6	16.6	415.9	5.5	101.8	0.4	23.8	15.7	2.0	18.6
Flatfish, Nearshore	-	3.3	0.9	140.1	0.9	18.8	0.0	2.2	3.0	0.1	0.6
Flatfish, Other	-	6.3	-	4.6	0.1	-	-	0.4	-	-	-
Darkblotched Rockfish	**0.3**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Pacific Ocean Perch	**19.1**	**180.8**	**10.7**	**85.3**	**36.0**	**168.9**	**37.8**	**185.4**	**13.6**	**5.1**	**58.7**
Thornyheads	0.8	317.3	15.3	124.2	56.9	2,547.1	6.5	295.3	11.4	7.2	135.3
Rockfish, Slope	2.4	-	1.1	14.0	2.5	57.8	-	59.7	0.5	0.5	5.7
Bocaccio Rockfish	**-**	**-**	**-**	**0.6**	**0.1**	**2.3**	**-**	**1.9**	**0.0**	**0.0**	**2.8**
Canary Rockfish	**0.5**	**205.0**	**2.0**	**67.6**	**73.0**	**101.0**	**1.2**	**33.5**	**34.4**	**60.9**	**89.1**
Chilipepper Rockfish	0.0	-	-	-	0.1	-	-	-	-	-	0.6
Cowcod	**-**	**-**	**-**	**0.0**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Widow Rockfish	**199.6**	**331.7**	**5.4**	**87.2**	**795.6**	**294.1**	**3.2**	**106.2**	**16.3**	**20.6**	**559.2**
Yelloweye Rockfish	**-**	**-**	**-**	**-**	**-**	**0.4**	**-**	**-**	**-**	**-**	**0.0**
Yellowtail Rockfish	272.6	261.7	6.0	152.7	247.3	221.9	0.5	54.2	135.8	14.6	116.1
Rockfish, Shelf	0.2	-	1.2	3.1	0.5	12.9	-	10.4	0.2	0.0	2.9
Rockfish, Nearshore, Shallow	-	-	-	-	-	0.0	-	-	-	-	-
Rockfish, Nearshore, Deep	0.0	0.6	-	16.5	0.2	13.2	-	0.1	0.3	-	0.0
Rockfish, Other	11.7	234.7	14.8	136.9	35.8	253.7	1.4	91.9	12.7	6.5	107.6
Slope, Other Groundfish	0.0	3.4	0.0	2.8	1.7	66.8	0.1	22.3	0.1	0.2	8.6
Shelf, Other Groundfish	3.7	145.2	3.4	157.5	4.3	35.2	0.1	5.6	17.0	2.8	14.1
Nearshore, Other Groundfish	-	-	-	0.2	-	0.4	-	-	0.0	-	-
Other Groundfish	-	-	-	-	-	-	-	-	-	-	-
Pink Shrimp	-	-	-	-	-	-	-	-	0.0	-	-
Prawns	-	-	0.7	-	-	-	-	0.5	-	-	-
Pacific Halibut	-	-	-	-	-	-	-	-	-	-	-
California Halibut	-	-	-	4.8	-	4.1	-	1.8	0.7	-	0.3
Salmon	0.0	-	-	-	-	-	-	-	-	-	-
Sea Cucumber	-	-	-	-	-	-	-	-	-	-	-
Sea Urchins	-	-	-	-	-	-	-	-	-	-	-
California Sheephead	-	-	-	-	-	-	-	-	-	-	-
Gillnet Complex	-	-	-	-	-	-	-	-	-	-	-
Squid	0.0	0.0	0.3	0.5	0.0	0.2	-	0.1	0.0	0.0	0.0
CPS FMP	59.3	0.1	-	0.1	0.3	1.0	0.0	1.8	-	-	0.4
HMS FMP	0.0	-	-	0.1	-	0.1	-	0.1	-	-	-
Dungeness Crab	-	-	-	-	0.0	-	-	-	-	-	-
Other Crustaceans	-	-	0.5	-	-	-	-	-	-	-	-
All Other Species	52.6	10.0	7.6	109.8	3.4	126.8	0.1	19.5	3.7	1.6	10.5

TABLE 3.4-9 Exvessel revenue by species and target fishery, 1998, north of Cape Mendocino (thousands of dollars, not adjusted for inflation).[a/] (Page 2 of 5)

North of Cape Mendocino	Entry Trawl, Other Rockfish	Limited Entry Trawl, Lingcod	Limited Entry Trawl, Left Over	Open Access Trawl, Other, >50% Groundfish	Limited Entry Fixed Gear Sablefish, Slope	Limited Entry Fixed Gear Sablefish, Shelf	Limited Entry Fixed Gear Sablefish, Nearshore	Limited Entry Fixed Gear Sablefish, No Strata	Limited Entry Fixed Gear, Other Groundfish, Slope	Limited Entry Fixed Gear, Other Groundfish, Shelf	Limited Entry Fixed Gear, Other Groundfish, Nearshore
Number of Trips	165	2	106	43	436	182	6	600	7	313	215
Total Revenue	1,393.4	0.3	330.2	172.6	1,567.2	710.6	2.9	1,487.8	5.6	295.3	119.5
Lingcod	**16.9**	**0.2**	**3.8**	**1.6**	**0.2**	**0.8**	**0.2**	-	**0.1**	**20.9**	**13.2**
Whiting	-	-	**9.6**	-	-	-	-	-	-	-	-
Sablefish	175.9	-	31.0	27.0	1,459.2	640.9	1.6	1,295.0	0.7	19.1	0.7
Dover, Shelf	75.7	-	4.9	17.9	0.5	0.4	-	0.0	0.0	0.0	-
Dover, Slope	61.1	-	6.4	11.3	0.1	0.0	-	-	0.0	0.0	-
Petrale, Shelf	23.4	0.0	21.8	6.6	0.2	0.2	-	-	-	0.0	0.0
Petrale, Slope	36.8	-	11.2	0.6	0.0	-	-	-	-	-	-
Arrowtooth, Shelf	6.7	-	1.3	5.5	0.0	0.1	-	0.0	-	0.1	-
Arrowtooth, Slope	2.6	-	0.6	0.2	-	0.0	-	-	-	-	-
Pacific Sanddab	1.6	-	1.4	0.0	-	-	-	-	-	-	-
Rex Sole	14.0	-	1.4	1.2	-	-	-	-	-	-	-
Flatfish, Slope	-	-	-	-	-	-	-	-	-	-	-
Flatfish, Shelf	16.4	-	7.2	1.5	-	-	-	-	-	-	-
Flatfish, Nearshore	0.7	-	1.6	0.8	-	-	-	-	-	0.0	0.0
Flatfish, Other	0.1	-	0.4	0.0	-	-	-	-	-	-	-
Darkblotched Rockfish	-	-	-	-	-	-	-	-	-	-	-
Pacific Ocean Perch	**82.2**	-	**10.7**	**6.9**	**0.9**	**0.2**	-	**0.0**	**1.0**	**2.1**	**0.0**
Thornyheads	123.4	-	13.4	13.0	31.3	0.8	-	0.0	2.0	0.6	-
Rockfish, Slope	11.5	-	1.2	0.0	0.0	-	-	-	-	0.1	0.0
Bocaccio Rockfish	**3.2**	-	**0.1**	**0.0**	-	**0.0**	-	-	-	**0.8**	**0.0**
Canary Rockfish	**118.5**	**0.0**	**10.3**	**7.0**	**0.1**	**2.5**	**0.0**	**0.0**	**0.2**	**123.1**	**5.7**
Chilipepper Rockfish	-	-	-	0.0	-	-	-	-	-	0.0	-
Cowcod	-	-	-	-	-	-	-	-	-	-	-
Widow Rockfish	**181.8**	-	**13.8**	**43.9**	-	**0.1**	-	**0.0**	**0.0**	**4.7**	**0.0**
Yelloweye Rockfish	**0.1**	-	-	-	-	**0.0**	-	-	-	**5.9**	**1.9**
Yellowtail Rockfish	139.6	0.0	25.6	16.1	0.1	1.0	-	-	0.1	37.1	0.7
Rockfish, Shelf	13.4	-	-	0.1	0.0	-	-	-	-	0.0	0.4
Rockfish, Nearshore, Shallow	-	-	-	-	-	-	-	-	-	1.1	1.8
Rockfish, Nearshore, Deep	25.4	-	0.0	-	-	0.1	0.2	-	-	5.0	28.9
Rockfish, Other	229.3	0.0	15.9	5.1	73.7	61.9	0.5	192.5	1.5	69.0	44.2
Slope, Other Groundfish	3.3	-	2.3	0.2	0.2	-	-	-	-	-	-
Shelf, Other Groundfish	11.0	-	123.8	4.3	0.1	0.7	-	-	-	0.3	0.2
Nearshore, Other Groundfish	-	-	-	-	-	0.0	0.3	0.0	-	3.3	21.3
Other Groundfish	-	-	-	-	-	-	-	-	-	-	-
Pink Shrimp	0.0	-	-	0.1	-	-	-	-	-	-	-
Prawns	0.7	-	-	-	-	-	-	-	-	-	-
Pacific Halibut	-	-	-	-	0.2	0.8	-	0.0	-	1.7	-
California Halibut	0.3	-	-	-	-	-	-	-	-	-	-
Salmon	-	-	-	-	-	-	-	-	-	-	-
Sea Cucumber	-	-	-	-	-	-	-	-	-	-	-
Sea Urchins	-	-	-	-	-	-	-	-	-	-	-
California Sheephead	-	-	-	-	-	-	-	-	-	-	-
Gillnet Complex	-	-	-	-	-	-	-	-	-	-	-
Squid	0.0	-	0.0	-	-	-	-	-	-	-	-
CPS FMP	-	-	-	-	-	-	-	-	-	-	-
HMS FMP	-	-	-	-	0.0	0.0	-	0.1	-	0.0	0.0
Dungeness Crab	-	-	-	-	-	-	-	-	-	-	-
Other Crustaceans	0.5	-	-	1.1	-	-	-	-	-	-	-
All Other Species	17.2	-	10.5	0.4	0.4	0.1	0.0	0.1	0.0	0.4	0.5

TABLE 3.4-9 Exvessel revenue by species and target fishery, 1998, north of Cape Mendocino (thousands of dollars, not adjusted for inflation).[a/] (Page 3 of 5)

North of Cape Mendocino	Open Access, Whiting	Open Access, Sablefish, Slope	Open Access, Sablefish, Shelf	Open Access, Sablefish, Nearshore	Open Access, Sablefish, No Strata	Open Access, Slope	Open Access, Shelf	Open Access, Nearshore	Other Groundfish (plurality, but <50%)	Groundfish/ Shrimp Combinations	Pink Shrimp
Number of Trips	1	109	94	7	462	11	1,265	2,201	179	11	1,105
Total Revenue	0.0	1,076.6	198.4	2.1	317.6	1.8	556.7	498.7	241.0	16.3	4,960.8
Lingcod	-	0.0	0.7	-	-	0.2	52.5	35.4	4.5	0.4	8.3
Whiting	0.0	-	-	-	-	-	-	-	1.8	-	0.2
Sablefish	-	994.7	189.9	1.9	261.7	-	7.9	2.5	130.1	3.8	37.7
Dover, Shelf	-	0.1	0.1	-	0.0	-	0.0	0.0	-	0.8	24.3
Dover, Slope	-	0.0	0.0	-	-	-	0.0	-	-	0.0	1.8
Petrale, Shelf	-	-	-	-	-	-	0.0	0.0	0.0	0.1	9.2
Petrale, Slope	-	-	-	-	-	-	-	-	-	0.1	1.6
Arrowtooth, Shelf	-	0.0	0.0	-	-	-	-	-	-	0.0	0.6
Arrowtooth, Slope	-	-	-	-	-	-	-	-	-	-	0.1
Pacific Sanddab	-	-	-	-	-	-	-	-	0.0	-	0.3
Rex Sole	-	-	-	-	-	-	-	-	-	-	1.2
Flatfish, Slope	-	-	-	-	-	-	-	-	-	-	-
Flatfish, Shelf	-	0.0	-	-	-	-	-	-	0.0	0.0	1.5
Flatfish, Nearshore	-	0.0	-	-	-	-	-	0.1	0.2	-	0.0
Flatfish, Other	-	-	-	-	-	-	-	-	-	-	0.0
Darkblotched Rockfish	-	-	-	-	-	-	-	-	-	-	-
Pacific Ocean Perch	-	0.0	0.0	-	-	0.2	1.7	0.0	0.5	0.6	3.4
Thornyheads	-	8.0	0.3	-	0.0	0.0	0.0	-	0.0	0.0	2.0
Rockfish, Slope	-	0.0	-	-	-	0.3	0.8	0.5	0.2	0.2	1.6
Bocaccio Rockfish	-	-	-	-	-	-	0.6	0.0	0.8	-	0.0
Canary Rockfish	-	0.0	1.1	0.0	-	0.0	219.5	5.4	42.9	0.4	10.0
Chilipepper Rockfish	-	-	-	-	-	-	0.3	0.1	-	-	-
Cowcod	-	-	-	-	-	-	-	-	-	-	-
Widow Rockfish	-	-	0.0	-	-	0.0	37.0	1.2	4.0	0.3	3.7
Yelloweye Rockfish	-	-	-	-	-	0.0	4.4	3.2	0.2	-	-
Yellowtail Rockfish	-	0.0	0.3	-	-	0.0	130.7	2.9	21.8	2.6	112.8
Rockfish, Shelf	-	-	-	-	-	-	1.1	2.0	0.0	-	0.1
Rockfish, Nearshore, Shallow	-	-	-	-	-	-	2.2	28.6	0.0	-	-
Rockfish, Nearshore, Deep	-	-	0.0	0.2	-	0.0	11.4	204.7	8.7	-	0.0
Rockfish, Other	-	19.3	5.5	0.0	51.6	0.9	79.1	80.5	18.0	0.2	10.5
Slope, Other Groundfish	-	-	0.0	-	-	-	-	-	-	-	-
Shelf, Other Groundfish	-	0.1	0.4	-	0.0	-	0.3	0.0	0.1	-	0.9
Nearshore, Other Groundfish	-	-	-	0.0	-	0.0	3.0	129.4	3.1	-	-
Other Groundfish	-	-	-	-	-	-	-	-	-	-	-
Pink Shrimp	-	-	-	-	-	-	-	-	-	6.7	4,726.7
Prawns	-	-	-	-	-	-	-	-	-	-	-
Pacific Halibut	-	54.4	-	-	4.1	-	0.6	0.2	0.4	0.1	-
California Halibut	-	-	-	-	-	-	0.0	0.1	0.6	-	-
Salmon	-	-	-	-	0.0	-	3.0	0.1	2.0	-	-
Sea Cucumber	-	-	-	-	-	-	-	-	-	-	-
Sea Urchins	-	-	-	-	-	-	-	-	-	-	-
California Sheephead	-	-	-	-	-	-	-	0.1	-	-	-
Gillnet Complex	-	-	-	-	-	-	-	-	0.3	-	-
Squid	-	-	-	-	-	-	-	-	-	-	0.7
CPS FMP	-	-	-	-	-	-	-	-	-	-	0.1
HMS FMP	-	-	-	-	0.0	-	0.1	-	0.1	-	-
Dungeness Crab	-	-	0.1	-	-	-	-	0.1	0.3	-	-
Other Crustaceans	-	-	-	-	-	-	-	-	-	-	0.2
All Other Species	-	0.0	0.0	0.0	0.1	-	0.3	1.5	0.2	0.0	1.3

TABLE 3.4-9 Exvessel revenue by species and target fishery, 1998, north of Cape Mendocino (thousands of dollars, not adjusted for inflation).[a/] (Page 4 of 5)

North of Cape Mendocino	Prawns	Pacific Halibut	California Halibut	Salmon	Sea Urchins	Gillnet Complex	Squid	CPS Plan Species	HMS Plan Species	Dungeness Crab	Other Crustaceans
Number of Trips	6	214	3	4,027	246	11	3	22	1,533	15,336	2,060
Total Revenue	9.6	755.5	20.2	2,763.4	154.3	2.4	1.8	65.6	15,868.2	38,526.8	1,421.8
Lingcod	-	**1.7**	**0.0**	**4.4**	-	-	-	-	**0.0**	**0.3**	**1.7**
Whiting	-	-	-	-	-	-	-	-	-	-	-
Sablefish	-	52.2	-	1.0	-	-	-	-	0.5	-	1.4
Dover, Shelf	-	0.0	-	-	-	-	-	-	-	-	0.1
Dover, Slope	-	-	-	-	-	-	-	-	-	-	0.2
Petrale, Shelf	-	0.0	-	-	-	-	-	-	-	-	0.3
Petrale, Slope	-	-	-	-	-	-	-	-	-	-	0.2
Arrowtooth, Shelf	-	0.0	-	-	-	-	-	-	-	-	-
Arrowtooth, Slope	-	-	-	-	-	-	-	-	-	-	0.0
Pacific Sanddab	-	-	0.0	-	-	-	-	-	-	-	-
Rex Sole	-	-	-	-	-	-	-	-	-	-	0.1
Flatfish, Slope	-	-	-	-	-	-	-	-	-	-	-
Flatfish, Shelf	-	-	0.0	-	-	-	-	-	-	-	0.1
Flatfish, Nearshore	-	-	1.4	-	-	-	-	-	-	0.0	-
Flatfish, Other	-	-	-	-	-	-	-	-	-	-	-
Darkblotched Rockfish	-	-	-	-	-	-	-	-	-	-	-
Pacific Ocean Perch	-	**0.0**	-	**0.1**	-	-	-	-	**0.0**	-	**0.8**
Thornyheads	-	0.4	-	-	-	-	-	-	-	-	0.0
Rockfish, Slope	-	-	-	-	-	-	-	-	-	-	-
Bocaccio Rockfish	-	-	-	-	-	-	-	-	-	-	-
Canary Rockfish	-	**0.4**	**0.0**	**2.3**	-	-	-	-	**0.1**	**0.0**	**1.0**
Chilipepper Rockfish	-	-	-	-	-	-	-	-	-	-	-
Cowcod	-	-	-	-	-	-	-	-	-	-	-
Widow Rockfish	-	**0.0**	-	**0.3**	-	-	-	-	**0.0**	-	**0.1**
Yelloweye Rockfish	-	-	-	-	-	-	-	-	-	-	-
Yellowtail Rockfish	-	0.1	-	18.1	-	-	-	-	0.2	-	0.7
Rockfish, Shelf	-	-	-	-	-	-	-	-	-	-	-
Rockfish, Nearshore, Shallow	-	-	-	-	-	-	-	-	-	-	-
Rockfish, Nearshore, Deep	-	-	-	0.2	-	-	-	-	-	0.2	-
Rockfish, Other	-	3.2	0.9	13.4	0.0	-	-	-	0.3	0.1	2.3
Slope, Other Groundfish	-	-	-	-	-	-	-	-	-	-	-
Shelf, Other Groundfish	-	0.7	0.2	0.0	-	-	-	-	-	-	0.5
Nearshore, Other Groundfish	-	-	-	-	-	-	-	-	-	0.4	0.0
Other Groundfish	-	-	-	-	-	-	-	-	-	-	-
Pink Shrimp	-	-	-	-	-	-	-	-	-	-	0.3
Prawns	9.6	-	-	-	-	-	-	-	-	-	-
Pacific Halibut	-	696.5	-	24.1	-	-	-	-	0.3	-	-
California Halibut	-	-	17.7	-	-	-	-	-	-	-	-
Salmon	-	0.4	-	2,698.2	-	-	-	-	7.7	-	-
Sea Cucumber	-	-	-	-	-	-	-	-	-	-	-
Sea Urchins	-	-	-	-	154.2	-	-	-	-	0.1	-
California Sheephead	-	-	-	-	-	-	-	-	-	-	-
Gillnet Complex	-	-	-	-	-	2.3	-	-	0.5	-	-
Squid	-	-	-	-	-	-	1.8	-	-	-	-
CPS FMP	-	-	-	-	-	-	-	65.6	-	-	-
HMS FMP	-	0.1	-	1.1	-	0.0	-	-	15,854.8	-	-
Dungeness Crab	-	-	-	-	-	-	-	-	-	38,523.2	-
Other Crustaceans	-	-	-	-	0.0	-	-	-	-	0.5	1,411.8
All Other Species	-	0.0	0.1	0.2	0.1	0.0	-	-	3.8	1.9	0.4

TABLE 3.4-9 Exvessel revenue by species and target fishery, 1998, north of Cape Mendocino (thousands of dollars, not adjusted for inflation[a]). (Page 5 of 5)

North of Cape Mendocino	Other Species	No Landing Weight or 2 Equal Weights	Total
Number of Trips	1,428	186	37,630
Total Revenue	9,261.6	43.9	111,519.1
Lingcod	**4.4**	**0.2**	**381.1**
Whiting	**0.2**	**-**	**4,765.8**
Sablefish	4.2	-	9,413.3
Dover, Shelf	12.6	-	2,690.2
Dover, Slope	0.0	-	1,990.9
Petrale, Shelf	18.3	-	1,016.6
Petrale, Slope	4.6	-	1,418.6
Arrowtooth, Shelf	0.4	-	621.9
Arrowtooth, Slope	0.0	-	91.9
Pacific Sanddab	4.6	-	84.6
Rex Sole	1.8	-	351.4
Flatfish, Slope	-	-	0.0
Flatfish, Shelf	13.9	-	694.6
Flatfish, Nearshore	16.7	-	191.6
Flatfish, Other	0.0	-	11.9
Darkblotched Rockfish	**-**	**-**	**0.3**
Pacific Ocean Perch	**0.0**	**-**	**912.8**
Thornyheads	0.9	-	3,713.2
Rockfish, Slope	5.0	-	165.7
Bocaccio Rockfish	**0.6**	**-**	**14.1**
Canary Rockfish	**2.1**	**0.1**	**1,221.0**
Chilipepper Rockfish	-	-	1.1
Cowcod	**-**	**-**	**0.0**
Widow Rockfish	**2.2**	**-**	**2,712.3**
Yelloweye Rockfish	**-**	**-**	**16.2**
Yellowtail Rockfish	0.4	0.0	1,994.3
Rockfish, Shelf	0.5	-	49.2
Rockfish, Nearshore, Shallow	1.8	-	35.4
Rockfish, Nearshore, Deep	0.3	0.1	316.4
Rockfish, Other	9.5	37.0	1,933.5
Slope, Other Groundfish	0.0	-	112.0
Shelf, Other Groundfish	1.2	-	533.6
Nearshore, Other Groundfish	2.5	0.0	164.1
Other Groundfish	-	-	0.0
Pink Shrimp	-	-	4,733.8
Prawns	-	-	11.4
Pacific Halibut	0.3	0.1	783.7
California Halibut	26.4	-	56.8
Salmon	-	0.8	2,712.2
Sea Cucumber	-	-	0.0
Sea Urchins	-	0.0	154.3
California Sheephead	-	-	0.1
Gillnet Complex	-	-	3.2
Squid	-	-	3.7
CPS FMP	0.0	-	128.8
HMS FMP	-	-	15,856.6
Dungeness Crab	2.3	0.3	38,526.3
Other Crustaceans	0.5	0.2	1,415.2
All Other Species	9,123.4	5.0	9,513.4

a/ Zero values indicate there was some landing, but less than 50 dollars in exvessel value.

TABLE 3.4-10 Exvessel revenue by species and target fishery, 1998, south of Cape Mendocino (thousands of dollars, not adjusted for inflation).[a/] (Page 1 of 5)

South of Cape Mendocino	Limited Entry Trawl, Petrale Sole	Limited Entry Trawl, Flatfish	Limited Entry Trawl, Midwater	Limited Entry Trawl, DTS	Entry Trawl, Slope Rockfish	Limited Entry Trawl, Chilipepper	Limited Entry Trawl, Yellowtail	Limited Entry Trawl, Canary	Limited Entry Trawl, Widow	Entry Trawl, Other Rockfish	Limited Entry Trawl, Lingcod
Number of Trips	41	386	16	548	316	111	3	5	29	141	1
Total Revenue	115.0	1,151.3	87.6	3,415.7	1,791.9	747.5	11.6	28.8	265.6	854.1	0.5
Lingcod	**0.4**	**8.6**	**1.2**	**15.5**	**9.1**	**6.7**	**0.4**	**0.7**	**2.7**	**8.9**	**0.0**
Whiting	-	-	-	**0.0**	**0.1**	-	-	-	-	-	-
Sablefish	6.0	34.8	1.6	619.6	127.7	23.8	0.2	0.4	17.1	33.7	-
Dover, Shelf	0.0	46.4	0.8	570.9	48.4	14.6	0.3	1.4	10.6	18.8	-
Dover, Slope	3.6	46.4	1.3	441.7	70.0	27.8	-	-	7.6	18.1	-
Petrale, Shelf	3.5	99.0	0.3	26.0	42.7	30.2	0.1	0.7	6.3	13.8	-
Petrale, Slope	82.6	87.0	2.1	39.7	91.1	42.0	-	-	0.7	16.4	-
Arrowtooth, Shelf	-	0.0	-	0.0	-	-	-	-	-	-	-
Arrowtooth, Slope	-	-	-	0.0	-	-	-	-	-	-	-
Pacific Sanddab	0.1	323.6	-	16.1	35.6	20.8	0.0	-	0.1	1.2	-
Rex Sole	1.9	32.7	0.1	48.4	39.8	13.8	-	0.0	0.7	4.9	-
Flatfish, Slope	-	-	-	-	-	-	-	-	-	-	-
Flatfish, Shelf	2.5	86.8	0.2	19.5	30.8	25.4	-	0.2	2.9	10.2	-
Flatfish, Nearshore	0.3	12.2	0.0	1.0	2.3	2.7	0.1	-	0.1	1.8	0.0
Flatfish, Other	0.0	3.0	0.0	0.3	0.8	1.2	0.1	-	-	0.1	-
Darkblotched Rockfish	-	-	-	-	**0.0**	-	-	-	-	-	-
Pacific Ocean Perch	-	-	-	-	-	-	-	-	-	-	-
Thornyheads	2.3	38.5	3.0	1,105.5	177.5	46.7	0.0	1.6	25.3	55.3	-
Rockfish, Slope	0.9	32.3	2.0	110.9	641.8	31.3	0.4	1.0	5.1	40.2	-
Bocaccio Rockfish	**0.2**	**6.3**	**0.8**	**9.6**	**6.8**	**7.9**	**0.3**	**0.5**	**2.0**	**7.8**	-
Canary Rockfish	**0.4**	**1.6**	**0.8**	**7.0**	**3.8**	**2.1**	**3.8**	**10.2**	**11.9**	**20.6**	-
Chilipepper Rockfish	0.4	55.3	1.1	85.7	101.4	338.5	-	0.1	6.9	8.6	-
Cowcod	-	-	**0.1**	**0.2**	**0.4**	**0.7**	-	-	**0.0**	**0.2**	-
Widow Rockfish	**0.1**	**21.0**	**61.3**	**54.3**	**54.4**	**38.7**	**0.1**	**3.6**	**101.6**	**64.6**	-
Yelloweye Rockfish	-	**0.0**	**0.0**	**0.1**	**0.1**	**0.2**	**0.0**	-	**0.1**	**1.0**	-
Yellowtail Rockfish	-	0.1	3.0	2.0	3.5	1.5	5.2	1.9	6.1	2.6	-
Rockfish, Shelf	0.2	23.8	3.2	28.6	50.2	10.2	0.0	-	4.7	114.0	-
Rockfish, Nearshore, Shallow	-	-	-	-	0.0	-	0.0	-	-	0.4	-
Rockfish, Nearshore, Deep	0.0	0.3	-	0.1	0.1	0.1	-	-	-	0.0	0.0
Rockfish, Other	6.5	55.4	4.0	103.7	165.8	3.6	-	6.3	52.2	384.7	-
Slope, Other Groundfish	0.1	4.4	0.1	49.7	16.2	0.6	-	0.2	0.6	1.8	-
Shelf, Other Groundfish	0.0	2.0	0.0	3.4	0.7	0.9	-	-	0.0	0.5	-
Nearshore, Other Groundfish	-	0.3	-	0.0	0.3	0.0	-	-	-	-	-
Other Groundfish	-	-	-	-	-	-	-	-	-	-	-
Pink Shrimp	-	-	-	-	-	-	-	-	-	-	-
Prawns	0.8	8.4	-	-	0.0	6.9	-	-	-	2.0	-
Pacific Halibut	-	-	-	-	-	-	-	-	-	-	-
California Halibut	1.0	78.7	0.1	30.0	21.5	18.0	0.6	-	-	16.5	0.4
Salmon	-	-	-	-	-	-	-	-	-	-	-
Sea Cucumber	-	-	-	-	-	-	-	-	-	-	-
Sea Urchins	-	-	-	-	-	-	-	-	-	-	-
California Sheephead	-	-	-	-	-	-	-	-	-	-	-
Gillnet Complex	-	-	-	-	-	-	-	-	-	-	-
Squid	-	0.0	-	-	0.0	-	-	-	-	0.3	-
CPS FMP	0.0	0.7	-	0.3	1.2	0.8	-	-	0.1	-	-
HMS FMP	-	-	-	-	-	-	-	-	-	-	-
Dungeness Crab	-	0.0	-	-	-	-	-	-	-	-	-
Other Crustaceans	-	-	-	-	-	-	-	-	-	-	-
All Other Species	1.1	41.4	0.4	26.0	47.8	29.8	0.0	0.1	0.3	5.2	-

TABLE 3.4-10 Exvessel revenue by species and target fishery, 1998, south of Cape Mendocino (thousands of dollars, not adjusted for inflation).[a/] (Page 2 of 5)

South of Cape Mendocino	Limited Entry Trawl, Left Over	Open Access Trawl, Prawn, >50% Groundfish	Open Access Trawl, Halibut, >50% Groundfish	Open Access Trawl, Sea Cucumbers, >50% Groundfish	Open Access Trawl, Other, >50% Groundfish	Limited Entry Fixed Gear, Whiting	Limited Entry Fixed Gear Sablefish, Slope	Limited Entry Fixed Gear Sablefish, Shelf	Limited Entry Fixed Gear Sablefish, Nearshore	Entry Fixed Gear Sablefish, No Strata Identified	Limited Entry Fixed Gear, Other Groundfish, Slope
Number of Trips	12	38	284	2	129	35	690	27	8	223	830
Total Revenue	38.2	85.2	95.8	0.9	28.1	9.4	669.2	23.5	3.0	98.2	648.6
Lingcod	**0.4**	**0.5**	**0.1**	-	**0.3**	-	**0.5**	**0.7**	**0.0**	-	**0.3**
Whiting	-	-	-	-	-	**0.8**	**0.2**	-	-	**0.1**	**0.7**
Sablefish	4.9	0.0	1.3	-	1.9	0.6	533.8	15.6	1.7	96.7	184.7
Dover, Shelf	1.3	0.1	-	-	0.2	-	0.1	0.0	-	-	0.0
Dover, Slope	0.3	-	1.3	-	-	-	0.1	-	-	-	0.2
Petrale, Shelf	0.8	1.7	0.0	-	0.2	-	-	-	-	-	0.0
Petrale, Slope	1.0	0.5	0.1	0.0	1.7	-	-	-	-	-	-
Arrowtooth, Shelf	-	-	-	-	-	-	-	-	-	-	-
Arrowtooth, Slope	-	-	-	-	-	-	-	-	-	-	-
Pacific Sanddab	0.3	0.1	0.4	-	1.0	-	-	-	-	-	0.1
Rex Sole	0.3	-	0.3	-	0.1	-	-	-	-	-	-
Flatfish, Slope	-	-	-	-	-	-	-	-	-	-	-
Flatfish, Shelf	1.9	0.1	0.0	-	0.3	-	-	-	-	-	0.0
Flatfish, Nearshore	-	-	2.9	-	0.1	-	-	-	-	-	-
Flatfish, Other	-	0.1	10.0	0.3	2.0	-	0.0	-	-	-	0.0
Darkblotched Rockfish	-	-	-	-	-	-	-	-	-	-	-
Pacific Ocean Perch	-	-	-	-	-	-	-	-	-	-	-
Thornyheads	10.6	0.0	1.9	-	0.8	-	119.4	0.3	0.1	-	270.8
Rockfish, Slope	1.0	0.1	0.2	-	0.8	-	5.5	0.1	0.0	-	142.3
Bocaccio Rockfish	**0.4**	**1.7**	**0.0**	-	**0.2**	-	**0.0**	**0.0**	-	-	**0.1**
Canary Rockfish	**0.0**	-	-	-	-	-	**0.0**	**0.6**	-	-	**0.1**
Chilipepper Rockfish	0.7	4.5	-	-	2.8	-	-	0.1	-	-	0.1
Cowcod	-	**0.0**	-	-	**0.4**	-	**0.0**	-	-	-	**0.0**
Widow Rockfish	**0.1**	**0.0**	-	-	**0.4**	-	**0.0**	**0.0**	-	-	**0.4**
Yelloweye Rockfish	-	-	**0.0**	-	-	-	**0.0**	**1.3**	-	-	-
Yellowtail Rockfish	-	-	-	-	0.0	-	0.0	1.1	-	-	-
Rockfish, Shelf	-	2.2	0.2	0.1	3.9	0.2	0.2	1.5	0.0	-	5.1
Rockfish, Nearshore, Shallow	-	0.0	31.6	0.3	7.0	-	-	0.1	0.4	-	-
Rockfish, Nearshore, Deep	-	-	0.1	-	0.1	-	-	1.5	0.3	-	0.3
Rockfish, Other	6.1	1.6	0.4	-	0.7	0.6	4.3	0.5	0.0	1.3	3.3
Slope, Other Groundfish	6.1	-	0.1	-	-	-	3.5	-	-	-	36.8
Shelf, Other Groundfish	1.5	0.0	0.2	-	2.8	-	0.0	-	-	-	0.2
Nearshore, Other Groundfish	-	-	0.0	-	0.0	-	0.2	0.0	0.3	-	-
Other Groundfish	-	-	-	-	-	-	-	-	-	-	-
Pink Shrimp	-	-	-	-	-	-	-	-	-	-	-
Prawns	-	72.0	0.1	-	-	-	-	-	-	-	-
Pacific Halibut	-	-	-	-	-	-	-	-	-	-	-
California Halibut	-	-	42.9	0.1	-	-	-	-	-	-	-
Salmon	-	-	-	-	-	-	-	-	-	-	-
Sea Cucumber	-	-	-	0.2	-	-	-	-	-	-	-
Sea Urchins	-	-	-	-	-	-	-	-	-	-	-
California Sheephead	-	-	0.4	-	0.0	-	-	-	0.0	-	-
Gillnet Complex	-	-	-	-	-	-	-	-	-	-	-
Squid	-	-	0.0	-	-	-	-	-	-	-	-
CPS FMP	-	-	-	-	0.0	2.7	0.3	-	-	-	0.3
HMS FMP	-	-	-	-	-	0.3	0.4	0.0	-	-	1.4
Dungeness Crab	-	-	-	-	-	-	-	-	-	-	-
Other Crustaceans	-	0.0	0.1	-	0.0	-	0.0	0.0	0.0	0.0	0.0
All Other Species	0.5	-	1.4	0.0	0.3	4.2	0.5	0.0	0.2	0.0	1.4

TABLE 3.4-10 Exvessel revenue by species and target fishery, 1998, south of Cape Mendocino (thousands of dollars, not adjusted for inflation)[a] (Page 3 of 5)

South of Cape Mendocino	Limited Entry Fixed Gear, Other Groundfish, Shelf	Limited Entry Fixed Gear, Other Groundfish, Nearshore	Open Access, Sablefish, Slope	Open Access, Sablefish, Shelf	Open Access, Sablefish, Nearshore	Access, Sablefish, No Strata Identified	Open Access, Slope	Open Access, Shelf	Open Access, Nearshore	Other Groundfish (plurality, but <50%)	Groundfish/ Shrimp Combinations
Number of Trips	312	169	58	22	1	522	166	2,441	6,201	333	1
Total Revenue	352.5	160.6	13.8	10.5	1.0	138.0	86.1	1,655.2	2,559.9	243.5	0.3
Lingcod	**14.2**	**4.4**	-	**0.0**	-	-	**0.9**	**53.7**	**50.2**	**2.3**	**0.0**
Whiting	-	-	-	-	-	-	-	**0.0**	-	-	-
Sablefish	7.9	2.5	12.3	4.7	0.3	133.4	14.2	10.8	0.5	15.4	-
Dover, Shelf	-	-	0.0	0.0	-	-	0.0	0.1	0.0	-	-
Dover, Slope	-	-	0.1	-	-	-	0.0	-	-	-	-
Petrale, Shelf	0.4	-	-	-	-	-	-	0.1	-	0.3	-
Petrale, Slope	0.4	-	-	-	-	-	-	0.9	-	0.1	-
Arrowtooth, Shelf	-	-	-	-	-	-	-	-	-	-	-
Arrowtooth, Slope	-	-	-	-	-	-	-	-	-	-	-
Pacific Sanddab	0.1	-	-	-	-	-	0.0	14.4	0.1	4.2	-
Rex Sole	0.0	-	-	-	-	-	-	-	-	0.0	-
Flatfish, Slope	-	-	-	-	-	-	-	-	-	-	-
Flatfish, Shelf	0.1	-	-	-	-	-	0.0	0.6	-	0.2	-
Flatfish, Nearshore	0.1	-	-	-	-	-	-	0.1	0.1	0.3	-
Flatfish, Other	1.3	0.1	0.0	-	-	0.0	0.0	0.6	0.3	1.2	-
Darkblotched Rockfish	-	-	-	-	-	-	-	-	**0.1**	-	-
Pacific Ocean Perch	-	-	-	-	-	-	-	-	-	-	-
Thornyheads	1.1	-	0.3	0.0	-	-	3.6	1.2	0.1	2.3	-
Rockfish, Slope	8.0	0.4	0.5	0.0	0.0	-	36.5	21.1	16.0	10.8	0.1
Bocaccio Rockfish	**9.8**	-	**0.0**	-	-	-	**2.5**	**72.4**	**0.7**	**1.3**	-
Canary Rockfish	**13.8**	**3.7**	-	**0.0**	-	-	**0.6**	**47.9**	**7.7**	**0.5**	**0.0**
Chilipepper Rockfish	12.7	-	-	0.1	-	-	1.3	287.5	0.9	7.7	-
Cowcod	**5.2**	-	-	-	-	-	**0.3**	**25.2**	**0.5**	**0.8**	-
Widow Rockfish	**7.6**	**0.0**	-	-	-	-	-	**130.7**	**0.1**	**2.0**	-
Yelloweye Rockfish	**11.1**	**0.8**	-	**0.1**	-	-	-	**18.5**	**0.6**	**0.5**	-
Yellowtail Rockfish	34.0	3.9	-	0.0	-	-	0.3	207.0	6.3	1.8	-
Rockfish, Shelf	145.7	7.0	0.1	0.2	-	0.0	2.4	471.9	27.0	48.2	-
Rockfish, Nearshore, Shallow	7.6	38.9	0.0	0.0	0.6	0.0	2.5	25.9	905.4	34.8	-
Rockfish, Nearshore, Deep	23.5	63.5	-	0.0	-	-	4.5	26.1	265.3	1.3	-
Rockfish, Other	30.5	1.0	0.2	5.3	-	3.7	10.1	151.1	89.5	27.3	0.1
Slope, Other Groundfish	0.1	-	0.3	-	-	-	4.9	0.0	-	1.9	-
Shelf, Other Groundfish	0.9	-	-	0.0	-	-	0.2	35.0	0.7	2.9	-
Nearshore, Other Groundfish	2.9	33.7	0.0	-	0.2	-	1.0	13.0	1,136.2	46.6	-
Other Groundfish	-	-	-	-	-	-	-	-	-	-	-
Pink Shrimp	-	-	-	-	-	-	-	-	-	-	0.2
Prawns	-	-	-	-	-	-	-	-	12.5	3.3	-
Pacific Halibut	6.0	-	-	-	-	-	-	-	-	-	-
California Halibut	0.5	0.1	-	-	-	-	0.0	1.5	3.9	10.2	-
Salmon	-	-	-	-	-	-	-	0.4	0.1	0.1	-
Sea Cucumber	-	-	-	-	-	-	-	-	-	0.1	-
Sea Urchins	-	-	-	-	-	-	-	-	-	-	-
California Sheephead	0.2	-	-	-	-	-	-	5.7	17.5	1.9	-
Gillnet Complex	-	-	-	-	-	-	-	16.9	4.5	5.0	-
Squid	-	-	-	-	-	-	-	-	-	-	-
CPS FMP	1.2	0.0	-	-	-	-	0.1	1.6	1.0	0.2	-
HMS FMP	0.3	-	-	-	-	-	0.1	4.1	1.9	0.7	-
Dungeness Crab	-	-	-	-	-	0.7	-	-	-	0.1	-
Other Crustaceans	0.1	0.1	-	-	-	-	0.0	0.3	0.4	1.4	-
All Other Species	5.4	0.6	0.1	0.0	-	0.1	0.0	9.1	10.0	5.7	-

TABLE 3.4-10 Exvessel revenue by species and target fishery, 1998, south of Cape Mendocino (thousands of dollars, not adjusted for inflation)[a/] (Page 4 of 5)

South of Cape Mendocino	Pink Shrimp	Prawns	Pacific Halibut	California Halibut	Salmon	Sea Cucumbers	Sea Urchins	California Sheephead	Gillnet Complex	Squid	CPS Plan Species
Number of Trips	70	3,132	3	3,194	7,526	947	7,981	860	2,272	328	2,768
Total Revenue	323.9	6,235.6	4.2	1,829.5	3,004.9	465.6	7,898.0	695.9	1,167.3	1,606.9	6,693.7
Lingcod	**0.0**	**0.9**	**0.1**	**2.6**	**0.5**	**-**	**0.0**	**1.1**	**0.7**	**-**	**0.0**
Whiting	**-**	**0.0**	**-**	**-**	**-**	**-**	**-**	**-**	**0.0**	**-**	**-**
Sablefish	0.1	2.3	-	0.0	0.2	0.0	-	-	0.3	-	1.6
Dover, Shelf	-	0.1	-	0.0	-	0.0	-	-	-	-	-
Dover, Slope	-	0.5	-	-	-	-	-	-	-	-	-
Petrale, Shelf	0.0	9.0	0.0	1.0	0.0	-	-	-	0.0	-	-
Petrale, Slope	-	6.5	-	0.5	-	0.1	-	-	0.0	-	-
Arrowtooth, Shelf	-	-	-	0.0	-	-	-	-	-	-	-
Arrowtooth, Slope	-	-	-	0.7	-	-	-	-	-	-	-
Pacific Sanddab	-	0.0	-	1.1	0.0	0.1	-	-	0.5	-	0.0
Rex Sole	0.0	0.0	-	0.5	-	-	-	-	-	-	0.0
Flatfish, Slope	-	-	-	-	-	-	-	-	-	-	-
Flatfish, Shelf	0.0	0.7	-	4.3	-	-	-	-	-	-	-
Flatfish, Nearshore	-	-	-	49.0	-	-	-	-	0.9	-	-
Flatfish, Other	-	6.2	-	18.1	-	1.0	-	0.0	0.8	0.0	0.0
Darkblotched Rockfish	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Pacific Ocean Perch	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Thornyheads	-	0.9	-	0.2	0.0	-	-	-	-	-	1.5
Rockfish, Slope	0.0	2.0	-	0.0	0.1	0.0	-	-	0.3	-	0.0
Bocaccio Rockfish	**0.0**	**2.4**	**-**	**0.0**	**0.1**	**0.0**	**-**	**0.0**	**0.3**	**-**	**0.0**
Canary Rockfish	**0.1**	**0.1**	**-**	**0.1**	**0.1**	**-**	**-**	**-**	**-**	**-**	**0.0**
Chilipepper Rockfish	0.0	8.5	-	0.1	0.0	-	-	-	0.3	-	-
Cowcod	**-**	**1.1**	**-**	**-**	**-**	**-**	**-**	**0.0**	**0.0**	**-**	**-**
Widow Rockfish	**0.8**	**-**	**-**	**0.2**	**0.0**	**-**	**-**	**-**	**0.0**	**-**	**-**
Yelloweye Rockfish	**-**	**0.1**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Yellowtail Rockfish	0.1	0.0	-	0.2	0.2	0.0	-	-	-	-	0.1
Rockfish, Shelf	-	10.8	-	1.0	0.5	0.1	-	0.4	0.2	0.0	0.0
Rockfish, Nearshore, Shallow	-	1.0	-	9.0	0.0	2.0	0.0	6.5	2.2	-	3.9
Rockfish, Nearshore, Deep	-	-	-	1.2	0.1	-	-	0.1	0.0	-	0.1
Rockfish, Other	1.1	13.8	-	0.6	2.5	0.2	-	2.7	1.4	-	1.8
Slope, Other Groundfish	-	0.0	-	-	0.0	-	-	-	-	-	-
Shelf, Other Groundfish	-	0.1	-	2.1	-	-	-	-	12.0	-	0.4
Nearshore, Other Groundfish	-	-	-	1.8	0.0	-	-	10.7	7.9	-	0.0
Other Groundfish	-	-	-	-	-	-	-	-	-	-	-
Pink Shrimp	316.5	1.3	-	-	-	-	-	-	-	-	-
Prawns	5.2	6,133.6	-	0.8	-	0.7	-	20.6	-	1.5	-
Pacific Halibut	-	-	4.2	-	-	-	-	-	-	-	-
California Halibut	-	4.8	-	1,715.3	3.9	9.1	0.4	0.2	-	-	0.5
Salmon	-	-	-	0.2	2,992.1	-	-	-	-	-	0.0
Sea Cucumber	-	0.6	-	0.0	-	447.7	6.3	0.0	-	0.0	-
Sea Urchins	-	-	-	-	-	3.5	7,885.0	0.4	-	-	-
California Sheephead	-	7.9	-	0.9	-	0.1	4.0	631.0	1.2	-	0.0
Gillnet Complex	-	-	-	-	-	-	-	0.1	1,082.3	-	1.9
Squid	-	4.5	-	-	-	-	-	-	-	1,603.5	13.9
CPS FMP	-	0.3	-	0.0	0.2	-	-	-	0.6	0.3	6,642.3
HMS FMP	-	-	-	0.9	3.6	-	-	0.1	18.5	-	10.4
Dungeness Crab	-	0.6	-	0.7	0.0	-	-	-	0.6	-	-
Other Crustaceans	0.1	10.0	-	0.9	-	0.1	0.0	15.5	5.3	0.0	0.1
All Other Species	0.0	4.8	-	15.4	0.8	0.9	2.2	6.4	31.0	1.5	14.9

TABLE 3.4-10 Exvessel revenue by species and target fishery, 1998, south of Cape Mendocino (thousands of dollars, not adjusted for inflation). [a] (Page 5 of 5)

South of Cape Mendocino	HMS Plan Species	Dungeness Crab	Other Crustaceans	Other Species	No Landing Weight or 2 Equal Weights	Total
Number of Trips	2,783	3,786	9,856	3,114	605	63,298
Total Revenue	24,316.1	7,722.3	7,214.8	3,211.7	235.3	88,009.7
Lingcod	**0.0**	**0.4**	**0.1**	**0.5**	**0.3**	**189.6**
Whiting	-	-	-	**0.0**	-	**2.0**
Sablefish	-	-	0.0	1.0	0.0	1,913.8
Dover, Shelf	-	-	-	-	-	714.2
Dover, Slope	-	-	-	0.1	-	619.2
Petrale, Shelf	-	-	-	0.4	-	236.7
Petrale, Slope	-	-	-	0.6	-	374.1
Arrowtooth, Shelf	-	-	-	-	-	0.0
Arrowtooth, Slope	-	-	-	-	-	0.7
Pacific Sanddab	0.1	-	-	2.0	0.0	421.9
Rex Sole	-	-	-	0.1	0.0	143.7
Flatfish, Slope	-	-	-	-	-	0.0
Flatfish, Shelf	-	-	-	0.5	-	187.1
Flatfish, Nearshore	0.0	0.0	-	0.4	-	74.4
Flatfish, Other	-	-	0.0	1.8	0.5	49.7
Darkblotched Rockfish	-	-	-	-	-	**0.1**
Pacific Ocean Perch	-	-	-	-	-	**0.0**
Thornyheads	-	-	-	0.1	0.1	1,870.9
Rockfish, Slope	0.0	0.0	0.0	0.8	0.4	1,113.0
Bocaccio Rockfish	**0.0**	-	**0.0**	**0.3**	**0.1**	**134.8**
Canary Rockfish	-	**0.1**	-	**0.2**	**0.1**	**137.6**
Chilipepper Rockfish	0.0	-	-	1.1	-	926.5
Cowcod	-	-	-	**0.1**	-	**35.2**
Widow Rockfish	-	-	-	**0.0**	-	**542.0**
Yelloweye Rockfish	-	-	-	-	**0.0**	**34.6**
Yellowtail Rockfish	0.0	0.1	-	0.0	0.0	281.0
Rockfish, Shelf	0.4	0.2	0.1	1.4	0.3	966.0
Rockfish, Nearshore, Shallow	0.8	-	1.6	13.8	0.4	1,096.8
Rockfish, Nearshore, Deep	0.2	-	0.0	1.5	0.6	390.7
Rockfish, Other	0.1	0.0	0.3	4.1	142.5	1,290.4
Slope, Other Groundfish	-	-	-	-	0.0	127.2
Shelf, Other Groundfish	1.4	-	0.3	1.7	0.0	70.1
Nearshore, Other Groundfish	0.7	0.0	2.3	5.1	0.4	1,263.7
Other Groundfish	-	-	-	-	-	0.0
Pink Shrimp	-	-	-	-	-	318.0
Prawns	-	0.0	25.5	6.2	2.8	6,302.8
Pacific Halibut	-	-	-	-	-	10.2
California Halibut	2.0	-	0.6	46.6	1.6	2,011.0
Salmon	3.7	-	-	0.0	2.0	2,998.8
Sea Cucumber	-	-	-	0.9	0.0	456.1
Sea Urchins	-	-	-	1.0	0.1	7,890.0
California Sheephead	0.1	-	13.7	6.8	0.1	691.5
Gillnet Complex	19.2	-	6.2	48.2	0.6	1,185.0
Squid	-	-	-	0.8	0.5	1,623.7
CPS FMP	0.5	-	0.0	3.9	0.7	6,656.8
HMS FMP	24,045.9	-	0.1	89.4	0.5	24,178.1
Dungeness Crab	0.0	7,704.1	45.8	-	-	7,752.6
Other Crustaceans	0.2	15.8	7,101.9	20.5	1.4	7,174.7
All Other Species	240.7	1.6	16.3	2,949.6	79.2	3,552.6

a/ Zero values indicate there was some landing, but less than 50 dollars in exvessel value.

TABLE 3.4-11 Exvessel revenue by species and target fishery, 2002, north of Cape Mendocino (thousands of dollars, not adjusted for inflation).[a/] (Page 1 of 4)

North of Cape Mendocino	Limited Entry Trawl, Whiting	Limited Entry Trawl, Arrowtooth	Entry Trawl, Petrale Sole	Limited Entry Trawl, Flatfish	Limited Entry Trawl, Midwater	Limited Entry Trawl, DTS	Limited Entry Trawl, Slope Rockfish	Limited Entry Trawl, Yellowtail	Limited Entry Trawl, Canary	Entry Trawl, Other Rockfish	Limited Entry Trawl, Lingcod
Number of Trips	632	184	229	1,275	63	1020	19	10	1	1	8
Total Revenue	4,824.8	2,345.7	1,570.7	4,975.0	601.8	7,477.4	108.4	9.3	0.1	2.2	3.9
Lingcod	**0.4**	**21.8**	**11.7**	**82.7**	**0.1**	**32.5**	**0.7**	**0.2**	-	**1.0**	**2.7**
Whiting	**4,524.9**	-	**0.0**	**4.2**	**0.0**	**0.8**	-	-	-	-	-
Sablefish	173.2	215.8	74.5	371.6	0.0	1,954.0	16.6	0.2	-	-	0.0
Dover, Shelf	-	175.9	23.1	625.0	-	626.3	0.1	-	-	-	0.0
Dover, Slope	-	171.5	101.8	637.2	0.0	1,086.1	3.3	0.0	-	-	-
Petrale, Shelf	0.1	444.8	297.6	611.1	-	75.2	0.6	0.1	-	0.1	0.4
Petrale, Slope	-	77.9	808.1	490.7	-	193.8	14.6	0.2	-	-	0.0
Arrowtooth, Shelf	0.1	329.2	1.2	30.8	0.4	9.4	0.0	0.0	-	-	0.0
Arrowtooth, Slope	-	76.8	4.3	24.9	-	18.6	1.1	-	-	-	-
Pacific Sanddab	0.0	4.5	15.0	302.3	-	17.4	1.5	-	-	-	0.2
Rex Sole	0.0	35.2	35.7	227.1	-	156.1	3.9	0.1	-	-	0.1
Flatfish, Slope	-	-	-	-	-	-	-	-	-	-	-
Flatfish, Shelf	-	76.8	51.0	564.5	0.1	71.5	4.1	0.9	-	0.2	0.3
Flatfish, Nearshore	-	7.3	9.8	270.9	-	15.2	0.1	0.0	-	-	-
Flatfish, Other	-	2.1	0.1	3.7	-	2.0	-	-	-	-	-
Darkblotched Rockfish	**0.0**	**5.2**	**9.3**	**14.8**	**0.1**	**31.2**	**1.5**	-	-	-	**0.0**
Pacific Ocean Perch	**0.2**	**44.2**	**7.8**	**28.4**	**0.0**	**58.9**	**3.5**	**0.0**	**0.0**	-	-
Thornyheads	0.0	104.9	45.0	131.5	-	2,975.9	53.2	-	0.0	-	0.0
Rockfish, Slope	0.1	22.1	5.8	22.1	0.3	36.9	1.5	-	0.0	-	0.0
Bocaccio Rockfish	**0.0**	-	-	**0.2**	-	**0.0**	**0.0**	-	-	-	-
Canary Rockfish	**0.4**	**12.9**	**2.3**	**16.0**	**1.2**	**5.3**	**0.3**	**0.3**	**0.1**	**0.2**	-
Chilipepper Rockfish	0.4	-	-	1.3	0.0	1.0	0.0	-	-	0.4	-
Cowcod	-	-	-	-	-	-	-	-	-	-	-
Widow Rockfish	**4.3**	**19.4**	**0.6**	**2.3**	**221.6**	**1.2**	**0.1**	-	-	-	**0.0**
Yelloweye Rockfish	-	**0.0**	**0.0**	**0.2**	-	**0.1**	-	-	-	-	-
Yellowtail Rockfish	25.3	164.5	13.4	126.8	370.9	18.2	0.3	3.5	-	0.4	-
Rockfish, Shelf	0.2	18.0	1.1	8.2	5.4	3.6	0.2	0.0	0.0	-	-
Rockfish, Nearshore, Shallov	-	-	-	-	-	-	-	-	-	-	-
Rockfish, Nearshore, Deep	-	0.2	0.0	1.6	-	0.7	-	-	-	-	0.1
Rockfish, Other	-	-	-	-	-	0.0	-	-	-	-	-
Slope, Other Groundfish	-	0.2	0.5	1.0	-	33.8	0.7	-	-	-	-
Shelf, Other Groundfish	3.5	292.0	15.4	237.8	1.3	13.5	0.1	3.2	-	-	-
Nearshore, Other Groundfish	-	-	-	1.0	-	-	-	-	-	-	-
Other Groundfish	-	-	-	-	-	-	-	-	-	-	-
Pink Shrimp	-	-	-	-	-	-	-	-	-	-	-
Prawns	-	-	-	-	-	-	-	-	-	-	-
Pacific Halibut	0.4	-	-	-	-	-	-	-	-	-	-
California Halibut	-	-	-	0.4	-	-	-	-	-	-	0.0
Salmon	7.6	-	-	-	-	-	-	-	-	-	-
Sea Cucumber	-	-	-	-	-	-	-	-	-	-	-
Sea Urchins	-	-	-	-	-	-	-	-	-	-	-
California Sheephead	-	-	-	-	-	-	-	-	-	-	-
Gillnet Complex	-	-	-	-	-	-	-	-	-	-	-
Squid	0.0	0.0	-	0.0	-	0.0	0.0	-	-	-	-
CPS FMP	1.7	-	-	-	-	-	-	-	-	-	-
HMS FMP	0.1	-	0.0	-	-	-	-	-	-	-	-
Dungeness Crab	0.0	-	-	-	-	-	-	-	-	-	-
Other Crustaceans	-	-	0.0	0.0	-	0.5	-	-	-	-	-
All Other Species	81.6	22.5	35.6	134.8	0.4	37.7	0.5	0.5	-	-	0.0

TABLE 3.4-11 Exvessel revenue by species and target fishery, 2002, north of Cape Mendocino (thousands of dollars, not adjusted for inflation).[a/] (Page 2 of 4)

North of Cape Mendocino	Limited Entry Trawl, Left Over	Open Access Trawl, Other, >50% Groundfish	Limited Entry Fixed Gear Sablefish, Slope	Limited Entry Fixed Gear Sablefish, Shelf	Limited Entry Fixed Gear Sablefish, Nearshore	Limited Entry Fixed Gear Sablefish, No Strata	Limited Entry Fixed Gear Other Groundfish, Slope	Limited Entry Fixed Gear Other Groundfish, Shelf	Limited Entry Fixed Gear Other Groundfish, Nearshore	Open Access, Sablefish, Slope	Open Access, Sablefish, Shelf
Number of Trips	158	135	316	105	4	233	21	52	185	216	128
Total Revenue	491.7	510.0	2,068.3	905.1	8.2	1,032.4	35.2	225.3	174.1	1,100.3	311.7
Lingcod	**4.7**	**7.7**	**1.8**	**4.8**	-	-	**1.0**	**2.4**	**11.9**	**0.2**	**3.2**
Whiting	**6.2**	-	-	-	-	-	-	-	-	-	-
Sablefish	21.4	31.1	1,944.6	835.4	5.6	1,008.5	14.0	42.0	0.5	981.0	292.1
Dover, Shelf	3.3	10.5	0.4	0.4	0.0	0.0	0.0	0.0	-	0.1	0.1
Dover, Slope	2.5	0.7	0.1	0.0	-	-	0.0	0.0	-	0.2	0.0
Petrale, Shelf	28.4	44.4	0.3	0.6	-	0.0	-	0.2	-	0.0	-
Petrale, Slope	13.3	1.9	-	0.0	-	-	-	0.2	-	0.0	-
Arrowtooth, Shelf	0.6	0.7	0.2	0.6	-	-	0.0	0.2	-	0.0	0.1
Arrowtooth, Slope	0.2	-	0.0	0.0	-	-	-	0.0	-	0.0	-
Pacific Sanddab	0.7	5.1	-	-	-	-	-	-	-	-	-
Rex Sole	1.5	2.6	-	-	-	-	-	-	-	-	-
Flatfish, Slope	-	-	-	-	-	-	-	-	-	-	-
Flatfish, Shelf	20.5	28.9	-	-	-	-	-	-	-	-	-
Flatfish, Nearshore	1.4	4.4	-	0.0	-	-	-	-	0.0	-	-
Flatfish, Other	0.1	2.8	-	-	-	-	-	-	-	-	-
Darkblotched Rockfish	**0.1**	**1.5**	**0.2**	**0.0**	-	-	-	-	-	**0.0**	-
Pacific Ocean Perch	**0.5**	**0.2**	**0.2**	**0.0**	-	-	-	-	-	-	-
Thornyheads	2.4	2.2	14.0	1.1	0.1	0.0	2.5	0.4	0.3	3.8	0.8
Rockfish, Slope	0.2	1.2	26.6	1.7	0.0	-	14.7	0.3	0.1	10.9	0.2
Bocaccio Rockfish	-	-	-	-	-	-	-	-	-	-	-
Canary Rockfish	**0.9**	**2.5**	**0.0**	**0.3**	-	-	-	**1.2**	-	**0.0**	**0.2**
Chilipepper Rockfish	-	-	-	-	-	-	-	-	-	-	-
Cowcod	-	-	-	-	-	-	-	-	-	-	-
Widow Rockfish	**0.0**	**13.4**	-	**0.0**	-	-	-	**0.0**	**0.0**	-	**0.0**
Yelloweye Rockfish	-	-	**0.0**	-	-	-	-	-	-	**0.0**	-
Yellowtail Rockfish	10.5	270.7	0.1	0.3	-	-	0.0	0.1	0.1	0.0	0.3
Rockfish, Shelf	0.3	7.1	0.4	1.6	0.0	-	0.2	0.5	3.6	0.1	0.2
Rockfish, Nearshore, Shallov	-	-	-	-	-	-	0.1	0.4	7.1	-	-
Rockfish, Nearshore, Deep	0.0	0.6	-	0.0	2.5	-	2.6	1.3	89.7	-	0.0
Rockfish, Other	-	-	-	-	-	-	-	-	-	-	-
Slope, Other Groundfish	1.1	0.2	0.0	-	-	-	-	-	-	-	-
Shelf, Other Groundfish	365.9	63.6	0.2	2.7	-	-	-	172.6	0.0	0.1	0.7
Nearshore, Other Groundfist	-	-	-	-	0.0	-	-	0.1	56.3	-	-
Other Groundfish	-	-	-	-	-	-	-	-	-	-	-
Pink Shrimp	-	-	-	-	-	-	-	-	-	-	-
Prawns	-	-	-	-	-	-	-	-	-	-	-
Pacific Halibut	-	-	78.4	54.6	-	22.5	0.1	2.4	-	103.7	13.7
California Halibut	-	-	-	-	-	-	-	-	-	-	-
Salmon	-	-	-	-	-	-	-	-	-	-	-
Sea Cucumber	-	-	-	-	-	-	-	-	-	-	-
Sea Urchins	-	-	-	-	-	-	-	-	0.1	-	-
California Sheephead	-	-	-	-	-	-	-	-	-	-	-
Gillnet Complex	-	-	-	-	-	-	-	-	-	-	-
Squid	-	-	-	-	-	-	-	-	-	-	-
CPS FMP	-	-	-	-	-	-	-	-	-	-	-
HMS FMP	-	-	-	0.1	-	-	-	-	-	-	-
Dungeness Crab	-	-	-	-	-	0.1	-	-	2.1	-	-
Other Crustaceans	-	-	-	-	-	0.9	-	0.0	-	-	-
All Other Species	5.0	6.2	0.7	0.7	-	0.5	-	1.1	2.3	0.0	0.1

TABLE 3.4-11 Exvessel revenue by species and target fishery, 2002, north of Cape Mendocino (thousands of dollars, not adjusted for inflation).[a/] (Page 3 of 4)

North of Cape Mendocino	Open Access, Sablefish, Nearshore	Open Access, Sablefish, No Strata	Open Access, Slope	Open Access, Shelf	Open Access, Nearshore	Other Groundfish (plurality, but <50%)	Pink Shrimp	Prawns	Pacific Halibut	California Halibut	Salmon
Number of Trips	7	535	2	381	4,229	336	1,963	1	379	115	8,390
Total Revenue	8.5	650.1	1.2	96.1	1,501.4	791.2	15,093.3	1.4	1,564.5	18.9	7,139.8
Lingcod	**0.4**	-	-	**54.4**	**93.6**	**8.6**	**12.2**	-	**7.0**	**0.0**	**7.8**
Whiting	-	-	-	-	-	-	-	-	-	-	-
Sablefish	5.3	624.0	0.1	4.9	3.7	653.6	33.7	-	131.8	-	1.8
Dover, Shelf	-	0.0	-	0.0	0.0	0.0	8.1	-	0.0	-	-
Dover, Slope	-	-	-	-	-	0.0	0.3	-	0.0	-	-
Petrale, Shelf	-	-	-	0.2	-	-	3.1	-	0.0	-	0.0
Petrale, Slope	-	-	-	0.0	-	-	0.3	-	-	-	-
Arrowtooth, Shelf	-	-	-	-	-	0.0	0.2	-	0.1	-	-
Arrowtooth, Slope	-	-	-	-	-	-	0.0	-	-	-	-
Pacific Sanddab	-	-	-	0.0	0.0	-	0.0	-	-	-	-
Rex Sole	-	-	-	0.0	-	-	1.2	-	-	-	-
Flatfish, Slope	-	-	-	-	-	-	-	-	-	-	-
Flatfish, Shelf	-	-	-	0.4	-	-	0.9	-	-	-	-
Flatfish, Nearshore	-	-	-	-	0.0	-	0.1	-	-	-	-
Flatfish, Other	-	-	-	-	0.0	-	0.0	-	-	-	-
Darkblotched Rockfish	-	-	**0.1**	**0.0**	**0.0**	**0.0**	**0.5**	-	-	-	-
Pacific Ocean Perch	-	-	-	-	**0.0**	-	**0.0**	-	**0.0**	-	-
Thornyheads	-	-	0.6	0.0	0.1	2.0	0.0	-	3.1	-	-
Rockfish, Slope	-	0.0	-	0.3	0.7	6.0	0.2	-	2.8	-	0.7
Bocaccio Rockfish	-	-	-	-	-	-	**0.0**	-	-	-	-
Canary Rockfish	-	-	-	**0.3**	**0.1**	**0.0**	**1.1**	-	**0.1**	-	**0.4**
Chilipepper Rockfish	-	-	-	-	-	-	-	-	-	-	-
Cowcod	-	-	-	-	-	-	-	-	-	-	-
Widow Rockfish	-	-	-	**0.2**	**0.3**	**0.0**	**0.2**	-	-	-	**0.0**
Yelloweye Rockfish	-	-	-	**0.0**	**0.0**	-	**0.0**	-	**0.2**	-	-
Yellowtail Rockfish	-	-	-	1.4	2.8	0.0	24.2	-	0.1	-	6.8
Rockfish, Shelf	0.4	-	-	1.3	12.9	1.0	0.2	-	0.8	-	2.4
Rockfish, Nearshore, Shallov	0.9	-	-	1.9	18.8	-	-	-	-	-	-
Rockfish, Nearshore, Deep	1.5	-	0.0	15.6	755.6	43.6	-	-	0.0	0.0	0.7
Rockfish, Other	-	-	-	-	-	-	-	-	-	-	-
Slope, Other Groundfish	-	-	-	-	0.0	0.1	-	-	-	-	-
Shelf, Other Groundfish	-	-	-	3.2	-	0.0	0.1	-	0.2	-	0.1
Nearshore, Other Groundfisł	-	-	-	7.1	610.4	61.9	-	-	-	0.1	0.0
Other Groundfish	-	-	-	-	-	-	-	-	-	-	-
Pink Shrimp	-	-	-	-	-	-	15,005.5	-	-	-	-
Prawns	-	-	-	-	-	-	-	1.3	-	-	-
Pacific Halibut	-	25.1	0.3	3.8	-	13.0	-	-	1,417.7	-	78.8
California Halibut	-	-	-	-	0.1	-	-	-	-	18.8	0.2
Salmon	-	-	-	1.0	0.1	0.4	-	-	0.6	-	7,037.1
Sea Cucumber	-	-	-	-	-	-	-	-	-	-	-
Sea Urchins	-	-	-	-	-	-	-	-	-	-	-
California Sheephead	-	-	-	-	-	-	-	-	-	-	-
Gillnet Complex	-	-	-	-	-	-	-	-	-	-	-
Squid	-	-	-	-	-	-	-	-	-	-	-
CPS FMP	-	-	-	-	-	-	-	-	-	-	0.0
HMS FMP	-	0.0	-	-	0.0	-	0.0	-	-	-	2.6
Dungeness Crab	-	0.9	-	-	0.2	-	-	-	-	-	-
Other Crustaceans	-	-	-	-	0.8	-	-	-	-	-	-
All Other Species	-	0.0	-	0.0	1.0	0.6	1.2	0.1	0.1	-	0.2

TABLE 3.4-11 Exvessel revenue by species and target fishery, 2002, north of Cape Mendocino (thousands of dollars, not adjusted for inflation)[a/]. (Page 4 of 4)

North of Cape Mendocino	Sea Urchins	Gillnet Complex	Squid	CPS Plan Species	HMS Plan Species	Dungeness Crab	Other Crustaceans	Other Species	No Landing Weight or 2 Equal Weights	Total
Number of Trips	342	1	2	1,139	1,490	13,725	1,636	3,880	8	43,556
Total Revenue	355.7	0.3	1.0	4,877.9	11,991.9	48,706.9	1,675.1	7,786.6	2.7	131,046
Lingcod	-	-	-	-	-	**0.0**	-	**2.6**	**0.5**	379
Whiting	-	-	-	-	-	-	-	**18.1**	-	4,554
Sablefish	-	-	-	-	-	1.3	-	3.3	-	9,446
Dover, Shelf	-	-	-	-	-	-	-	1.1	-	1,475
Dover, Slope	-	-	-	-	-	-	-	2.8	-	2,007
Petrale, Shelf	-	-	-	-	-	-	-	2.9	-	1,510
Petrale, Slope	-	-	-	-	-	0.0	-	23.5	-	1,624
Arrowtooth, Shelf	-	-	-	-	-	-	-	0.0	-	374
Arrowtooth, Slope	-	-	-	-	-	-	-	0.0	-	126
Pacific Sanddab	-	-	-	-	-	-	-	1.9	-	349
Rex Sole	-	-	-	-	-	-	-	1.4	-	465
Flatfish, Slope	-	-	-	-	-	-	-	-	-	0
Flatfish, Shelf	-	-	0.0	-	-	-	-	5.7	-	826
Flatfish, Nearshore	-	-	0.4	-	-	0.0	-	3.2	-	313
Flatfish, Other	-	-	-	-	-	-	-	0.0	-	11
Darkblotched Rockfish	-	-	-	-	-	-	-	**0.2**	-	65
Pacific Ocean Perch	-	-	-	-	-	-	-	**0.0**	-	144
Thornyheads	-	-	-	-	-	-	-	1.5	-	3,345
Rockfish, Slope	-	-	-	-	-	-	-	0.1	-	156
Bocaccio Rockfish	-	-	-	-	-	-	-	-	-	0
Canary Rockfish	-	-	-	-	-	-	-	**0.2**	-	46
Chilipepper Rockfish	-	-	-	-	-	-	-	-	-	3
Cowcod	-	-	-	-	-	-	-	-	-	0
Widow Rockfish	-	-	-	-	-	-	-	**0.1**	-	264
Yelloweye Rockfish	-	-	-	-	-	-	-	-	-	1
Yellowtail Rockfish	-	-	-	-	-	-	-	1.0	-	1,042
Rockfish, Shelf	-	-	-	-	-	0.0	-	0.1	0.0	70
Rockfish, Nearshore, Shallo	-	-	-	-	-	-	-	-	-	29
Rockfish, Nearshore, Deep	-	-	-	-	-	1.0	-	0.1	0.3	918
Rockfish, Other	-	-	-	-	-	-	-	-	-	0
Slope, Other Groundfish	-	-	-	-	-	-	-	-	-	38
Shelf, Other Groundfish	-	-	-	-	-	-	-	7.6	-	1,184
Nearshore, Other Groundfisl	-	-	-	-	0.0	1.3	-	0.4	0.2	739
Other Groundfish	-	-	-	-	-	-	-	-	-	0
Pink Shrimp	-	-	-	-	-	-	-	-	-	15,006
Prawns	-	-	-	-	-	-	-	-	-	1
Pacific Halibut	-	-	-	-	-	-	-	-	-	1,814
California Halibut	-	-	-	-	-	-	-	0.1	-	20
Salmon	-	-	-	0.0	3.2	-	-	-	-	7,050
Sea Cucumber	-	-	-	-	-	-	-	-	-	0
Sea Urchins	355.4	-	-	-	-	0.2	0.0	0.1	-	356
California Sheephead	-	-	-	-	-	-	-	-	-	0
Gillnet Complex	-	0.3	-	-	0.1	-	-	-	-	0
Squid	-	-	0.6	-	-	-	-	-	-	1
CPS FMP	-	-	-	4,856.4	-	-	-	0.2	-	4,858
HMS FMP	-	-	-	-	11,987.8	-	-	0.0	-	11,991
Dungeness Crab	-	-	-	-	-	48,689.0	5.2	7.0	1.0	48,706
Other Crustaceans	-	-	-	-	0.0	9.0	1,667.8	11.8	0.4	1,691
All Other Species	0.3	-	0.0	21.4	0.7	5.1	2.1	7,689.5	0.4	8,053

a/ Zero values indicate there was some landing, but less than 50 dollars in exvessel value.

TABLE 3.4-12 Exvessel revenue by species and target fishery, 2002, south of Cape Mendocino (thousands of dollars, not adjusted for inflation).[a/] (Page 1 of 4)

South of Cape Mendocino	Entry Trawl, Petrale Sole	Limited Entry Trawl, Flatfish	Limited Entry Trawl, Midwater	Limited Entry Trawl, DTS	Entry Trawl, Slope Rockfish	Limited Entry Trawl, Chilipepper	Limited Entry Trawl, Widow	Entry Trawl, Other Rockfish	Limited Entry Trawl, Lingcod	Limited Entry Trawl, Leftover	Open Access Trawl, Prawn, >50% Groundfish
Number of Trips	53	369	2	625	53	54	1	28	6	3	2
Total Revenue	288.0	1,025.6	1.3	4,279.3	250.8	137.7	3.7	194.0	3.7	10.8	1.0
Lingcod	**3.4**	**8.2**	**-**	**10.9**	**0.3**	**3.7**	**-**	**0.3**	**1.8**	**0.4**	**-**
Whiting	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Sablefish	8.1	59.4	0.1	764.6	11.7	5.9	0.6	2.2	0.1	0.0	-
Dover, Shelf	0.0	95.7	-	869.9	0.1	-	-	3.6	-	-	-
Dover, Slope	6.6	97.1	-	470.7	15.7	5.4	-	0.8	-	0.1	-
Petrale, Shelf	1.3	36.6	-	33.6	1.4	2.2	0.1	0.9	-	-	0.4
Petrale, Slope	204.8	116.2	0.1	48.6	25.1	7.4	-	4.8	0.1	0.8	-
Arrowtooth, Shelf	-	0.1	-	0.1	-	-	-	-	-	-	-
Arrowtooth, Slope	-	0.0	-	0.0	-	-	-	-	-	-	-
Pacific Sanddab	1.4	275.6	-	2.1	0.3	0.6	-	-	-	0.1	-
Rex Sole	7.7	26.6	-	65.2	8.6	2.0	-	0.1	-	-	-
Flatfish, Slope	-	-	-	-	-	-	-	-	-	-	-
Flatfish, Shelf	10.3	42.7	-	20.2	5.9	3.1	0.4	0.4	-	0.1	-
Flatfish, Nearshore	3.2	43.4	-	1.3	-	0.4	-	0.1	-	-	-
Flatfish, Other	-	0.1	-	0.3	-	-	-	0.0	-	-	0.0
Darkblotched Rockfish	**0.0**	**0.3**	**-**	**3.2**	**8.1**	**0.2**	**-**	**-**	**-**	**-**	**-**
Pacific Ocean Perch	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Thornyheads	3.2	30.2	-	1,769.8	29.5	5.1	-	6.8	-	1.2	-
Rockfish, Slope	10.0	26.2	0.0	74.2	114.7	11.5	0.6	5.4	0.0	0.0	-
Bocaccio Rockfish	**3.8**	**6.1**	**-**	**7.1**	**0.0**	**2.2**	**-**	**1.8**	**0.3**	**0.1**	**-**
Canary Rockfish	**0.1**	**0.9**	**-**	**1.6**	**0.1**	**0.7**	**0.0**	**0.0**	**-**	**0.0**	**-**
Chilipepper Rockfish	8.4	32.8	0.1	41.5	3.8	82.2	0.2	1.7	0.1	-	-
Cowcod	**-**	**0.0**	**-**	**0.0**	**-**	**0.0**	**-**	**-**	**-**	**-**	**-**
Widow Rockfish	**0.1**	**1.2**	**1.0**	**2.2**	**0.4**	**1.2**	**1.8**	**0.7**	**-**	**0.2**	**-**
Yelloweye Rockfish	**0.0**	**0.0**	**-**	**0.0**	**0.0**	**-**	**-**	**-**	**-**	**-**	**-**
Yellowtail Rockfish	0.0	1.2	-	0.3	-	-	-	-	-	-	-
Rockfish, Shelf	1.1	9.8	-	45.7	20.7	0.5	0.0	153.2	0.1	0.2	-
Rockfish, Nearshore, Shallov	-	0.3	-	0.0	-	-	-	-	-	-	-
Rockfish, Nearshore, Deep	-	1.4	-	0.0	-	0.2	-	-	-	-	-
Rockfish, Other	2.7	1.3	-	0.7	3.5	0.0	-	8.2	-	-	0.1
Slope, Other Groundfish	0.0	0.5	-	18.6	0.6	0.1	-	-	-	0.7	-
Shelf, Other Groundfish	-	0.2	-	0.8	-	0.1	-	-	0.0	6.3	-
Nearshore, Other Groundfish	0.0	0.1	-	0.7	-	-	-	0.6	-	-	-
Other Groundfish	-	-	-	-	-	-	-	-	-	-	-
Pink Shrimp	-	-	-	-	-	-	-	-	-	-	-
Prawns	-	-	-	0.1	-	-	-	-	1.2	-	0.5
Pacific Halibut	-	-	-	-	-	-	-	-	-	-	-
California Halibut	10.8	102.2	-	19.2	-	1.6	-	1.7	-	0.4	-
Salmon	-	-	-	-	-	-	-	-	-	-	-
Sea Cucumber	-	-	-	-	-	-	-	-	-	-	-
Sea Urchins	-	-	-	-	-	-	-	-	-	-	-
California Sheephead	-	-	-	-	-	-	-	-	-	-	-
Gillnet Complex	-	-	-	-	-	-	-	-	-	-	-
Squid	-	0.0	-	0.0	-	-	-	-	-	-	-
CPS FMP	-	-	-	-	-	-	-	-	-	-	-
HMS FMP	-	0.0	-	0.2	-	-	-	-	-	-	-
Dungeness Crab	-	-	-	-	-	-	-	-	-	-	-
Other Crustaceans	-	0.1	-	0.0	-	-	-	-	-	-	-
All Other Species	1.0	9.2	-	5.7	0.3	1.4	0.0	0.4	0.0	0.0	-

TABLE 3.4-12 Exvessel revenue by species and target fishery, 2002, south of Cape Mendocino (thousands of dollars, not adjusted for inflation).[a/] (Page 2 of 4)

South of Cape Mendocino	Access Trawl, Halibut, >50% Groundfish	Open Access Trawl, Other, >50% Groundfish	Entry Fixed Gear Sablefish, Slope	Limited Entry Fixed Gear Sablefish, Shelf	Limited Entry Fixed Gear Sablefish, Nearshore	Limited Entry Fixed Gear Sablefish, No Strata	Limited Entry Fixed Gear Other Groundfish, Slope	Limited Entry Fixed Gear Other Groundfish, Shelf	Limited Entry Fixed Gear Other Groundfish, Nearshore	Open Access, Whiting	Open Access, Sablefish, Slope
Number of Trips	25	29	695	4	4	171	746	32	43	1	281
Total Revenue	7.0	29.4	613.4	3.9	10.0	145.2	740.9	29.0	51.4	0.1	180.3
Lingcod	-	-	**0.0**	**0.1**	-	-	**0.1**	**2.7**	**0.7**	-	**0.1**
Whiting	-	-	**0.3**	-	**0.0**	-	**0.1**	-	-	**0.1**	**0.2**
Sablefish	-	11.5	411.1	2.0	2.6	144.3	152.5	1.8	-	-	150.2
Dover, Shelf	-	1.1	0.1	-	0.0	-	0.0	-	-	-	0.1
Dover, Slope	-	-	0.1	-	-	-	0.1	-	-	-	0.0
Petrale, Shelf	0.2	1.2	-	-	-	-	-	-	-	-	0.1
Petrale, Slope	-	0.4	-	-	-	-	-	-	-	-	0.1
Arrowtooth, Shelf	-	-	-	-	-	-	-	-	-	-	-
Arrowtooth, Slope	-	-	-	-	-	-	-	-	-	-	-
Pacific Sanddab	0.2	-	-	-	0.0	-	-	-	-	-	0.0
Rex Sole	-	0.3	-	-	-	-	-	-	-	-	-
Flatfish, Slope	-	-	-	-	-	-	-	-	-	-	-
Flatfish, Shelf	-	0.0	-	-	-	-	-	-	-	-	-
Flatfish, Nearshore	0.6	0.1	0.0	-	-	-	-	-	-	-	-
Flatfish, Other	0.4	-	0.0	-	0.0	-	0.3	0.1	-	-	-
Darkblotched Rockfish	-	**0.0**	-	-	-	-	-	-	-	-	**0.0**
Pacific Ocean Perch	-	-	-	-	-	-	-	-	-	-	-
Thornyheads	-	10.4	175.1	0.3	0.6	-	499.8	1.8	0.2	0.0	14.8
Rockfish, Slope	-	0.1	19.1	0.2	0.1	-	64.4	0.0	-	0.0	11.8
Bocaccio Rockfish	-	**0.1**	-	-	-	-	**0.1**	**0.5**	-	-	**0.1**
Canary Rockfish	-	-	-	-	-	-	-	-	-	-	-
Chilipepper Rockfish	-	0.1	-	0.2	-	-	0.2	1.2	-	-	0.1
Cowcod	-	-	**0.0**	-	-	-	-	-	-	-	-
Widow Rockfish	-	**0.0**	-	-	-	-	-	**0.0**	-	-	-
Yelloweye Rockfish	-	-	-	-	-	-	-	-	-	-	-
Yellowtail Rockfish	-	-	-	-	0.1	-	-	0.2	-	-	-
Rockfish, Shelf	0.0	0.0	0.1	0.8	0.7	-	2.8	12.3	7.9	-	0.1
Rockfish, Nearshore, Shallov	0.9	0.3	-	-	-	-	0.3	1.4	15.7	-	0.1
Rockfish, Nearshore, Deep	-	3.2	-	-	5.2	-	0.0	2.9	20.4	-	0.0
Rockfish, Other	0.1	0.2	3.0	0.2	0.0	-	0.6	0.5	-	-	0.0
Slope, Other Groundfish	-	0.2	1.7	-	-	-	16.8	-	-	-	1.7
Shelf, Other Groundfish	-	-	-	-	-	-	-	0.2	0.0	-	-
Nearshore, Other Groundfish	-	0.1	-	-	0.5	-	0.5	0.8	6.4	-	-
Other Groundfish	-	-	-	-	-	-	-	-	-	-	-
Pink Shrimp	-	-	-	-	-	-	-	-	-	-	-
Prawns	-	-	-	-	-	-	-	-	-	-	0.2
Pacific Halibut	-	-	-	-	-	0.8	-	-	-	-	-
California Halibut	4.2	-	-	-	-	0.0	0.1	0.1	-	-	-
Salmon	-	-	-	-	-	-	-	-	-	-	-
Sea Cucumber	-	-	-	-	-	-	-	-	-	-	-
Sea Urchins	-	-	-	-	-	-	-	-	-	-	-
California Sheephead	-	-	-	-	-	-	0.2	1.2	-	-	-
Gillnet Complex	-	-	-	-	-	-	-	-	-	-	-
Squid	-	-	-	-	-	-	-	-	-	-	-
CPS FMP	-	-	-	-	-	-	-	-	-	-	-
HMS FMP	-	-	0.7	0.1	-	-	0.7	-	-	-	0.2
Dungeness Crab	-	-	0.3	-	-	-	-	-	-	-	-
Other Crustaceans	0.2	-	0.2	-	-	-	0.0	-	-	-	0.4
All Other Species	0.0	0.0	1.7	-	0.1	0.1	1.3	1.3	0.0	-	0.1

TABLE 3.4-12 Exvessel revenue by species and target fishery, 2002, south of Cape Mendocino (thousands of dollars, not adjusted for inflation). [a/] (Page 3 of 4)

South of Cape Mendocino	Open Access, Sablefish, Shelf	Open Access, Sablefish, Nearshore	Open Access, Sablefish, No Strata	Open Access, Slope	Open Access, Shelf	Open Access, Nearshore	Other Groundfish (plurality, but <50%)	Pink Shrimp	Prawns	California Halibut	Salmon
Number of Trips	7	5	979	269	928	3,838	180	57	2,083	4,326	8,117
Total Revenue	3.6	3.6	503.8	185.8	250.1	1,760.4	170.1	345.2	3,990.0	1,805.2	7,058.3
Lingcod	**0.7**	**-**	**-**	**0.1**	**30.0**	**54.5**	**1.7**	**-**	**0.0**	**2.5**	**1.2**
Whiting	**-**	**-**	**0.0**	**0.0**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Sablefish	2.7	1.8	489.2	56.1	6.4	0.1	53.7	-	4.9	0.1	0.2
Dover, Shelf	-	-	0.0	0.0	-	0.1	3.7	-	-	0.0	-
Dover, Slope	-	-	-	-	-	-	-	-	0.0	0.0	-
Petrale, Shelf	0.0	-	-	-	0.6	0.0	0.1	0.3	1.1	0.6	-
Petrale, Slope	-	-	-	-	0.1	0.0	1.1	0.0	1.9	1.0	-
Arrowtooth, Shelf	-	-	-	-	-	-	-	-	-	0.1	-
Arrowtooth, Slope	-	-	-	-	-	-	-	-	-	0.2	-
Pacific Sanddab	-	-	-	-	38.2	0.1	0.8	-	0.2	0.7	-
Rex Sole	-	-	-	-	-	-	-	-	0.2	0.3	-
Flatfish, Slope	-	-	-	-	-	-	-	-	-	-	-
Flatfish, Shelf	-	-	-	-	-	-	0.8	-	1.0	0.7	-
Flatfish, Nearshore	-	-	-	-	0.0	0.2	4.9	-	-	51.3	0.0
Flatfish, Other	-	-	0.1	-	0.0	0.5	0.4	-	2.8	6.6	0.0
Darkblotched Rockfish	**-**	**-**	**-**	**0.0**	**0.1**	**0.1**	**-**	**-**	**-**	**-**	**-**
Pacific Ocean Perch	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Thornyheads	-	-	0.0	14.9	0.3	0.1	10.8	-	0.0	0.1	-
Rockfish, Slope	-	-	-	100.3	1.8	0.7	28.3	-	0.0	0.1	0.1
Bocaccio Rockfish	**-**	**-**	**-**	**0.0**	**6.7**	**0.0**	**1.5**	**-**	**0.1**	**0.1**	**0.0**
Canary Rockfish	**-**	**-**	**-**	**-**	**0.0**	**0.3**	**0.0**	**-**	**0.1**	**-**	**-**
Chilipepper Rockfish	-	-	-	-	9.5	0.1	0.1	0.0	0.1	0.1	0.0
Cowcod	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Widow Rockfish	**-**	**-**	**-**	**-**	**0.9**	**-**	**-**	**-**	**-**	**0.4**	**-**
Yelloweye Rockfish	**-**	**-**	**-**	**-**	**-**	**0.1**	**-**	**-**	**-**	**-**	**-**
Yellowtail Rockfish	0.1	-	-	-	0.9	0.3	0.0	-	-	0.0	0.2
Rockfish, Shelf	0.1	0.1	-	0.1	65.0	34.7	16.3	-	0.5	0.2	0.0
Rockfish, Nearshore, Shallov	-	0.2	-	-	21.7	812.6	1.5	-	2.0	7.7	0.1
Rockfish, Nearshore, Deep	-	0.3	-	-	10.1	312.7	2.0	-	0.0	0.7	1.1
Rockfish, Other	-	-	0.0	0.1	1.2	1.7	0.4	-	3.5	0.0	0.1
Slope, Other Groundfish	0.0	-	-	12.5	0.0	-	1.4	-	-	-	-
Shelf, Other Groundfish	-	-	-	-	20.7	0.2	1.7	-	0.0	0.6	-
Nearshore, Other Groundfish	-	0.1	-	-	3.1	519.2	1.6	-	0.0	1.0	0.0
Other Groundfish	-	-	-	-	-	-	-	-	-	-	-
Pink Shrimp	-	-	-	-	-	-	-	344.2	1.0	0.2	-
Prawns	-	0.3	1.8	-	-	1.1	-	0.6	3,918.8	1.3	-
Pacific Halibut	-	-	-	-	-	-	-	-	-	-	-
California Halibut	-	-	-	-	2.4	2.1	20.6	-	7.8	1,704.1	3.1
Salmon	-	-	1.4	-	0.1	-	0.1	-	-	0.6	7,048.4
Sea Cucumber	-	-	-	-	-	-	-	-	4.8	0.5	-
Sea Urchins	-	-	-	-	-	-	-	-	-	-	-
California Sheephead	-	0.8	1.1	1.0	3.2	10.9	1.9	-	7.1	0.1	-
Gillnet Complex	-	-	0.2	-	19.5	3.1	6.9	-	-	-	-
Squid	-	-	0.0	-	-	-	-	-	1.2	0.1	-
CPS FMP	-	-	-	-	0.0	0.0	0.0	-	-	-	0.0
HMS FMP	-	-	-	-	4.8	0.0	0.5	-	-	0.5	0.7
Dungeness Crab	-	-	1.7	-	0.0	0.4	2.2	-	0.2	1.2	0.9
Other Crustaceans	-	-	7.9	-	0.2	1.1	0.6	-	15.6	9.1	-
All Other Species	0.0	-	0.2	0.6	2.5	3.2	4.4	-	15.0	12.1	2.0

TABLE 3.4-12 Exvessel revenue by species and target fishery, 2002, south of Cape Mendocino (thousands of dollars, not adjusted for inflation[a]). (Page 4 of 4)

South of Cape Mendocino	Sea Cucumber	Sea Urchins	California Sheephead	Gillnet Complex	Squid	CPS Plan Species	HMS Plan Species	Dungeness Crab	Other Crustaceans	Other Species	No Landing Weight or 2 Equal Weights	Total
Number of Trips	1,177	9,719	387	2,767	2,857	2,969	1,966	3,249	8,526	3,651	143	61,003
Total Revenue	790.5	9,845.8	378.5	1,495.5	17,942.4	7,175.6	8,970.8	7,700.0	6,400.0	3,028.5	701.2	87,196.5
Lingcod	**0.0**	**0.1**	**0.6**	**0.2**	-	**0.1**	**0.3**	-	**0.2**	**0.4**	**0.6**	**114.6**
Whiting	-	-	-	**0.0**	-	-	-	-	-	-	-	**0.8**
Sablefish	-	-	1.3	-	-	-	0.1	0.8	11.0	0.3	0.0	2,289.9
Dover, Shelf	0.0	-	-	0.0	-	-	-	-	-	-	-	878.7
Dover, Slope	-	-	-	-	-	-	-	-	-	-	-	492.9
Petrale, Shelf	-	-	-	-	-	-	-	-	0.1	-	0.1	43.0
Petrale, Slope	-	-	-	0.0	-	-	-	-	-	0.0	0.1	91.5
Arrowtooth, Shelf	-	-	-	-	-	-	-	-	-	-	0.1	0.3
Arrowtooth, Slope	-	-	-	-	-	-	-	-	-	-	0.2	0.4
Pacific Sanddab	-	-	-	0.0	-	0.1	-	0.0	0.0	1.7	0.2	45.4
Rex Sole	0.0	-	-	-	-	-	-	-	-	-	-	76.7
Flatfish, Slope	-	-	-	-	-	-	-	-	-	-	-	0.0
Flatfish, Shelf	-	-	-	0.0	-	-	-	-	-	0.0	-	32.9
Flatfish, Nearshore	-	-	-	0.7	-	-	0.0	0.0	-	0.2	0.2	60.2
Flatfish, Other	0.5	-	-	1.7	-	0.0	0.0	0.0	0.4	0.4	3.7	18.5
Darkblotched Rockfish	-	-	-	-	-	-	-	-	-	-	-	**11.8**
Pacific Ocean Perch	-	-	-	-	-	-	-	-	-	-	-	**0.0**
Thornyheads	-	-	-	-	-	-	0.4	-	0.9	-	-	2,542.8
Rockfish, Slope	-	-	0.0	0.4	-	-	0.4	-	0.2	0.2	0.7	435.6
Bocaccio Rockfish	-	-	**0.0**	**0.0**	-	**0.0**	-	-	**0.0**	**0.0**	**0.0**	**20.8**
Canary Rockfish	-	-	-	-	-	-	-	-	-	-	-	**2.9**
Chilipepper Rockfish	-	-	0.0	-	-	-	-	-	-	-	0.0	141.1
Cowcod	-	-	-	-	-	-	-	-	-	-	-	**0.1**
Widow Rockfish	-	-	-	**0.0**	-	-	-	-	-	-	-	**7.9**
Yelloweye Rockfish	-	-	-	-	-	-	-	-	-	-	-	**0.1**
Yellowtail Rockfish	-	-	-	-	-	-	-	-	0.1	-	0.0	2.3
Rockfish, Shelf	0.0	-	1.5	0.0	0.0	0.0	-	0.0	0.3	2.5	0.5	367.1
Rockfish, Nearshore, Shallow	0.9	2.8	6.2	2.8	0.0	-	0.1	0.1	1.3	2.7	2.4	883.9
Rockfish, Nearshore, Deep	0.1	0.1	0.7	-	0.0	-	0.1	0.1	0.5	0.9	0.3	361.6
Rockfish, Other	0.1	-	1.4	0.3	-	0.1	-	0.0	0.4	0.3	1.7	28.8
Slope, Other Groundfish	-	-	-	-	-	-	-	-	-	-	-	54.1
Shelf, Other Groundfish	-	-	0.1	9.3	-	0.0	2.7	0.1	0.3	0.2	-	43.5
Nearshore, Other Groundfish	0.0	0.1	7.9	7.3	-	0.0	0.2	0.2	0.9	1.4	0.2	552.6
Other Groundfish	-	-	-	-	-	-	-	-	-	-	-	0.0
Pink Shrimp	-	-	-	-	-	-	-	-	-	-	-	345.4
Prawns	4.5	-	1.9	-	-	-	-	-	25.1	1.4	0.2	3,959.3
Pacific Halibut	-	-	-	-	-	-	-	-	-	-	-	0.8
California Halibut	12.4	1.3	0.3	-	-	0.1	1.6	-	14.9	40.2	6.5	1,844.9
Salmon	-	-	-	-	-	-	1.9	-	-	1.0	0.0	7,053.4
Sea Cucumber	765.2	13.8	0.0	-	-	-	-	-	0.1	0.6	0.9	785.9
Sea Urchins	4.9	9,826.4	-	-	-	-	-	-	-	-	2.5	9,833.8
California Sheephead	0.2	1.0	350.2	0.9	0.3	-	-	-	8.5	1.8	0.6	390.9
Gillnet Complex	-	-	-	1,417.0	-	1.0	33.6	0.5	7.9	8.7	0.4	1,499.0
Squid	0.1	-	0.1	-	17,905.6	157.4	0.4	-	-	2.7	-	18,067.6
CPS FMP	-	-	-	0.8	36.5	7,004.5	0.2	-	0.0	3.3	0.4	7,045.7
HMS FMP	-	-	0.1	27.4	-	0.4	8,851.6	-	0.3	23.4	0.1	8,911.7
Dungeness Crab	-	-	-	5.2	-	-	-	7,685.1	21.6	1.4	0.1	7,720.3
Other Crustaceans	0.4	-	3.5	7.6	-	0.8	0.1	10.4	6,284.3	26.3	1.4	6,370.2
All Other Species	1.1	0.1	2.9	13.6	0.0	11.0	77.1	2.6	20.4	2,906.6	676.9	3,765.0

a/ Zero values indicate there was some landing, but less than 50 dollars in exvessel value.

TABLE 3.4-13 Percent of trips in which the overfished species was taken, by target fishery, 1998, north of Cape Mendocino.[a/] (Page 1 of 1)

	Number of Trips	Total Exvessel Revenue ($'000)	Lingcod	Whiting	Darkblotched Rockfish	Pacific Ocean Perch	Bocaccio Rockfish	Canary Rockfish	Cowcod	Widow Rockfish	Yelloweye Rockfish
Limited Entry Trawl, Whiting	1,326	5,400	1.1%	100.0%	0.8%	25.3%	-	12.4%	-	67.3%	-
Limited Entry Trawl, Arrowtooth	257	3,574	71.2%	1.6%	-	88.7%	-	87.9%	-	81.7%	-
Limited Entry Trawl, Petrale Sole	115	631	66.1%	0.9%	-	49.6%	-	28.7%	-	15.7%	-
Limited Entry Trawl, Flatfish	957	4,000	63.8%	3.6%	-	36.1%	2.3%	47.1%	0.2%	26.0%	-
Limited Entry Trawl, Midwater	255	1,462	55.7%	1.2%	-	45.9%	3.1%	65.1%	-	91.4%	-
Limited Entry Trawl, DTS	1,627	10,067	52.3%	0.7%	-	43.0%	5.0%	38.0%	-	35.8%	0.7%
Limited Entry Trawl, Pacific Ocean Perch	14	67	57.1%	-	-	100.0%	-	57.1%	-	71.4%	-
Limited Entry Trawl, Slope Rockfish	212	1,326	70.8%	0.9%	-	64.2%	7.5%	70.8%	-	75.0%	-
Limited Entry Trawl, Yellowtail	93	399	81.7%	-	-	55.9%	2.2%	82.8%	-	59.1%	-
Limited Entry Trawl, Canary	35	159	65.7%	2.9%	-	51.4%	2.9%	100.0%	-	60.0%	-
Limited Entry Trawl, Widow	144	1,583	68.1%	2.8%	-	70.1%	12.5%	83.3%	-	100.0%	1.4%
Limited Entry Trawl, Other Rockfish	165	1,393	73.3%	-	-	62.4%	9.7%	80.6%	-	80.6%	2.4%
Limited Entry Trawl, Lingcod	2	0	100.0%	-	-	-	-	50.0%	-	-	-
Limited Entry Trawl, Left Over	106	330	42.5%	30.2%	-	18.9%	2.8%	39.6%	-	23.6%	-
Open Access Trawl, Other, >50% Groundfish	43	173	48.8%	-	-	32.6%	2.3%	37.2%	-	32.6%	-
Limited Entry Fixed Gear Sablefish, Slope	436	1,567	0.9%	-	-	9.9%	-	1.4%	-	-	-
Limited Entry Fixed Gear Sablefish, Shelf	182	711	13.2%	-	-	15.4%	0.5%	26.4%	-	3.3%	0.5%
Limited Entry Fixed Gear Sablefish, Nearshore	6	3	66.7%	-	-	-	-	50.0%	-	-	-
Limited Entry Fixed Gear Sablefish, No Strata	600	1,488	-	-	-	0.2%	-	0.2%	-	0.2%	-
Limited Entry Fixed Gear, Other Groundfish, Slope	7	6	28.6%	-	-	57.1%	-	42.9%	-	14.3%	-
Limited Entry Fixed Gear, Other Groundfish, Shelf	313	295	67.7%	-	-	51.4%	2.9%	93.6%	-	20.4%	6.4%
Limited Entry Fixed Gear, Other Groundfish, Nearsho	215	120	63.7%	-	-	8.4%	0.5%	72.1%	-	2.8%	9.3%
Open Access, Whiting	1	0	-	100.0%	-	-	-	-	-	-	-
Open Access, Sablefish, Slope	109	1,077	1.8%	-	-	2.8%	-	1.8%	-	-	-
Open Access, Sablefish, Shelf	94	198	17.0%	-	-	3.2%	-	33.0%	-	2.1%	-
Open Access, Sablefish, Nearshore	7	2	-	-	-	-	-	14.3%	-	-	-
Open Access, Sablefish, No Strata	462	318	-	-	-	-	-	-	-	-	-
Open Access, Slope	11	2	36.4%	-	-	54.5%	-	27.3%	-	27.3%	9.1%
Open Access, Shelf	1,265	557	52.3%	-	-	7.9%	2.4%	71.1%	-	24.5%	6.1%
Open Access, Nearshore	2,201	499	35.6%	-	-	0.3%	0.2%	20.9%	-	1.0%	3.7%
Other Groundfish (plurality, but <50%)	179	241	31.3%	0.6%	-	12.3%	3.4%	52.5%	-	20.1%	4.5%
Groundfish/Shrimp Combinations	11	16	36.4%	-	-	18.2%	-	54.5%	-	54.5%	-
Pink Shrimp	1,105	4,961	32.5%	0.1%	-	14.8%	0.2%	40.2%	-	11.4%	-
Prawns	6	10	-	-	-	-	-	-	-	-	-
Pacific Halibut	214	756	13.6%	-	-	1.9%	-	6.5%	-	0.5%	-
California Halibut	3	20	66.7%	-	-	-	-	33.3%	-	-	-
Salmon	4,027	2,763	6.9%	-	-	0.9%	-	8.9%	-	1.6%	-
Sea Urchins	246	154	-	-	-	-	-	-	-	-	-
Gillnet Complex	11	2	-	-	-	-	-	-	-	-	-
Squid	3	2	-	-	-	-	-		-	-	-
CPS Plan Species	22	66	-	-	-	-	-	-	-	-	-
HMS Plan Species	1,533	15,868	0.1%	-	-	0.3%	-	0.2%	-	0.1%	-
Dungenes Crab	15,336	38,527	0.2%	-	-	-	-	0.0%	-	0.0%	-
Other Crustaceans	2,060	1,422	1.5%	-	-	1.3%	-	1.0%	-	0.4%	-
Other Species	1,428	9,262	7.6%	0.7%	-	0.1%	1.1%	3.3%	-	1.8%	-
No Landing Weight or 2 Equal Weights	186	44	2.7%	-	-	-	-	0.5%	-	-	-

a/ Zeros indicate some amount that rounds to zero.

TABLE 3.4-14 Percent of trips in which the overfished species was taken, by target fishery, 1998, south of Cape Mendocino.[a/] (Page 1 of 1)

	Number of Trips	Total Exvessel Revenue ($'000)	Lingcod	Whiting	Darkblotched Rockfish	Pacific Ocean Perch	Bocaccio Rockfish	Canary Rockfish	Cowcod	Widow Rockfish	Yelloweye Rockfish
Limited Entry Trawl, Petrale Sole	41	115	34.1%	-	-	-	22.0%	17.1%	-	9.8%	-
Limited Entry Trawl, Flatfish	386	1,151	40.9%	-	-	-	24.1%	12.2%	-	18.1%	0.3%
Limited Entry Trawl, Midwater	16	88	68.8%	-	-	-	31.3%	31.3%	12.5%	100.0%	6.3%
Limited Entry Trawl, DTS	548	3,416	35.0%	0.2%	-	-	24.8%	13.3%	1.5%	19.3%	1.3%
Limited Entry Trawl, Slope Rockfish	316	1,792	42.4%	0.3%	0.3%	-	30.4%	8.2%	3.5%	28.5%	2.8%
Limited Entry Trawl, Chilipepper	111	748	53.2%	-	-	-	45.9%	13.5%	9.9%	36.0%	6.3%
Limited Entry Trawl, Yellowtail	3	12	100.0%	-	-	-	33.3%	33.3%	-	33.3%	66.7%
Limited Entry Trawl, Canary	5	29	80.0%	-	-	-	80.0%	100.0%	-	100.0%	-
Limited Entry Trawl, Widow	29	266	72.4%	-	-	-	55.2%	51.7%	3.4%	100.0%	13.8%
Limited Entry Trawl, Other Rockfish	141	854	63.1%	-	-	-	49.6%	33.3%	2.8%	54.6%	10.6%
Limited Entry Trawl, Lingcod	1	0	100.0%	-	-	-	-	-	-	-	-
Limited Entry Trawl, Leftover	12	38	58.3%	-	-	-	58.3%	16.7%	-	41.7%	-
Open Access Trawl, Prawn, >50% Groundfish	38	85	28.9%	-	-	-	39.5%	-	2.6%	2.6%	-
Open Access Trawl, Halibut, >50% Groundfish	284	96	1.8%	-	-	-	1.4%	-	-	-	0.4%
Open Access Trawl, Sea Cucumber, >50% Groundfis	2	1	-	-	-	-	-	-	-	-	-
Open Access Trawl, Other, >50% Groundfish	129	28	7.8%	-	-	-	5.4%	-	4.7%	0.8%	-
Limited Entry Fixed Gear, Whiting	7	2	-	100.0%	-	-	-	-	-	-	-
Limited Entry Fixed Gear Sablefish, Slope	690	669	0.7%	0.9%	-	-	0.1%	0.1%	0.1%	0.1%	0.3%
Limited Entry Fixed Gear Sablefish, Shelf	27	24	48.1%	-	-	-	7.4%	11.1%	-	3.7%	18.5%
Limited Entry Fixed Gear Sablefish, Nearshore	8	3	25.0%	-	-	-	-	-	-	-	-
Limited Entry Fixed Gear Sablefish, No Strata	223	98	-	1.8%	-	-	-	-	-	-	-
Limited Entry Fixed Gear, Other Groundfish, Slope	830	649	0.5%	2.5%	-	-	0.4%	0.1%	0.1%	1.0%	-
Limited Entry Fixed Gear, Other Groundfish, Shelf	312	353	46.8%	-	-	-	37.2%	16.7%	9.9%	10.6%	13.8%
Limited Entry Fixed Gear, Other Groundfish, Nearshc	169	161	51.5%	-	-	-	-	20.1%	-	0.6%	5.3%
Open Access, Sablefish, Slope	58	14	-	-	-	-	1.7%	-	-	-	-
Open Access, Sablefish, Shelf	22	10	9.1%	-	-	-	-	4.5%	-	-	9.1%
Open Access, Sablefish, Nearshore	1	1	-	-	-	-	-	-	-	-	-
Open Access, Sablefish, No Strata	522	138	-	-	-	-	-	-	-	-	-
Open Access, Slope	166	86	15.7%	-	-	-	7.2%	7.2%	3.6%	-	-
Open Access, Shelf	2,441	1,655	24.4%	0.3%	-	-	27.3%	10.0%	3.2%	16.1%	4.8%
Open Access, Nearshore	6,201	2,560	23.6%	-	0.0%	-	0.2%	3.0%	0.0%	0.0%	0.3%
Other Groundfish (plurality but <50%)	333	243	17.7%	-	-	-	4.5%	0.9%	2.7%	0.9%	1.2%
Groundfish/Shrimp Combinations	1	0	100.0%	-	-	-	-	100.0%	-	-	-
Pink Shrimp	70	324	4.3%	-	-	-	2.9%	5.7%	-	5.7%	-
Prawns	3,132	6,236	1.4%	0.2%	-	-	1.8%	0.0%	0.6%	-	0.0%
Pacific Halibut	3	4	33.3%	-	-	-	-	-	-	-	-
California Halibut	3,194	1,829	5.0%	-	-	-	0.1%	0.1%	-	0.1%	-
Salmon	7,526	3,005	0.5%	-	-	-	0.2%	0.1%	-	0.0%	0.0%
Sea Cucumber	947	466	-	-	-	-	0.1%	-	-	-	-
Sea Urchins	7,981	7,898	0.0%	-	-	-	-	-	-	-	-
California Sheephead	860	696	1.6%	-	-	-	0.2%	-	0.1%	-	-
Gillnet Complex	2,272	1,167	2.9%	0.0%	-	-	0.5%	-	0.0%	0.0%	-
Squid	328	1,607	-	-	-	-	-	-	-	-	-
CPS Plan Species	2,768	6,694	0.0%	-	-	-	0.1%	0.1%	-	-	-
HMS Plan Species	2,783	24,316	0.0%	-	-	-	0.0%	-	-	-	-
Dungeness Crab	3,786	7,722	0.3%	-	-	-	-	0.0%	-	-	-
Other Crustaceans	9,856	7,215	0.1%	-	-	-	0.0%	-	-	-	-
Other Species	3,114	3,212	1.3%	0.0%	-	-	0.4%	0.1%	0.1%	0.0%	-
No Landing Weight or 2 Equal Weights	605	235	1.8%	-	-	-	0.3%	0.2%	-	-	0.2%

a/ Zeros indicate some amount that rounds to zero.

TABLE 3.4-15 Percent of trips in which the overfished species was taken, by target fishery, 2002, north of Cape Mendocino.[a/] (Page 1 of 1)

	Number of Trips	Exvessel Revenue ($'000)	Lingcod	Whiting	Darkblotched Rockfish	Pacific Ocean Perch	Bocaccio Rockfish	Canary Rockfish	Cowcod	Widow Rockfish	Yelloweye Rockfish
Limited Entry Trawl, Whiting	632	4,825	10.1%	100.0%	0.5%	1.7%	0.2%	14.2%	-	18.8%	-
Limited Entry Trawl, Arrowtooth	184	2,346	55.4%	-	45.1%	69.6%	-	57.1%	-	33.2%	0.5%
Limited Entry Trawl, Petrale Sole	229	1,571	38.4%	0.4%	25.3%	17.0%	-	21.8%	-	2.6%	0.9%
Limited Entry Trawl, Flatfish	1,275	4,975	59.1%	1.2%	12.1%	11.4%	0.9%	34.7%	-	7.2%	1.7%
Limited Entry Trawl, Midwater	63	602	7.9%	1.6%	4.8%	1.6%	-	36.5%	-	96.8%	-
Limited Entry Trawl, DTS	1,020	7,477	19.6%	0.7%	20.6%	18.9%	0.1%	12.3%	-	3.1%	1.3%
Limited Entry Trawl, Slope Rockfish	19	108	31.6%	-	26.3%	42.1%	5.3%	21.1%	-	10.5%	-
Limited Entry Trawl, Yellowtail	10	9	60.0%	-	-	10.0%	-	50.0%	-	-	-
Limited Entry Trawl, Canary	1	0	-	-	100.0%	100.0%	-	100.0%	-	-	-
Limited Entry Trawl, Other Rockfish	1	2	100.0%	-	-	-	-	100.0%	-	-	-
Limited Entry Trawl, Lingcod	8	4	100.0%	-	12.5%	-	-	-	-	12.5%	-
Limited Entry Trawl, Leftover	158	492	48.1%	3.8%	1.3%	2.5%	-	20.9%	-	3.8%	-
Open Access Trawl, Other, >50% Groundfish	135	510	50.4%	-	8.9%	2.2%	-	32.6%	-	29.6%	-
Limited Entry Fixed Gear Sablefish, Slope	316	2,068	13.9%	-	3.5%	2.2%	-	0.3%	-	-	0.6%
Limited Entry Fixed Gear Sablefish, Shelf	105	905	58.1%	-	3.8%	2.9%	-	4.8%	-	1.0%	-
Limited Entry Fixed Gear Sablefish, Nearshore	4	8	-	-	-	-	-	-	-	-	-
Limited Entry Fixed Gear Sablefish, No Strata	233	1,032	-	-	-	-	-	-	-	-	-
Limited Entry Fixed Gear, Other Groundfish, Slope	21	35	19.0%	-	-	-	-	-	-	-	-
Limited Entry Fixed Gear, Other Groundfish, Shelf	52	225	36.5%	-	-	-	-	1.9%	-	1.9%	-
Limited Entry Fixed Gear, Other Groundfish, Nearshc	185	174	53.0%	-	-	-	-	-	-	0.5%	-
Open Access, Sablefish, Slope	216	1,100	6.9%	-	0.9%	-	-	0.5%	-	-	0.5%
Open Access, Sablefish, Shelf	128	312	27.3%	-	-	-	-	3.9%	-	0.8%	-
Open Access, Sablefish, Nearshore	7	9	14.3%	-	-	-	-	-	-	-	-
Open Access, Sablefish, No Strata	535	650	-	-	-	-	-	-	-	-	-
Open Access, Slope	2	1	-	-	50.0%	-	-	-	-	-	-
Open Access, Shelf	381	96	95.5%	-	0.3%	-	-	1.3%	-	0.5%	0.3%
Open Access, Nearshore	4,229	1,501	35.3%	-	0.0%	0.0%	-	0.2%	-	0.2%	0.0%
Other Groundfish (plurality but <50%)	336	791	28.0%	-	0.6%	-	-	1.2%	-	0.3%	-
Pink Shrimp	1,963	15,093	12.3%	-	0.8%	0.2%	0.1%	4.8%	-	1.3%	0.1%
Prawns	1	1	-	-	-	-	-	-	-	-	-
Pacific Halibut	379	1,565	19.3%	-	-	0.3%	-	1.3%	-	-	0.5%
California Halibut	115	19	0.9%	-	-	-	-	-	-	-	-
Salmon	8,390	7,140	3.2%	-	-	-	-	0.2%	-	0.1%	-
Sea Urchins	342	356	-	-	-	-	-	-	-	-	-
Gillnet Complex	1	0	-	-	-	-	-	-	-	-	-
Squid	2	1	-	-	-	-	-	-	-	-	-
CPS Plan Species	1,139	4,878	-	-	-	-	-	-	-	-	-
HMS Plan Species	1,490	11,992	-	-	-	-	-	-	-	-	-
Dungeness Crab	13,725	48,707	0.0%	-	-	-	-	-	-	-	-
Other Crustaceans	1,636	1,675	-	-	-	-	-	-	-	-	-
Other Species	3,880	7,787	0.6%	0.9%	0.1%	0.1%	-	0.3%	-	0.1%	-
No Landing Weight or 2 Equal Weights	8	3	62.5%	-	-	-	-	-	-	-	-

a/ Zeros indicate some amount that rounds to zero.

TABLE 3.4-16 Percent of trips in which the overfished species was taken, by target fishery, 2002, south of Cape Mendocino.[a/] (Page 1 of 1)

	Number of Trips	Total Exvessel Revenue ($'000)	Lingcod	Whiting	Darkblotched Rockfish	Pacific Ocean Perch	Bocaccio Rockfish	Canary Rockfish	Cowcod	Widow Rockfish	Yelloweye Rockfish
Limited Entry Trawl, Petrale Sole	53	288	30.2%	-	1.9%	-	13.2%	11.3%	-	5.7%	1.9%
Limited Entry Trawl, Flatfish	369	1,026	15.7%	-	3.8%	-	19.0%	6.2%	0.8%	9.8%	0.8%
Limited Entry Trawl, Midwater	2	1	-	-	-	-	-	-	-	100.0%	-
Limited Entry Trawl, DTS	625	4,279	11.4%	-	6.4%	-	11.7%	7.7%	0.2%	6.2%	0.2%
Limited Entry Trawl, Slope Rockfish	53	251	3.8%	-	9.4%	-	5.7%	1.9%	-	9.4%	1.9%
Limited Entry Trawl, Chilipepper	54	138	44.4%	-	3.7%	-	35.2%	25.9%	1.9%	33.3%	-
Limited Entry Trawl, Widow	1	4	-	-	-	-	-	100.0%	-	100.0%	-
Limited Entry Trawl, Other Rockfish	28	194	10.7%	3.6%	-	-	17.9%	3.6%	-	14.3%	-
Limited Entry Trawl, Lingcod	6	4	100.0%	-	-	-	33.3%	-	-	-	-
Limited Entry Trawl, Leftover	3	11	33.3%	-	-	-	66.7%	33.3%	-	33.3%	-
Open Access Trawl, Prawn, >50% Groundfish	2	1	-	-	-	-	-	-	-	-	-
Open Access Trawl, Halibut, >50% Groundfish	25	7	-	-	-	-	-	-	-	-	-
Open Access Trawl, Other, >50% Groundfish	29	29	-	-	3.4%	-	10.3%	-	-	3.4%	-
Limited Entry Fixed Gear Sablefish, Slope	695	613	0.4%	0.9%	-	-	-	-	0.1%	-	-
Limited Entry Fixed Gear Sablefish, Shelf	4	4	25.0%	-	-	-	-	-	-	-	-
Limited Entry Fixed Gear Sablefish, Nearshore	4	10	-	25.0%	-	-	-	-	-	-	-
Limited Entry Fixed Gear Sablefish, No Strata	171	145	-	-	-	-	-	-	-	-	-
Limited Entry Fixed Gear, Other Groundfish, Slope	746	741	0.3%	0.7%	-	-	0.3%	-	-	-	-
Limited Entry Fixed Gear, Other Groundfish, Shelf	32	29	34.4%	-	-	-	31.3%	-	-	3.1%	-
Limited Entry Fixed Gear, Other Groundfish, Nearsho	43	51	23.3%	-	-	-	-	-	-	-	-
Open Access, Whiting	1	0	-	100.0%	-	-	-	-	-	-	-
Open Access, Sablefish, Slope	281	180	0.7%	1.4%	0.4%	-	0.4%	-	-	-	-
Open Access, Sablefish, Shelf	7	4	57.1%	-	-	-	-	-	-	-	-
Open Access, Sablefish, Nearshore	5	4	-	-	-	-	-	-	-	-	-
Open Access, Sablefish, No Strata	979	504	-	0.1%	-	-	-	-	-	-	-
Open Access, Slope	269	186	1.1%	1.5%	0.4%	-	0.7%	-	-	-	-
Open Access, Shelf	928	250	32.0%	-	0.5%	-	15.3%	0.3%	-	2.3%	-
Open Access, Nearshore	3,838	1,760	36.7%	-	0.1%	-	0.1%	0.2%	-	-	0.1%
Other Groundfish (plurality, but <50%)	180	170	7.2%	-	-	-	10.6%	0.6%	-	-	-
Pink Shrimp	57	345	-	-	-	-	-	-	-	-	-
Prawns	2,083	3,990	0.1%	-	-	-	0.2%	0.1%	-	-	-
California Halibut	4,326	1,805	1.8%	-	-	-	0.0%	-	-	0.1%	-
Salmon	8,117	7,058	0.6%	-	-	-	0.0%	-	-	-	-
Sea Cucumber	1,177	790	0.1%	-	-	-	-	-	-	-	-
Sea Urchins	9,719	9,846	0.1%	-	-	-	-	-	-	-	-
California Sheephead	387	378	2.8%	-	-	-	0.3%	-	-	-	-
Gillnet Complex	2,767	1,495	0.6%	0.1%	-	-	0.1%	-	-	0.0%	-
Squid	2,857	17,942	-	-	-	-	-	-	-	-	-
CPS Plan Species	2,969	7,176	0.0%	-	-	-	0.0%	-	-	-	-
HMS Plan Species	1,966	8,971	0.5%	-	-	-	-	-	-	-	-
Dungeness Crab	3,249	7,700	-	-	-	-	-	-	-	-	-
Other Crustaceans	8,526	6,400	0.1%	-	-	-	0.0%	-	-	-	-
Other Species	3,651	3,029	0.2%	-	-	-	0.1%	-	-	-	-
No Landing Weight or 2 Equal Weights	143	701	10.5%	-	-	-	2.1%	-	-	-	-

a/ Zeros indicate some amount that rounds to zero.

TABLE 3.4-17 Catch of overfished species (thousands of pounds) landed and taken as bycatch where bycatch estimates are available (bolded rows), 1998, 2002.[a/b/c/] (Page 1 of 6)

Target	Trips	All Species Round Weight (pounds thousands)	Darkblotched Rockfish	Pacific Ocean Perch	Bocaccio	Canary Rockfish	Cowcod	Lingcod	Yelloweye Rockfish	Widow Rockfish	Whiting
1998											
North of Cape Mendocino											
Limited Entry Trawl, Whiting	1,326	198,999	8	74	-	2	-	1	-	812	193,305
Limited Entry Trawl, Arrowtooth	**257**	**12,068**	**2**	**421**	**-**	**447**	**-**	**45**	**-**	**765**	**10**
Limited Entry Trawl, Petrale Sole	**115**	**973**	**16**	**22**	**-**	**2**	**-**	**4**	**-**	**3**	**1**
Limited Entry Trawl, Flatfish	**957**	**9,375**	**159**	**160**	**2**	**18**	**0**	**89**	**-**	**13**	**52**
Limited Entry Trawl, Midwater	**255**	**3,638**	**1**	**2**	**0**	**26**	**-**	**9**	**-**	**2,099**	**2**
Limited Entry Trawl, DTS	**1,627**	**20,193**	**161**	**169**	**6**	**36**	**-**	**86**	**1**	**31**	**39**
Limited Entry Trawl, Pacific Ocean Perch	14	163	-	112	-	3	-	1	-	8	-
Limited Entry Trawl, Slope Rockfish	212	3,032	-	556	5	74	-	25	-	283	4
Limited Entry Trawl, Yellowtail	93	883	-	41	0	80	-	13	-	42	-
Limited Entry Trawl, Canary	35	362	-	15	0	136	-	6	-	54	2
Limited Entry Trawl, Widow	144	3,722	-	170	7	201	-	21	0	1,466	8
Limited Entry Trawl, Other Rockfish	165	3,239	-	243	8	269	-	28	0	469	-
Limited Entry Trawl, Lingcod	2	1	-	-	-	0	-	0	-	-	-
Limited Entry Trawl, Left Over	**106**	**1,241**	**8**	**16**	**0**	**1**	**-**	**4**	**-**	**4**	**194**
Open Access Trawl, Other, >50% Groundfish	43	500	-	20	0	18	-	3	-	184	-
Limited Entry Fixed Gear Sablefish, Slope	436	1,369	-	2	-	0	-	0	-	-	-
Limited Entry Fixed Gear Sablefish, Shelf	182	645	-	1	0	4	-	1	0	0	-
Limited Entry Fixed Gear Sablefish, Nearshore	6	3	-	-	-	0	-	0	-	-	-
Limited Entry Fixed Gear Sablefish, No Strata	600	1,370	-	0	-	0	-	-	-	0	-
Limited Entry Fixed Gear, Other Groundfish, Slope	7	6	-	1	-	0	-	0	-	0	-
Limited Entry Fixed Gear, Other Groundfish, Shelf	313	364	-	6	2	152	-	22	4	10	-
Limited Entry Fixed Gear, Other Groundfish, Nearshc	215	118	-	0	0	6	-	12	1	0	-
Open Access, Whiting	1	0	-	-	-	-	-	-	-	-	0
Open Access, Sablefish, Slope	109	851	-	0	-	0	-	0	-	-	-
Open Access, Sablefish, Shelf	94	152	-	0	-	2	-	1	-	0	-
Open Access, Sablefish, Nearshore	7	2	-	-	-	0	-	-	-	-	-
Open Access, Sablefish, No Strata	462	307	-	-	-	-	-	-	-	-	-
Open Access, Slope	11	4	-	1	-	0	-	0	0	0	-
Open Access, Shelf	1,265	813	-	4	1	267	-	61	3	80	-
Open Access, Nearshore	2,201	568	-	0	0	7	-	31	2	3	-
Other Groundfish (plurality, but <50%)	179	319	-	1	1	53	-	5	0	7	60
Groundfish/Shrimp Combinations	11	34	-	2	-	1	-	1	-	1	-
Pink Shrimp	1,105	9,642	-	13	0	23	-	14	-	10	4
Prawns	6	2	-	-	-	-	-	-	-	-	-
Pacific Halibut	214	491	-	0	-	1	-	3	-	0	-
California Halibut	3	15	-	-	-	0	-	0	-	-	-
Salmon	4,027	2,079	-	0	-	5	-	7	-	1	-
Sea Urchins	246	349	-	-	-	-	-	-	-	-	-
Gillnet Complex	11	6	-	-	-	-	-	-	-	-	-
Squid	3	9	-	-	-	-	-	-	-	-	-
CPS Plan Species	22	274	-	-	-	-	-	-	-	-	-
HMS Plan Species	1,533	25,104	-	0	-	0	-	0	-	0	-
Dungeness Crab	15,336	22,629	-	-	-	0	-	0	-	0	-
Other Crustaceans	2,060	442	-	2	-	2	-	3	-	0	-
Other Species	1,428	4,691	-	0	1	4	-	7	-	6	4
No Landing Weight or 2 Equal Weights	186	65	-	-	-	0	-	0	-	-	-

TABLE 3.4-17. Catch of overfished species (thousands of pounds) landed and taken as bycatch where bycatch estimates are available (bolded rows), 1998, 2002.[a/b/c] (Page 2 of 6)

Target	Trips	All Species Round Weight (pounds thousands)	Darkblotched Rockfish	Pacific Ocean Perch	Bocaccio	Canary Rockfish	Cowcod	Lingcod	Yelloweye Rockfish	Widow Rockfish	Whiting
1998											
South of Cape Mendocino											
Limited Entry Trawl, Petrale Sole	**41**	**148**	**6**	-	**0**	**0**	-	**1**	-	**0**	-
Limited Entry Trawl, Flatfish	**386**	**2,757**	**33**	-	**43**	**1**	-	**10**	**0**	**12**	-
Limited Entry Trawl, Midwater	16	191	-	-	2	2	0	2	0	137	-
Limited Entry Trawl, DTS	**548**	**7,187**	**49**	-	**5**	**0**	**0**	**3**	**0**	**3**	**0**
Limited Entry Trawl, Slope Rockfish	316	4,994	0	-	17	8	1	13	0	139	2
Limited Entry Trawl, Chilipepper	111	1,665	-	-	20	3	1	10	0	96	-
Limited Entry Trawl, Yellowtail	3	24	-	-	1	8	-	0	0	0	-
Limited Entry Trawl, Canary	5	67	-	-	1	22	-	1	-	9	-
Limited Entry Trawl, Widow	29	599	-	-	5	22	0	4	0	251	-
Limited Entry Trawl, Other Rockfish	141	1,885	-	-	17	41	0	13	2	158	-
Limited Entry Trawl, Lingcod	1	0	-	-	-	-	-	0	-	-	-
Limited Entry Trawl, Leftover	**12**	**103**	**1**	-	**0**	**0**	-	**0**	-	**0**	-
Open Access Trawl, Prawn, >50% Groundfish	38	33	-	-	3	-	0	1	-	0	-
Open Access Trawl, Halibut, >50% Groundfish	284	78	-	-	0	-	-	0	0	-	-
Open Access Trawl, Sea Cucumber, >50% Groundfis	2	1	-	-	-	-	-	-	-	-	-
Open Access Trawl, Other, >50% Groundfish	129	37	-	-	0	-	0	0	-	1	-
Limited Entry Fixed Gear, Whiting	7	1	-	-	-	-	-	-	-	-	1
Limited Entry Fixed Gear Sablefish, Slope	690	566	-	-	0	0	0	0	0	0	0
Limited Entry Fixed Gear Sablefish, Shelf	27	23	-	-	0	1	-	1	1	0	-
Limited Entry Fixed Gear Sablefish, Nearshore	8	3	-	-	-	-	-	0	-	-	-
Limited Entry Fixed Gear Sablefish, No Strata	223	106	-	-	-	-	-	-	-	-	0
Limited Entry Fixed Gear, Other Groundfish, Slope	830	736	-	-	0	0	0	0	-	0	1
Limited Entry Fixed Gear, Other Groundfish, Shelf	312	362	-	-	15	15	3	14	8	13	-
Limited Entry Fixed Gear, Other Groundfish, Nearshc	169	72	-	-	-	3	-	3	1	0	-
Open Access, Sablefish, Slope	58	17	-	-	0	-	-	-	-	-	-
Open Access, Sablefish, Shelf	22	17	-	-	-	0	-	0	0	-	-
Open Access, Sablefish, Nearshore	1	1	-	-	-	-	-	-	-	-	-
Open Access, Sablefish, No Strata	522	137	-	-	-	-	-	-	-	-	-
Open Access, Slope	166	149	-	-	5	1	0	1	-	-	-
Open Access, Shelf	2,441	2,392	-	-	125	58	17	55	13	268	0
Open Access, Nearshore	6,201	1,001	0	-	1	9	0	47	0	0	-
Other Groundfish (plurality, but <50%)	333	187	-	-	2	0	1	2	0	4	-
Groundfish/Shrimp Combinations	1	1	-	-	-	0	-	0	-	-	-
Pink Shrimp	70	473	-	-	0	0	-	0	-	2	-
Prawns	3,132	1,335	-	-	5	0	1	1	0	-	0
Pacific Halibut	3	3	-	-	-	-	-	0	-	-	-
California Halibut	3,194	925	-	-	0	0	-	4	-	0	-
Salmon	7,526	2,099	-	-	0	0	-	1	0	0	-
Sea Cucumber	947	776	-	-	0	-	-	-	-	-	-
Sea Urchins	7,981	10,432	-	-	-	-	-	0	-	-	-
California Sheephead	860	254	-	-	0	-	0	1	-	-	-
Gillnet Complex	2,272	772	-	-	1	-	0	1	-	0	0
Squid	328	6,331	-	-	-	-	-	-	-	-	-
CPS Plan Species	2,768	147,290	-	-	0	0	-	0	-	-	-
HMS Plan Species	2,783	40,436	-	-	0	-	-	0	-	-	-
Dungeness Crab	3,786	3,278	-	-	-	0	-	0	-	-	-
Other Crustaceans	9,856	3,209	-	-	0	-	-	0	-	-	-
Other Species	3,114	8,012	-	-	0	0	0	1	-	0	0
No Landing Weight or 2 Equal Weights	605	125	-	-	0	0	-	0	0	-	-

TABLE 3.4-17. Catch of overfished species (thousands of pounds) landed and taken as bycatch where bycatch estimates are available (bolded rows), 1998, 2002.[a/b/c/] (Page 3 of 6)

Target	Trips	All Species Round Weight (pounds thousands)	Darkblotched Rockfish	Pacific Ocean Perch	Bocaccio	Canary Rockfish	Cowcod	Lingcod	Yelloweye Rockfish	Widow Rockfish	Whiting
1998											
Coastwide											
Limited Entry Trawl, Whiting	1,326	198,999	8	74	-	2	-	1	-	812	193,305
Limited Entry Trawl, Arrowtooth	**257**	**12,068**	**2**	**421**	**-**	**447**	**-**	**45**	**-**	**765**	**10**
Limited Entry Trawl, Petrale Sole	**156**	**1,121**	**22**	**22**	**0**	**2**	**-**	**6**	**-**	**3**	**1**
Limited Entry Trawl, Flatfish	**1,343**	**12,132**	**191**	**160**	**44**	**19**	**0**	**99**	**0**	**25**	**52**
Limited Entry Trawl, Midwater	**271**	**3,829**	**1**	**2**	**2**	**28**	**0**	**10**	**0**	**2,236**	**2**
Limited Entry Trawl, DTS	**2,175**	**27,380**	**209**	**169**	**11**	**36**	**0**	**89**	**1**	**34**	**39**
Limited Entry Trawl, Pacific Ocean Perch	14	163	-	112	-	3	-	1	-	8	-
Limited Entry Trawl, Slope Rockfish	528	8,025	0	556	22	82	1	38	0	422	6
Limited Entry Trawl, Chilipepper	111	1,665	-	-	20	3	1	10	0	96	-
Limited Entry Trawl, Yellowtail	96	907	-	41	1	87	-	13	0	42	-
Limited Entry Trawl, Canary	40	428	-	15	1	157	-	7	-	63	2
Limited Entry Trawl, Widow	173	4,321	-	170	12	223	0	24	0	1,717	8
Limited Entry Trawl, Other Rockfish	306	5,124	-	243	26	310	0	41	2	628	-
Limited Entry Trawl, Lingcod	3	1	-	-	-	0	-	0	-	-	-
Limited Entry Trawl, Leftover	**118**	**1,344**	**9**	**16**	**0**	**1**	**-**	**5**	**-**	**5**	**194**
Open Access Trawl, Prawn, >50% Groundfish	38	33	-	-	3	-	0	1	-	0	-
Open Access Trawl, Halibut, >50% Groundfish	284	78	-	-	0	-	-	0	0	-	-
Open Access Trawl, Sea Cucumber, >50% Groundfi:	2	1	-	-	-	-	-	-	-	-	-
Open Access Trawl, Other, >50% Groundfish	172	537	-	20	0	18	0	3	-	185	-
Limited Entry Fixed Gear, Whiting	7	1	-	-	-	-	-	-	-	-	1
Limited Entry Fixed Gear Sablefish, Slope	1,126	1,935	-	2	0	0	0	0	0	0	0
Limited Entry Fixed Gear Sablefish, Shelf	209	668	-	1	0	4	-	2	1	0	-
Limited Entry Fixed Gear Sablefish, Nearshore	14	5	-	-	-	0	-	0	-	-	-
Limited Entry Fixed Gear Sablefish, No Strata	823	1,476	-	0	-	0	-	-	-	0	0
Limited Entry Fixed Gear, Other Groundfish, Slope	837	741	-	1	0	0	0	0	-	1	1
Limited Entry Fixed Gear, Other Groundfish, Shelf	625	726	-	6	16	168	3	36	11	23	-
Limited Entry Fixed Gear, Other Groundfish, Nearshc	384	190	-	0	0	9	-	15	2	0	-
Open Access, Whiting	1	0	-	-	-	-	-	-	-	-	0
Open Access, Sablefish, Slope	167	868	-	0	0	0	-	0	-	-	-
Open Access, Sablefish, Shelf	116	169	-	0	-	2	-	1	0	0	-
Open Access, Sablefish, Nearshore	8	2	-	-	-	0	-	-	-	-	-
Open Access, Sablefish, No Strata	984	443	-	-	-	-	-	-	-	-	-
Open Access, Slope	177	153	-	1	5	1	0	1	0	0	-
Open Access, Shelf	3,706	3,205	-	4	126	325	17	116	17	348	0
Open Access, Nearshore	8,402	1,569	0	0	1	16	0	79	3	3	-
Other Groundfish (plurality, but <50%)	512	505	-	1	3	53	1	7	0	12	60
Groundfish/Shrimp Combinations	12	35	-	2	-	1	-	1	-	1	-
Pink Shrimp	1,175	10,115	-	13	0	23	-	14	-	12	4
Prawns	3,139	1,337	-	-	5	0	1	1	0	-	0
Pacific Halibut	217	494	-	0	-	1	-	3	-	0	-
California Halibut	3,197	939	-	-	0	0	-	4	-	0	-
Salmon	11,553	4,178	-	0	0	5	-	7	0	1	-
Sea Cucumber	947	776	-	-	0	-	-	-	-	-	-
Sea Urchins	8,227	10,781	-	-	-	-	-	0	-	-	-
California Sheephead	860	254	-	-	0	-	0	1	-	-	-
Gillnet Complex	2,283	778	-	-	1	-	0	1	-	0	0
Squid	331	6,340	-	-	-	-	-	-	-	-	-
CPS Plan Species	2,790	147,564	-	-	0	0	-	0	-	-	-
HMS Plan Species	4,316	65,539	-	0	0	0	-	0	-	0	-
Dungeness Crab	19,123	25,908	-	-	-	0	-	1	-	0	-
Other Crustaceans	12,069	3,809	-	2	0	2	-	3	-	0	-
Other Species	5,213	12,755	-	0	2	5	0	7	-	6	4
No Landing Weight or 2 Equal Weights	794	191	-	-	0	0	-	0	0	-	-

TABLE 3.4-17. Catch of overfished species (thousands of pounds) landed and taken as bycatch where bycatch estimates are available (bolded rows), 1998, 2002.[a/b/c/] (Page 4 of 6)

Target	Trips	Round Weight (pounds thousands)	Darkblotched Rockfish	Pacific Ocean Perch	Bocaccio	Canary Rockfish	Cowcod	Lingcod	Yelloweye Rockfish	Widow Rockfish	Whiting
2002											
North of Cape Mendocino											
Limited Entry Trawl, Whiting	632	101,001	0	0	0	1	-	0	-	12	100,220
Limited Entry Trawl, Arrowtooth	**184**	**7,481**	**11**	**88**	**-**	**27**	**-**	**32**	**0**	**42**	**-**
Limited Entry Trawl, Petrale Sole	**229**	**2,481**	**40**	**32**	**-**	**3**	**-**	**15**	**0**	**3**	**1**
Limited Entry Trawl, Flatfish	**1,275**	**11,007**	**182**	**181**	**0**	**32**	**-**	**149**	**0**	**18**	**55**
Limited Entry Trawl, Midwater	**63**	**1,317**	**0**	**-**	**-**	**6**	**-**	**0**	**-**	**493**	**0**
Limited Entry Trawl, DTS	**1,020**	**11,555**	**65**	**83**	**0**	**2**	**-**	**20**	**0**	**16**	**8**
Limited Entry Trawl, Slope Rockfish	19	163	3	7	0	1	-	1	-	0	-
Limited Entry Trawl, Yellowtail	10	20	-	0	-	1	-	0	-	-	-
Limited Entry Trawl, Canary	1	0	0	0	-	0	-	-	-	-	-
Limited Entry Trawl, Other Rockfish	1	4	-	-	-	1	-	1	-	-	-
Limited Entry Trawl, Lingcod	8	5	0	-	-	-	-	2	-	0	-
Limited Entry Trawl, Leftover	**158**	**1,403**	**6**	**8**	**-**	**1**	**-**	**3**	**-**	**3**	**81**
Open Access Trawl, Other, >50% Groundfish	135	1,033	3	0	-	5	-	11	-	28	-
Limited Entry Fixed Gear Sablefish, Slope	316	1,200	0	0	-	0	-	2	0	-	-
Limited Entry Fixed Gear Sablefish, Shelf	105	514	0	0	-	1	-	6	-	0	-
Limited Entry Fixed Gear Sablefish, Nearshore	4	8	-	-	-	-	-	-	-	-	-
Limited Entry Fixed Gear Sablefish, No Strata	233	578	-	-	-	-	-	-	-	-	-
Limited Entry Fixed Gear, Other Groundfish, Slope	21	43	-	-	-	-	-	1	-	-	-
Limited Entry Fixed Gear, Other Groundfish, Shelf	52	924	-	-	-	3	-	2	-	0	-
Limited Entry Fixed Gear, Other Groundfish, Nearshc	185	82	-	-	-	-	-	6	-	0	-
Open Access, Sablefish, Slope	216	699	0	-	-	0	-	0	0	-	-
Open Access, Sablefish, Shelf	128	201	-	-	-	0	-	4	-	0	-
Open Access, Sablefish, Nearshore	7	5	-	-	-	-	-	0	-	-	-
Open Access, Sablefish, No Strata	535	406	-	-	-	-	-	-	-	-	-
Open Access, Slope	2	1	0	-	-	-	-	-	-	-	-
Open Access, Shelf	381	76	0	-	-	1	-	40	0	0	-
Open Access, Nearshore	4,229	752	0	0	-	0	-	56	0	0	-
Other Groundfish (plurality, but <50%)	336	429	0	-	-	0	-	5	-	0	-
Pink Shrimp	1,963	54,995	1	0	0	3	-	14	0	0	-
Prawns	1	1	-	-	-	-	-	-	-	-	-
Pacific Halibut	379	857	-	0	-	0	-	9	0	-	-
California Halibut	115	7	-	-	-	-	-	0	-	-	-
Salmon	8,390	5,862	-	-	-	1	-	9	-	0	-
Sea Urchins	342	823	-	-	-	-	-	-	-	-	-
Gillnet Complex	1	1	-	-	-	-	-	-	-	-	-
Squid	2	5	-	-	-	-	-	-	-	-	-
CPS Plan Species	1,139	87,051	-	-	-	-	-	-	-	-	-
HMS Plan Species	1,490	18,553	-	-	-	-	-	-	-	-	-
Dungeness Crab	13,725	29,660	-	-	-	-	-	0	-	-	-
Other Crustaceans	1,636	389	-	-	-	-	-	-	-	-	-
Other Species	3,880	13,131	0	0	-	0	-	3	-	0	403
No Landing Weight or 2 Equal Weights	8	1	-	-	-	-	-	0	-	-	-

TABLE 3.4-17. Catch of overfished species (thousands of pounds) landed and taken as bycatch where bycatch estimates are available (bolded rows), 1998, 2002.[a/b/c] (Page 5 of 6)

Target	Trips	All Species Round Weight (pounds thousands)	Darkblotched Rockfish	Pacific Ocean Perch	Bocaccio	Canary Rockfish	Cowcod	Lingcod	Yelloweye Rockfish	Widow Rockfish	Whiting
2002											
South of Cape Mendocino											
Limited Entry Trawl, Petrale Sole	**53**	**348**	**17**	**-**	**0**	**-**	**-**	**2**	**0**	**1**	**-**
Limited Entry Trawl, Flatfish	**369**	**1,982**	**27**	**-**	**40**	**1**	**0**	**7**	**0**	**7**	**-**
Limited Entry Trawl, Midwater	2	2	-	-	-	-	-	-	-	2	-
Limited Entry Trawl, DTS	**625**	**7,425**	**58**	**-**	**6**	**0**	**0**	**3**	**0**	**4**	**-**
Limited Entry Trawl, Slope Rockfish	53	501	18	-	0	0	-	0	0	1	-
Limited Entry Trawl, Chilipepper	54	244	0	-	5	2	0	4	-	2	-
Limited Entry Trawl, Widow	1	6	-	-	-	0	-	-	-	3	-
Limited Entry Trawl, Other Rockfish	28	359	-	-	3	0	-	0	-	1	0
Limited Entry Trawl, Lingcod	6	3	-	-	1	-	-	2	-	-	-
Limited Entry Trawl, Leftover	**3**	**40**	**0**	**-**	**0**	**-**	**-**	**0**	**-**	**0**	**-**
Open Access Trawl, Prawn, >50% Groundfish	2	0	-	-	-	-	-	-	-	-	-
Open Access Trawl, Halibut, >50% Groundfish	25	4	-	-	-	-	-	-	-	-	-
Open Access Trawl, Other, >50% Groundfish	29	22	0	-	0	-	-	-	-	0	-
Limited Entry Fixed Gear Sablefish, Slope	695	416	-	-	-	-	0	0	-	-	0
Limited Entry Fixed Gear Sablefish, Shelf	4	3	-	-	-	-	-	0	-	-	-
Limited Entry Fixed Gear Sablefish, Nearshore	4	4	-	-	-	-	-	-	-	-	0
Limited Entry Fixed Gear Sablefish, No Strata	171	115	-	-	-	-	-	-	-	-	-
Limited Entry Fixed Gear, Other Groundfish, Slope	746	450	-	-	0	-	-	0	-	-	0
Limited Entry Fixed Gear, Other Groundfish, Shelf	32	15	-	-	0	-	-	3	-	0	-
Limited Entry Fixed Gear, Other Groundfish, Nearshc	43	17	-	-	-	-	-	0	-	-	-
Open Access, Whiting	1	0	-	-	-	-	-	-	-	-	0
Open Access, Sablefish, Slope	281	146	0	-	0	-	-	0	-	-	0
Open Access, Sablefish, Shelf	7	3	-	-	-	-	-	1	-	-	-
Open Access, Sablefish, Nearshore	5	2	-	-	-	-	-	-	-	-	-
Open Access, Sablefish, No Strata	979	354	-	-	-	-	-	-	-	-	0
Open Access, Slope	269	217	0	-	0	-	-	0	-	-	0
Open Access, Shelf	928	170	0	-	6	0	-	22	-	1	-
Open Access, Nearshore	3,838	413	0	-	0	0	-	34	0	-	-
Other Groundfish (plurality, but <50%)	180	120	-	-	1	0	-	1	-	-	-
Pink Shrimp	57	865	-	-	-	-	-	-	-	-	-
Prawns	2,083	900	-	-	0	0	-	0	-	-	-
California Halibut	4,326	689	-	-	0	-	-	2	-	0	-
Salmon	8,117	5,313	-	-	0	-	-	1	-	-	-
Sea Cucumber	1,177	926	-	-	-	-	-	0	-	-	-
Sea Urchins	9,719	13,476	-	-	-	-	-	0	-	-	-
California Sheephead	387	110	-	-	0	-	-	0	-	-	-
Gillnet Complex	2,767	840	-	-	0	-	-	0	-	0	0
Squid	2,857	158,856	-	-	-	-	-	-	-	-	-
CPS Plan Species	2,969	148,005	-	-	0	-	-	0	-	-	-
HMS Plan Species	1,966	8,965	-	-	-	-	-	0	-	-	-
Dungeness Crab	3,249	3,734	-	-	-	-	-	-	-	-	-
Other Crustaceans	8,526	2,732	-	-	0	-	-	0	-	-	-
Other Species	3,651	7,816	-	-	0	-	-	0	-	-	-
No Landing Weight or 2 Equal Weights	143	12	-	-	0	-	-	0	-	-	-

TABLE 3.4-17. Catch of overfished species (thousands of pounds) landed and taken as bycatch where bycatch estimates are available (bolded rows), 1998, 2002. [a/b/c] (Page 6 of 6)

Target	Trips	All Species Round Weight (pounds thousands)	Darkblotched Rockfish	Pacific Ocean Perch	Bocaccio	Canary Rockfish	Cowcod	Lingcod	Yelloweye Rockfish	Widow Rockfish	Whiting
2002											
Coastwide											
Limited Entry Trawl, Whiting	632	101,001	0	0	0	1	-	0	-	12	100,220
Limited Entry Trawl, Arrowtooth	**184**	**7,481**	**11**	**88**	**-**	**27**	**-**	**32**	**0**	**42**	**-**
Limited Entry Trawl, Petrale Sole	**282**	**2,829**	**58**	**32**	**0**	**3**	**-**	**17**	**0**	**3**	**1**
Limited Entry Trawl, Flatfish	**1,644**	**12,989**	**209**	**181**	**41**	**33**	**0**	**155**	**1**	**25**	**55**
Limited Entry Trawl, Midwater	**65**	**1,319**	**0**	**-**	**-**	**6**	**-**	**0**	**-**	**495**	**0**
Limited Entry Trawl, DTS	**1,645**	**18,980**	**124**	**83**	**6**	**2**	**0**	**23**	**0**	**19**	**8**
Limited Entry Trawl, Slope Rockfish	72	664	21	7	0	1	-	1	0	1	-
Limited Entry Trawl, Chilipepper	54	244	0	-	5	2	0	4	-	2	-
Limited Entry Trawl, Yellowtail	10	20	-	0	-	1	-	0	-	-	-
Limited Entry Trawl, Canary	1	0	0	0	-	0	-	-	-	-	-
Limited Entry Trawl, Widow	1	6	-	-	-	0	-	-	-	3	-
Limited Entry Trawl, Other Rockfish	29	363	-	-	3	1	-	1	-	1	0
Limited Entry Trawl, Lingcod	14	8	0	-	1	-	-	4	-	0	-
Limited Entry Trawl, Leftover	**161**	**1,443**	**6**	**8**	**0**	**1**	**-**	**3**	**-**	**4**	**81**
Open Access Trawl, Prawn, >50% Groundfish	2	0	-	-	-	-	-	-	-	-	-
Open Access Trawl, Halibut, >50% Groundfish	25	4	-	-	-	-	-	-	-	-	-
Open Access Trawl, Other, >50% Groundfish	164	1,055	3	0	0	5	-	11	-	28	-
Limited Entry Fixed Gear Sablefish, Slope	1,011	1,616	0	0	-	0	0	2	0	-	0
Limited Entry Fixed Gear Sablefish, Shelf	109	516	0	0	-	1	-	6	-	0	-
Limited Entry Fixed Gear Sablefish, Nearshore	8	13	-	-	-	-	-	-	-	-	0
Limited Entry Fixed Gear Sablefish, No Strata	404	694	-	-	-	-	-	-	-	-	-
Limited Entry Fixed Gear, Other Groundfish, Slope	767	494	-	-	0	-	-	1	-	-	0
Limited Entry Fixed Gear, Other Groundfish, Shelf	84	939	-	-	0	3	-	5	-	0	-
Limited Entry Fixed Gear, Other Groundfish, Nearsho	228	99	-	-	-	-	-	7	-	0	-
Open Access, Whiting	1	0	-	-	-	-	-	-	-	-	0
Open Access, Sablefish, Slope	497	845	0	-	0	0	-	0	0	-	0
Open Access, Sablefish, Shelf	135	204	-	-	-	0	-	4	-	0	-
Open Access, Sablefish, Nearshore	12	7	-	-	-	-	-	0	-	-	-
Open Access, Sablefish, No Strata	1,514	760	-	-	-	-	-	-	-	-	0
Open Access, Slope	271	218	0	-	0	-	-	0	-	-	0
Open Access, Shelf	1,309	246	0	-	6	1	-	62	0	1	-
Open Access, Nearshore	8,067	1,165	0	0	0	0	-	90	0	0	-
Other Groundfish (plurality, but <50%)	516	549	0	-	1	0	-	6	-	0	-
Pink Shrimp	2,020	55,860	1	0	0	3	-	14	0	0	-
Prawns	2,085	901	-	-	0	0	-	0	-	-	-
Pacific Halibut	379	857	-	0	-	0	-	9	0	-	-
California Halibut	4,441	696	-	-	0	-	-	2	-	0	-
Salmon	16,509	11,175	-	-	0	1	-	10	-	0	-
Sea Cucumber	1,178	926	-	-	-	-	-	0	-	-	-
Sea Urchins	10,062	14,306	-	-	-	-	-	0	-	-	-
California Sheephead	387	110	-	-	0	-	-	0	-	-	-
Gillnet Complex	2,768	841	-	-	0	-	-	0	-	0	0
Squid	2,859	158,861	-	-	-	-	-	-	-	-	-
CPS Plan Species	4,108	235,056	-	-	0	-	-	0	-	-	-
HMS Plan Species	3,456	27,519	-	-	-	-	-	0	-	-	-
Dungeness Crab	16,974	33,394	-	-	-	-	-	0	-	-	-
Other Crustaceans	10,209	3,131	-	-	0	-	-	0	-	-	-
Other Species	7,898	21,000	0	0	0	0	-	3	-	0	403
No Landing Weight or 2 Equal Weights	151	14	-	-	0	-	-	1	-	-	-

a/ Bolded lines are those for which a bycatch rate was used to estimate at least some of the landings for the indicated target fishery.
b/ For a few target species there are trips included in the coastwide totals that were not assigned to north and south areas.
c/ Zero values indicate there was some landing, but less than 500 pounds.

TABLE 3.4-18. Average revenue of target species per pound of overfished species, based on 1998 harvest complex exvessel revenues and bycatch rates used for the 2003 fishery (Hastie, 2003). (Page 1 of 7)

			For All Depth Rates from 2001 Analysis		Based on Logbook Values Adjusted to Council Decisions for Modeling the 2002 Fishery											
							In Depths Shallower Than						In Depths Deeper Than			
Overfished Species	Trawl Target Complex	Per	EDCP (Rate)	EDCP (Rev/ Pounds)	All Depths (Rate)	All Depths (Rev/ Pounds)	50 fm (Rate)	50 fm (Rev/ Pounds)	North: 75 fm; South: 70 fm (Rate)	North: 75 fm; South: 70 fm (Rev/ Pounds)	100 fm (Rate)	100 fm (Rev/ Pounds)	150 fm (Rate)	150 fm (Rev/ Pounds)	250 fm (Rate)	250 fm (Rev/ Pounds)
North																
Lingcod	DTS	1	0.010%	5,244	0.030%	1,748	0.000%	0	0.000%	0	0.000%	0	0.030%	1,748	0.000%	0
		2	0.041%	1,436	0.275%	214	0.000%	0	0.300%	196	0.000%	0	0.272%	217	0.000%	0
		3	0.365%	166	0.651%	93	0.000%	0	1.594%	38	1.335%	45	0.334%	182	0.000%	0
		4	0.942%	59	0.818%	68	0.000%	0	3.783%	15	4.651%	12	0.206%	270	0.000%	0
		5	1.234%	45	1.175%	47	0.000%	0	4.609%	12	4.900%	11	0.778%	72	0.000%	0
		6	0.011%	4,886	0.055%	977	0.000%	0	0.000%	0	0.000%	0	0.052%	1,034	0.000%	0
	Flatfish	1	0.609%	73	0.214%	207	1.395%	32	1.303%	34	1.184%	37	0.160%	276	0.000%	0
		2	2.926%	14	1.493%	28	2.440%	17	2.752%	15	4.830%	9	0.649%	63	0.000%	0
		3	2.167%	20	1.558%	28	0.345%	125	0.953%	45	1.594%	27	0.635%	68	0.000%	0
		4	2.240%	18	2.123%	19	0.767%	53	1.383%	30	2.016%	20	0.765%	53	0.000%	0
		5	4.546%	9	2.370%	18	0.619%	67	1.905%	22	2.370%	18	1.014%	41	0.000%	0
		6	1.796%	25	1.080%	41	2.802%	16	3.653%	12	2.778%	16	0.715%	62	0.000%	0
	Arrowtooth	1			0.030%	343	0.000%	0					0.005%	2,058	0.000%	0
		2	0.000%	0	0.200%	54	0.000%	0					0.115%	94	0.000%	0
		6			0.030%	328	0.000%	0					0.005%	1,970	0.000%	0
	Petrale	1	0.597%	153	0.612%	149	0.000%	0					0.551%	166	0.000%	0
		2	0.000%	0	1.752%	50	0.000%	0					1.250%	71	0.000%	0
		6	0.617%	149	0.759%	121	0.000%	0					0.532%	173	0.000%	0
	Midwater	1	0.105%	375	0.072%	547	0.000%	0							0.000%	0
		2	0.000%	0	0.000%	0	0.000%	0							0.000%	0
		3			0.000%	0	0.000%	0							0.000%	0
		4	0.000%	0	0.681%	55	0.000%	0							0.000%	0
		5	0.000%	0	0.712%	51	0.000%	0							0.000%	0
		6	0.000%	0	0.000%	0	0.000%	0							0.000%	0
	Leftover	1	3.120%	19	1.650%	35	0.330%	175	1.238%	47	1.650%	35	0.330%	175	0.000%	0
		2	0.713%	72	0.500%	103	0.100%	513	0.375%	137	0.500%	103	0.100%	513	0.000%	0
		3	0.554%	79	0.850%	51	0.170%	257	0.638%	69	0.850%	51	0.170%	257	0.000%	0
		4	23.940%	3	2.900%	21	0.580%	105	2.175%	28	2.900%	21	0.580%	105	0.000%	0
		5	7.345%	8	3.150%	18	0.630%	92	2.363%	24	3.150%	18	0.630%	92	0.000%	0
		6	2.344%	20	1.950%	24	0.390%	121	1.463%	32	1.950%	24	0.390%	121	0.000%	0
Canary RF	DTS	1	0.000%	0	0.010%	5,244	0.000%	0	0.101%	519	0.101%	519	0.000%	0	0.000%	0
		2	0.000%	0	0.010%	5,889	0.000%	0	0.200%	294	0.035%	1,683	0.000%	0	0.000%	0
		3	0.000%	0	0.010%	6,067	0.000%	0	0.119%	510	0.208%	292	0.000%	0	0.000%	0
		4	1.062%	52	0.300%	186	0.000%	0	1.362%	41	1.403%	40	0.000%	0	0.000%	0
		5	0.844%	66	0.797%	70	0.000%	0	10.359%	5	6.348%	9	0.000%	0	0.000%	0
		6	0.000%	0	0.010%	5,375	0.000%	0	0.000%	0	0.000%	0	0.000%	0	0.000%	0

TABLE 3.4-18. Average revenue of target species per pound of overfished species, based on 1998 harvest complex exvessel revenues and bycatch rates used for the 2003 fishery (Hastie, 2003). (Page 2 of 7)

			For All Depth Rates from 2001 Analysis		Based on Logbook Values Adjusted to Council Decisions for Modeling the 2002 Fishery											
							In Depths Shallower Than						In Depths Deeper Than			
Overfished Species	Trawl Target Complex	Per	EDCP (Rate)	EDCP (Rev/ Pounds)	All Depths (Rate)	All Depths (Rev/ Pounds)	50 fm (Rate)	50 fm (Rev/ Pounds)	North: 75 fm; South: 70 fm (Rate)	North: 75 fm; South: 70 fm (Rev/ Pounds)	100 fm (Rate)	100 fm (Rev/ Pounds)	150 fm (Rate)	150 fm (Rev/ Pounds)	250 fm (Rate)	250 fm (Rev/ Pounds)
	Flatfish	1	0.317%	140	0.048%	921	0.191%	232	0.098%	451	0.230%	192	0.000%	0	0.000%	0
		2	0.000%	0	0.120%	342	0.386%	106	0.335%	123	0.469%	88	0.000%	0	0.000%	0
		3	0.181%	237	0.236%	182	0.030%	1,432	0.257%	167	0.437%	98	0.000%	0	0.000%	0
		4	1.368%	30	0.895%	46	0.091%	448	0.436%	94	1.260%	32	0.000%	0	0.000%	0
		5	1.078%	39	0.367%	114	0.405%	103	0.431%	97	0.488%	86	0.000%	0	0.000%	0
		6	0.026%	1,698	0.050%	883	0.046%	960	0.264%	167	0.214%	206	0.000%	0	0.000%	0
		1			0.010%	1,029	0.000%	0					0.000%	0	0.000%	0
		2	0.000%	0	0.010%	1,083	0.000%	0					0.000%	0	0.000%	0
		6			0.010%	985	0.000%	0					0.000%	0	0.000%	0
	Petrale	1	0.000%	0	0.012%	7,604	0.000%	0					0.000%	0	0.000%	0
		2	0.000%	0	0.452%	195	0.000%	0					0.000%	0	0.000%	0
		6	0.000%	0	0.012%	7,673	0.000%	0					0.000%	0	0.000%	0
	Midwater	1	0.096%	410	0.013%	3,029	0.000%	0	0.200%	197	0.013%	3,029			0.000%	0
		2	0.000%	0	0.058%	670	0.000%	0	0.212%	183	0.058%	670			0.000%	0
		3			2.758%	14	0.000%	0	2.373%	17	2.758%	14			0.000%	0
		4	1.849%	20	0.971%	38	0.000%	0	2.373%	16	0.971%	38			0.000%	0
		5	0.000%	0	0.775%	46	0.000%	0	0.200%	180	0.775%	46			0.000%	0
		6	0.000%	0	0.011%	3,441	0.000%	0	0.200%	189	0.011%	3,441			0.000%	0
	Leftover	1	0.000%	0	0.010%	5,785	0.004%	14,463	0.009%	6,428	0.010%	5,785	0.000%	0	0.000%	0
		2	0.721%	71	0.100%	513	0.040%	1,283	0.090%	570	0.100%	513	0.000%	0	0.000%	0
		3	0.000%	0	0.500%	87	0.200%	219	0.450%	97	0.500%	87	0.000%	0	0.000%	0
		4	20.942%	3	1.000%	61	0.400%	152	0.900%	68	1.000%	61	0.000%	0	0.000%	0
		5	0.176%	328	0.150%	385	0.060%	962	0.135%	428	0.150%	385	0.000%	0	0.000%	0
		6	8.842%	5	0.100%	473	0.040%	1,183	0.090%	526	0.100%	473	0.000%	0	0.000%	0
POP	DTS	1	0.061%	860	0.522%	100	0.000%	0	0.000%	0	0.631%	83	0.521%	101	0.395%	133
		2	0.581%	101	1.243%	47	0.000%	0	0.000%	0	3.285%	18	1.202%	49	0.472%	125
		3	1.405%	43	1.985%	31	0.000%	0	0.000%	0	2.743%	22	1.705%	36	0.482%	126
		4	2.435%	23	1.562%	36	0.000%	0	0.000%	0	1.926%	29	1.078%	52	0.497%	112
		5	0.358%	156	0.646%	86	0.000%	0	0.000%	0	0.764%	73	0.385%	145	0.141%	396
		6	0.606%	89	1.014%	53	0.000%	0	0.000%	0	0.000%	0	0.992%	54	0.329%	163
	Flatfish	1	0.459%	96	1.315%	34	0.000%	0	0.000%	0	0.306%	145	1.330%	33	0.000%	0
		2	4.161%	10	3.003%	14	0.000%	0	0.000%	0	2.706%	15	2.391%	17	0.000%	0
		3	6.587%	7	4.464%	10	0.000%	0	0.000%	0	2.262%	19	6.824%	6	0.000%	0
		4	3.723%	11	1.865%	22	0.000%	0	0.000%	0	0.627%	65	2.570%	16	0.000%	0
		5	4.715%	9	2.929%	14	0.000%	0	0.000%	0	0.529%	79	4.211%	10	0.000%	0
		6	1.327%	33	1.319%	33	0.000%	0	0.000%	0	0.481%	92	1.325%	33	0.000%	0
	Arrowtooth	1			2.369%	4	0.000%	0					2.369%	4	0.000%	0
		2	14.500%	1	3.160%	3	0.000%	0					1.129%	10	0.000%	0
		6			2.276%	4	0.000%	0					2.276%	4	0.000%	0
		1	0.636%	143	2.337%	39	0.000%	0					2.415%	38	0.000%	0
		2	0.000%	0	5.555%	16	0.000%	0					6.122%	14	0.000%	0
		6	4.632%	20	6.903%	13	0.000%	0					7.232%	13	0.000%	0

TABLE 3.4-18. Average revenue of target species per pound of overfished species, based on 1998 harvest complex exvessel revenues and bycatch rates used for the 2003 fishery (Hastie, 2003). (Page 3 of 7)

			For All Depth Rates from 2001 Analysis		Based on Logbook Values Adjusted to Council Decisions for Modeling the 2002 Fishery											
							In Depths Shallower Than						In Depths Deeper Than			
Overfished Species	Trawl Target Complex	Per	EDCP (Rate)	EDCP (Rev/ Pounds)	All Depths (Rate)	All Depths (Rev/ Pounds)	50 fm (Rate)	50 fm (Rev/ Pounds)	North: 75 fm; South: 70 fm (Rate)	North: 75 fm; South: 70 fm (Rev/ Pounds)	100 fm (Rate)	100 fm (Rev/ Pounds)	150 fm (Rate)	150 fm (Rev/ Pounds)	250 fm (Rate)	250 fm (Rev/ Pounds)
	Midwater	1	0.000%	0	0.000%	0	0.000%	0							0.000%	0
		2	0.000%	0	0.009%	4,316	0.000%	0							0.000%	0
		3			0.000%	0	0.000%	0							0.000%	0
		4	0.000%	0	0.000%	0	0.000%	0							0.000%	0
		5	0.000%	0	0.241%	149	0.000%	0							0.000%	0
		6	0.000%	0	0.001%	37,852	0.000%	0							0.000%	0
	Leftover	1	66.274%	1	11.500%	5	0.000%	0	0.000%	0	1.150%	50	6.900%	8	0.000%	0
		2	0.565%	91	2.750%	19	0.000%	0	0.000%	0	0.275%	187	1.650%	31	0.000%	0
		3	5.885%	7	5.000%	9	0.000%	0	0.000%	0	0.500%	87	3.000%	15	0.000%	0
		4	21.309%	3	10.750%	6	0.000%	0	0.000%	0	1.075%	57	6.450%	9	0.000%	0
		5	3.893%	15	4.250%	14	0.000%	0	0.000%	0	0.425%	136	2.550%	23	0.000%	0
		6	1.291%	37	5.650%	8	0.000%	0	0.000%	0	0.565%	84	3.390%	14	0.000%	0
Darkblotched	DTS	1	1.682%	31	0.656%	80	0.000%	0	0.000%	0	0.000%	0	1.127%	47	0.000%	0
		2	0.506%	116	0.564%	104	0.000%	0	0.000%	0	0.000%	0	1.047%	56	0.000%	0
		3	1.602%	38	2.374%	26	0.000%	0	0.000%	0	0.000%	0	1.930%	31	0.000%	0
		4	2.144%	26	1.570%	35	0.000%	0	0.000%	0	0.000%	0	1.139%	49	0.000%	0
		5	2.303%	24	0.825%	68	0.000%	0	0.000%	0	0.000%	0	1.325%	42	0.000%	0
		6	5.850%	9	0.408%	132	0.000%	0	0.000%	0	0.000%	0	2.483%	22	0.000%	0
	Flatfish	1	1.206%	37	1.804%	25	0.000%	0	0.000%	0	0.500%	88	1.764%	25	0.000%	0
		2	1.018%	40	1.983%	21	0.000%	0	0.000%	0	0.500%	82	1.909%	22	0.000%	0
		3	1.370%	31	3.170%	14	0.000%	0	0.000%	0	0.500%	86	3.006%	14	0.000%	0
		4	0.849%	48	3.701%	11	0.000%	0	0.000%	0	0.500%	82	3.258%	13	0.000%	0
		5	2.471%	17	3.264%	13	0.000%	0	0.000%	0	0.500%	84	2.149%	19	0.000%	0
		6	1.902%	23	1.141%	39	0.000%	0	0.000%	0	0.500%	88	0.973%	45	0.000%	0
	Arrowtooth	1			0.180%	57	0.000%	0					0.180%	57	0.000%	0
		2	0.000%	0	0.537%	20	0.000%	0					0.533%	20	0.000%	0
		6			0.500%	20	0.000%	0					0.500%	20	0.000%	0
	Petrale	1	3.662%	25	3.940%	23	0.000%	0					4.020%	23	0.000%	0
		2	0.000%	0	5.456%	16	0.000%	0					5.164%	17	0.000%	0
		6	1.971%	47	3.037%	30	0.000%	0					3.072%	30	0.000%	0
	Midwater	1	0.001%	39,375	0.030%	1,313	0.000%	0							0.000%	0
		2	0.000%	0	0.030%	1,295	0.000%	0							0.000%	0
		3			0.030%	1,311	0.000%	0							0.000%	0
		4	0.000%	0	0.030%	1,240	0.000%	0							0.000%	0
		5	0.000%	0	0.030%	1,200	0.000%	0							0.000%	0
		6	0.000%	0	0.030%	1,262	0.000%	0							0.000%	0
	Leftover	1	2.713%	21	5.250%	11	0.000%	0	0.525%	110	1.050%	55	3.150%	18	0.000%	0
		2	0.000%	0	3.500%	15	0.000%	0	0.350%	147	0.700%	73	2.100%	24	0.000%	0
		3	0.000%	0	3.500%	12	0.000%	0	0.350%	125	0.700%	62	2.100%	21	0.000%	0
		4	4.879%	12	3.000%	20	0.000%	0	0.300%	203	0.600%	102	1.800%	34	0.000%	0
		5	0.346%	167	2.250%	26	0.000%	0	0.225%	257	0.450%	128	1.350%	43	0.000%	0
		6	4.919%	10	4.250%	11	0.000%	0	0.425%	111	0.850%	56	2.550%	19	0.000%	0

TABLE 3.4-18. Average revenue of target species per pound of overfished species, based on 1998 harvest complex exvessel revenues and bycatch rates used for the 2003 fishery (Hastie, 2003). (Page 4 of 7)

			For All Depth Rates from 2001 Analysis		Based on Logbook Values Adjusted to Council Decisions for Modeling the 2002 Fishery											
							In Depths Shallower Than						In Depths Deeper Than			
Overfished Species	Trawl Target Complex	Per	EDCP (Rate)	EDCP (Rev/ Pounds)	All Depths (Rate)	All Depths (Rev/ Pounds)	50 fm (Rate)	50 fm (Rev/ Pounds)	North: 75 fm; South: 70 fm (Rate)	North: 75 fm; South: 70 fm (Rev/ Pounds)	100 fm (Rate)	100 fm (Rev/ Pounds)	150 fm (Rate)	150 fm (Rev/ Pounds)	250 fm (Rate)	250 fm (Rev/ Pounds)
Widow RF	DTS	1	0.000%	0	0.401%	131	0.000%	0	15.467%	3	15.467%	3	0.311%	169	0.000%	0
		2	0.000%	0	0.152%	387	0.000%	0	0.200%	294	0.051%	1,155	0.152%	387	0.000%	0
		3	0.000%	0	0.198%	306	0.000%	0	0.000%	0	0.144%	421	0.158%	384	0.000%	0
		4	0.427%	130	0.303%	184	0.000%	0	0.576%	97	0.610%	91	0.132%	422	0.000%	0
		5	0.152%	367	0.259%	215	0.000%	0	3.484%	16	1.934%	29	0.149%	375	0.000%	0
		6	0.000%	0	0.051%	1,054	0.000%	0	0.000%	0	6.710%	8	0.041%	1,311	0.000%	0
	Flatfish	1	0.038%	1,164	0.220%	201	0.013%	3,402	0.000%	0	1.358%	33	0.185%	239	0.000%	0
		2	0.000%	0	0.146%	281	0.000%	0	0.015%	2,739	0.602%	68	0.095%	432	0.000%	0
		3	0.000%	0	0.200%	215	0.016%	2,685	0.210%	205	0.244%	176	0.137%	314	0.000%	0
		4	0.844%	48	0.471%	87	0.011%	3,710	0.126%	324	0.443%	92	0.174%	235	0.000%	0
		5	0.002%	20,891	0.108%	387	0.025%	1,671	0.013%	3,214	0.031%	1,348	0.059%	708	0.000%	0
		6	0.000%	0	0.098%	451	0.011%	4,014	0.001%	44,155	0.112%	394	0.003%	14,718	0.000%	0
	Arrowtooth	1			0.050%	206	0.000%	0					0.050%	206	0.000%	0
		2	0.000%	0	0.085%	127	0.000%	0					0.026%	417	0.000%	0
		6			0.030%	328	0.000%	0					0.030%	328	0.000%	0
	Petrale	1	0.000%	0	0.160%	570	0.000%	0					0.167%	546	0.000%	0
		2	0.000%	0	0.162%	545	0.000%	0					0.039%	2,263	0.000%	0
		6	0.000%	0	0.147%	626	0.000%	0					0.028%	3,289	0.000%	0
	Leftover	1	18.442%	3	10.000%	6	0.500%	116	4.000%	14	5.000%	12	1.000%	58	0.000%	0
		2	0.000%	0	0.700%	73	0.035%	1,466	0.280%	183	0.350%	147	0.070%	733	0.000%	0
		3	0.000%	0	1.000%	44	0.050%	875	0.400%	109	0.500%	87	0.100%	437	0.000%	0
		4	0.022%	2,769	1.600%	38	0.080%	761	0.640%	95	0.800%	76	0.160%	381	0.000%	0
		5	0.000%	0	1.400%	41	0.070%	825	0.560%	103	0.700%	82	0.140%	412	0.000%	0
		6	1.112%	43	0.800%	59	0.040%	1,183	0.320%	148	0.400%	118	0.080%	592	0.000%	0
South																
Bocaccio	Petrale	1				0	0.000%	0					0.080%	1,158	0.000%	0
		2				0	0.000%	0					1.000%	113	0.000%	0
		6				0	0.000%	0					0.000%	0	0.000%	0
	Flatfish	1			2.840%	16	0.000%	0	3.879%	12			0.504%	90	0.000%	0
		2			2.320%	18	1.548%	27	2.113%	20			0.105%	394	0.000%	0
		3			2.279%	18	0.373%	109	0.595%	68			1.724%	24	0.000%	0
		4			2.163%	17	0.000%	0	0.459%	80			0.021%	1,753	0.000%	0
		5			2.032%	17	0.000%	0	0.596%	59			0.503%	70	0.000%	0
		6			2.648%	16	0.000%	0	5.236%	8			0.204%	209	0.000%	0
	DTS	1			0.017%	2,874	0.000%	0					0.007%	6,980	0.000%	0
		2			0.066%	833	0.000%	0					0.026%	2,113	0.000%	0
		3			0.146%	382	0.000%	0					0.049%	1,138	0.000%	0
		4			0.067%	781	0.000%	0					0.002%	26,152	0.000%	0
		5			0.195%	264	0.000%	0					0.070%	735	0.000%	0
		6			0.007%	6,987	0.000%	0					0.003%	16,304	0.000%	0

TABLE 3.4-18. Average revenue of target species per pound of overfished species, based on 1998 harvest complex exvessel revenues and bycatch rates used for the 2003 fishery (Hastie, 2003). (Page 5 of 7)

			For All Depth Rates from 2001 Analysis		Based on Logbook Values Adjusted to Council Decisions for Modeling the 2002 Fishery											
							In Depths Shallower Than						In Depths Deeper Than			
Overfished Species	Trawl Target Complex	Per	EDCP (Rate)	EDCP (Rev/ Pounds)	All Depths (Rate)	All Depths (Rev/ Pounds)	50 fm (Rate)	50 fm (Rev/ Pounds)	North: 75 fm; South: 70 fm (Rate)	North: 75 fm; South: 70 fm (Rev/ Pounds)	100 fm (Rate)	100 fm (Rev/ Pounds)	150 fm (Rate)	150 fm (Rev/ Pounds)	250 fm (Rate)	250 fm (Rev/ Pounds)
	Leftover	1			1.400%		0.070%		0.280%				0.140%		0.000%	
		2			0.050%	1,203	0.003%	20,049	0.010%	6,015			0.005%	12,029	0.000%	0
		3			21.193%		1.060%		4.239%				2.119%		0.000%	
		4			0.050%	1,473	0.003%	24,548	0.010%	7,365			0.005%	14,729	0.000%	0
		5			0.619%	96	0.031%	1,918	0.124%	479			0.062%	959	0.000%	0
		6			0.162%	384	0.008%	7,770	0.032%	1,942			0.016%	3,885	0.000%	0
Lingcod	Petrale	1				0	0.000%	0					0.614%	151	0.000%	0
		2				0	0.000%	0					2.074%	55	0.000%	0
		6				0	0.000%	0					0.855%	116	0.000%	0
	Flatfish	1			0.131%	348	0.000%	0	0.075%	607			0.092%	495	0.000%	0
		2			0.246%	168	0.142%	291	0.166%	249			0.138%	300	0.000%	0
		3			0.746%	55	0.657%	62	0.384%	106			0.314%	130	0.000%	0
		4			0.603%	61	2.697%	14	0.322%	114			0.050%	736	0.000%	0
		5			0.512%	68	0.666%	53	0.105%	334			0.282%	124	0.000%	0
		6			0.471%	90	0.736%	58	0.714%	60			0.044%	968	0.000%	0
	DTS	1			0.012%	4,072	0.000%	0					0.012%	4,072	0.000%	0
		2			0.008%	6,869	0.000%	0					0.008%	6,869	0.000%	0
		3			0.053%	1,052	0.000%	0					0.016%	3,486	0.000%	0
		4			0.053%	987	0.000%	0					0.015%	3,487	0.000%	0
		5			0.083%	620	0.000%	0					0.065%	792	0.000%	0
		6			0.038%	1,287	0.000%	0					0.038%	1,287	0.000%	0
	Leftover	1			0.368%		0.074%		0.257%				0.074%		0.000%	
		2			3.269%	18	0.654%	92	2.288%	26			0.654%	92	0.000%	0
		3			6.098%		1.220%		4.268%				1.220%		0.000%	
		4			0.000%	0	0.000%	0	0.000%	0			0.000%	0	0.000%	0
		5			0.840%	71	0.168%	354	0.588%	101			0.168%	354	0.000%	0
		6			0.858%	72	0.172%	361	0.601%	103			0.172%	361	0.000%	0
Canary RF	Petrale	1				0	0.000%	0					0.000%	0	0.000%	0
		2				0	0.000%	0					0.000%	0	0.000%	0
		6				0	0.000%	0					0.000%	0	0.000%	0
	Flatfish	1			0.011%	4,142	0.000%	0	0.000%	0			0.000%	0	0.000%	0
		2			0.098%	422	0.000%	0	0.033%	1,252			0.000%	0	0.000%	0
		3			0.064%	637	0.000%	0	0.000%	0			0.000%	0	0.000%	0
		4			0.046%	800	0.000%	0	0.000%	0			0.000%	0	0.000%	0
		5			0.082%	428	0.000%	0	0.099%	354			0.000%	0	0.000%	0
		6			0.039%	1,092	0.000%	0	0.048%	888			0.000%	0	0.000%	0
	DTS	1			0.000%	0	0.000%	0					0.000%	0	0.000%	0
		2			0.020%	2,747	0.000%	0					0.000%	0	0.020%	2,747
		3			0.002%	27,886	0.000%	0					0.000%	0	0.000%	0
		4			0.015%	3,487	0.000%	0					0.000%	0	0.001%	52,305
		5			0.002%	25,738	0.000%	0					0.000%	0	0.000%	0
		6			0.000%	0	0.000%	0					0.000%	0	0.000%	0

TABLE 3.4-18. Average revenue of target species per pound of overfished species, based on 1998 harvest complex exvessel revenues and bycatch rates used for the 2003 fishery (Hastie, 2003). (Page 6 of 7)

Overfished Species	Trawl Target Complex	Per	For All Depth Rates from 2001 Analysis: EDCP (Rate)	EDCP (Rev/ Pounds)	Based on Logbook Values Adjusted to Council Decisions for Modeling the 2002 Fishery: All Depths (Rate)	All Depths (Rev/ Pounds)	In Depths Shallower Than: 50 fm (Rate)	50 fm (Rev/ Pounds)	North: 75 fm; South: 70 fm (Rate)	North: 75 fm; South: 70 fm (Rev/ Pounds)	100 fm (Rate)	100 fm (Rev/ Pounds)	In Depths Deeper Than: 150 fm (Rate)	150 fm (Rev/ Pounds)	250 fm (Rate)	250 fm (Rev/ Pounds)
	Leftover	1			0.010%		0.004%		0.008%				0.000%		0.000%	
		2			0.010%	6,015	0.004%	15,037	0.008%	7,518			0.000%	0	0.000%	0
		3			0.010%		0.004%		0.008%				0.000%		0.000%	
		4			0.010%	7,365	0.004%	18,411	0.008%	9,206			0.000%	0	0.000%	0
		5			0.010%	5,944	0.004%	14,861	0.008%	7,430			0.000%	0	0.000%	0
		6			0.121%	514	0.048%	1,295	0.097%	641			0.000%	0	0.000%	0
Darkblotched	Petrale	1				0	0.000%	0					11.487%	8	0.000%	0
		2				0	0.000%	0					8.399%	13	0.000%	0
		6				0	0.000%	0					7.161%	14	0.000%	0
	Flatfish	1				0	0.000%	0					1.426%	32	0.000%	0
		2				0	0.000%	0					1.055%	39	0.000%	0
		3				0	0.000%	0					2.058%	20	0.000%	0
		4				0	0.000%	0					1.089%	34	0.000%	0
		5				0	0.000%	0					1.833%	19	0.000%	0
		6				0	0.000%	0					3.187%	13	0.000%	0
	DTS	1			0.567%	86	0.000%	0					0.280%	174	0.000%	0
		2			0.596%	92	0.000%	0					0.298%	184	0.000%	0
		3			1.483%	38	0.000%	0					0.717%	78	0.000%	0
		4			0.563%	93	0.000%	0					0.279%	187	0.000%	0
		5			1.168%	44	0.000%	0					0.584%	88	0.000%	0
		6			0.731%	67	0.000%	0					0.365%	134	0.000%	0
	Leftover	1			3.675%		0.000%		0.184%				2.205%		0.000%	
		2			2.450%	25	0.000%	0	0.123%	489			1.470%	41	0.000%	0
		3			2.450%		0.000%		0.123%				1.470%		0.000%	
		4			2.100%	35	0.000%	0	0.105%	701			1.260%	58	0.000%	0
		5			1.575%	38	0.000%	0	0.079%	752			0.945%	63	0.000%	0
		6			2.975%	21	0.000%	0	0.149%	417			1.785%	35	0.000%	0
Widow RF	Petrale	1				0	0.000%	0					0.446%	208	0.000%	0
		2				0	0.000%	0					1.410%	80	0.000%	0
		6				0	0.000%	0					0.008%	12,416	0.000%	0
	Flatfish	1			0.112%	407	0.000%	0	0.043%	1,059			0.062%	735	0.000%	0
		2			0.059%	701	0.000%	0	0.017%	2,431			0.026%	1,590	0.000%	0
		3			0.900%	45	0.102%	399	0.073%	558			0.167%	244	0.000%	0
		4			1.191%	31	0.000%	0	1.174%	31			0.148%	249	0.000%	0

TABLE 3.4-18. Average revenue of target species per pound of overfished species, based on 1998 harvest complex exvessel revenues and bycatch rates used for the 2003 fishery (Hastie, 2003). (Page 7 of 7)

			For All Depth Rates from 2001 Analysis		Based on Logbook Values Adjusted to Council Decisions for Modeling the 2002 Fishery											
							In Depths Shallower Than						In Depths Deeper Than			
Overfished Species	Trawl Target Complex	Per	EDCP (Rate)	EDCP (Rev/ Pounds)	All Depths (Rate)	All Depths (Rev/ Pounds)	50 fm (Rate)	50 fm (Rev/ Pounds)	North: 75 fm; South: 70 fm (Rate)	North: 75 fm; South: 70 fm (Rev/ Pounds)	100 fm (Rate)	100 fm (Rev/ Pounds)	150 fm (Rate)	150 fm (Rev/ Pounds)	250 fm (Rate)	250 fm (Rev/ Pounds)
		5			0.255%	137	0.156%	225	0.163%	215			0.086%	408	0.000%	0
		6			0.791%	54	0.000%	0	0.000%	0			0.056%	761	0.000%	0
	DTS	1			0.006%	8,143	0.000%	0					0.006%	8,143	0.000%	0
		2			0.020%	2,747	0.000%	0					0.020%	2,747	0.000%	0
		3			0.283%	197	0.000%	0					0.141%	396	0.000%	0
		4			0.003%	17,435	0.000%	0					0.003%	17,435	0.000%	0
		5			0.009%	5,720	0.000%	0					0.009%	5,720	0.000%	0
		6			0.010%	4,891	0.000%	0					0.010%	4,891	0.000%	0
	Leftover	1			7.000%		0.350%		2.100%				0.700%		0.000%	
		2			0.490%	123	0.025%	2,406	0.147%	409			0.049%	1,227	0.000%	0
		3			0.700%		0.035%		0.210%				0.070%		0.000%	
		4			1.120%	66	0.056%	1,315	0.336%	219			0.112%	658	0.000%	0
		5			0.980%	61	0.049%	1,213	0.294%	202			0.098%	607	0.000%	0
		6			0.560%	111	0.028%	2,220	0.168%	370			0.056%	1,110	0.000%	0

TABLE 3.4.2-19. Average revenue of target species per pound of overfished species, based on 2002 harvest complex exvessel revenues and bycatch rates used for the 2003 fishery (Hastie, 2003). (Page 1 of 8)

			For All Depth Rates from 2001 Analysis		Based on Logbook Values Adjusted to Council Decisions for Modeling the 2002 Fishery											
							In Depths Shallower Than						In Depths Deeper Than			
Overfished Species	Trawl Target Complex	Per	EDCP (Rate)	EDCP (Rev/ Pounds)	All Depths (Rate)	All Depths (Rev/ Pounds)	50 fm (Rate)	50 fm (Rev/ Pounds)	North: 75 fm; South: 70 fm (Rate)	North: 75 fm; South: 70 fm (Rev/ Pounds)	100 fm (Rate)	100 fm (Rev/ Pounds)	150 fm (Rate)	150 fm (Rev/ Pounds)	250 fm (Rate)	250 fm (Rev/ Pounds)
North																
Lingcod	DTS	1	0.010%	6,850	0.030%	2,283	0.000%	0	0.000%	0	0.000%	0	0.030%	2,283	0.000%	0
		2	0.041%	1,683	0.275%	251	0.000%	0	0.300%	230	0.000%	0	0.272%	254	0.000%	0
		3	0.365%	197	0.651%	111	0.000%	0	1.594%	45	1.335%	54	0.334%	216	0.000%	0
		4	0.942%	65	0.818%	74	0.000%	0	3.783%	16	4.651%	13	0.206%	296	0.000%	0
		5	1.234%	60	1.175%	63	0.000%	0	4.609%	16	4.900%	15	0.778%	95	0.000%	0
		6	0.011%	6,430	0.055%	1,286	0.000%	0	0.000%	0	0.000%	0	0.052%	1,360	0.000%	0
	Flatfish	1	0.609%	75	0.214%	214	1.395%	33	1.303%	35	1.184%	39	0.160%	286	0.000%	0
		2	2.926%	14	1.493%	28	2.440%	17	2.752%	15	4.830%	9	0.649%	64	0.000%	0
		3	2.167%	21	1.558%	29	0.345%	132	0.953%	48	1.594%	29	0.635%	72	0.000%	0
		4	2.240%	21	2.123%	22	0.767%	61	1.383%	34	2.016%	23	0.765%	61	0.000%	0
		5	4.546%	10	2.370%	18	0.619%	70	1.905%	23	2.370%	18	1.014%	43	0.000%	0
		6	1.796%	24	1.080%	41	2.802%	16	3.653%	12	2.778%	16	0.715%	61	0.000%	0
	Arrowtooth	1		0	0.030%	404	0.000%	0					0.005%	2,422	0.000%	0
		2	0.000%	0	0.200%	61	0.000%	0					0.115%	106	0.000%	0
		6		0	0.030%	433	0.000%	0					0.005%	2,600	0.000%	0
	Petrale	1	0.597%	124	0.612%	121	0.000%	0					0.551%	134	0.000%	0
		2	0.000%	0	1.752%	56	0.000%	0					1.250%	78	0.000%	0
		6	0.617%	171	0.759%	139	0.000%	0					0.532%	198	0.000%	0
	Midwater	1	0.105%		0.072%		0.000%								0.000%	
		2	0.000%		0.000%		0.000%								0.000%	
		3		0	0.000%	0	0.000%	0							0.000%	0
		4	0.000%	0	0.681%	70	0.000%	0							0.000%	0
		5	0.000%		0.712%		0.000%								0.000%	
		6	0.000%	0	0.000%	0	0.000%	0							0.000%	0
	Leftover	1	3.120%	14	1.650%	26	0.330%	129	1.238%	34	1.650%	26	0.330%	129	0.000%	0
		2	0.713%	88	0.500%	125	0.100%	627	0.375%	167	0.500%	125	0.100%	627	0.000%	0
		3	0.554%	107	0.850%	70	0.170%	348	0.638%	93	0.850%	70	0.170%	348	0.000%	0
		4	23.940%	2	2.900%	18	0.580%	92	2.175%	25	2.900%	18	0.580%	92	0.000%	0
		5	7.345%	7	3.150%	17	0.630%	84	2.363%	22	3.150%	17	0.630%	84	0.000%	0
		6	2.344%	16	1.950%	20	0.390%	98	1.463%	26	1.950%	20	0.390%	98	0.000%	0

TABLE 3.4-19. Average revenue of target species per pound of overfished species, based on 2002 harvest complex exvessel revenues and bycatch rates used for the 2003 fishery (Hastie, 2003). (Page 2 of 8)

			For All Depth Rates from 2001 Analysis		Based on Logbook Values Adjusted to Council Decisions for Modeling the 2002 Fishery											
							In Depths Shallower Than						In Depths Deeper Than			
Overfished Species	Trawl Target Complex	Per	EDCP (Rate)	EDCP (Rev/ Pounds)	All Depths (Rate)	Depths (Rev/ Pounds)	50 fm (Rate)	50 fm (Rev/ Pounds)	North: 75 fm; South: 70 fm (Rate)	fm; South: 70 fm (Rev/ Pounds)	100 fm (Rate)	100 fm (Rev/ Pounds)	150 fm (Rate)	150 fm (Rev/ Pounds)	250 fm (Rate)	250 fm (Rev/ Pounds)
Canary RF	DTS	1	0.000%	0	0.010%	6,850	0.000%	0	0.101%	678	0.101%	678	0.000%	0	0.000%	0
		2	0.000%	0	0.010%	6,902	0.000%	0	0.200%	345	0.035%	1,972	0.000%	0	0.000%	0
		3	0.000%	0	0.010%	7,204	0.000%	0	0.119%	605	0.208%	346	0.000%	0	0.000%	0
		4	1.062%	57	0.300%	203	0.000%	0	1.362%	45	1.403%	43	0.000%	0	0.000%	0
		5	0.844%	87	0.797%	93	0.000%	0	10.359%	7	6.348%	12	0.000%	0	0.000%	0
		6	0.000%	0	0.010%	7,074	0.000%	0	0.000%	0	0.000%	0	0.000%	0	0.000%	0
	Flatfish	1	0.317%	144	0.048%	953	0.191%	240	0.098%	467	0.230%	199	0.000%	0	0.000%	0
		2	0.000%	0	0.120%	346	0.386%	108	0.335%	124	0.469%	89	0.000%	0	0.000%	0
		3	0.181%	252	0.236%	193	0.030%	1,522	0.257%	178	0.437%	104	0.000%	0	0.000%	0
		4	1.368%	34	0.895%	53	0.091%	517	0.436%	108	1.260%	37	0.000%	0	0.000%	0
		5	1.078%	40	0.367%	118	0.405%	107	0.431%	101	0.488%	89	0.000%	0	0.000%	0
		6	0.026%	1,683	0.050%	875	0.046%	951	0.264%	166	0.214%	204	0.000%	0	0.000%	0
		1			0.010%	1,211	0.000%	0					0.000%	0	0.000%	0
		2	0.000%	0	0.010%	1,216	0.000%	0					0.000%	0	0.000%	0
		6			0.010%	1,300	0.000%	0					0.000%	0	0.000%	0
	Petrale	1	0.000%	0	0.012%	6,152	0.000%	0					0.000%	0	0.000%	0
		2	0.000%	0	0.452%	216	0.000%	0					0.000%	0	0.000%	0
		6	0.000%	0	0.012%	8,779	0.000%	0					0.000%	0	0.000%	0
	Midwater	1	0.096%		0.013%		0.000%		0.200%		0.013%				0.000%	
		2	0.000%		0.058%		0.000%		0.212%		0.058%				0.000%	
		3		0	2.758%	17	0.000%	0	2.373%	20	2.758%	17		0	0.000%	0
		4	1.849%	26	0.971%	49	0.000%	0	2.373%	20	0.971%	49		0	0.000%	0
		5	0.000%		0.775%		0.000%		0.200%		0.775%				0.000%	
		6	0.000%	0	0.011%	4,139	0.000%	0	0.200%	228	0.011%	4,139		0	0.000%	0
	Leftover	1	0.000%	0	0.010%	4,246	0.004%	10,615	0.009%	4,718	0.010%	4,246	0.000%	0	0.000%	0
		2	0.721%	87	0.100%	627	0.040%	1,566	0.090%	696	0.100%	627	0.000%	0	0.000%	0
		3	0.000%	0	0.500%	118	0.200%	296	0.450%	132	0.500%	118	0.000%	0	0.000%	0
		4	20.942%	3	1.000%	54	0.400%	134	0.900%	59	1.000%	54	0.000%	0	0.000%	0
		5	0.176%	300	0.150%	353	0.060%	881	0.135%	392	0.150%	353	0.000%	0	0.000%	0
		6	8.842%	4	0.100%	384	0.040%	960	0.090%	427	0.100%	384	0.000%	0	0.000%	0
POP	DTS	1	0.061%	1,123	0.522%	131	0.000%	0	0.000%	0	0.631%	109	0.521%	131	0.395%	145
		2	0.581%	119	1.243%	56	0.000%	0	0.000%	0	3.285%	21	1.202%	57	0.472%	68
		3	1.405%	51	1.985%	36	0.000%	0	0.000%	0	2.743%	26	1.705%	42	0.482%	65
		4	2.435%	25	1.562%	39	0.000%	0	0.000%	0	1.926%	32	1.078%	56	0.497%	85
		5	0.358%	206	0.646%	114	0.000%	0	0.000%	0	0.764%	97	0.385%	192	0.141%	248
		6	0.606%	117	1.014%	70	0.000%	0	0.000%	0	0.000%	0	0.992%	71	0.329%	178

TABLE 3.4-19. Average revenue of target species per pound of overfished species, based on 2002 harvest complex exvessel revenues and bycatch rates used for the 2003 fishery (Hastie, 2003). (Page 3 of 8)

			For All Depth Rates from 2001 Analysis		Based on Logbook Values Adjusted to Council Decisions for Modeling the 2002 Fishery											
							In Depths Shallower Than						In Depths Deeper Than			
Overfished Species	Trawl Target Complex	Per	EDCP (Rate)	EDCP (Rev/ Pounds)	All Depths (Rate)	All Depths (Rev/ Pounds)	50 fm (Rate)	50 fm (Rev/ Pounds)	North: 75 fm; South: 70 fm (Rate)	North: 75 fm; South: 70 fm (Rev/ Pounds)	100 fm (Rate)	100 fm (Rev/ Pounds)	150 fm (Rate)	150 fm (Rev/ Pounds)	250 fm (Rate)	250 fm (Rev/ Pounds)
	Flatfish	1	0.459%	100	1.315%	35	0.000%	0	0.000%	0	0.306%	150	1.330%	34	0.000%	0
		2	4.161%	10	3.003%	14	0.000%	0	0.000%	0	2.706%	15	2.391%	17	0.000%	0
		3	6.587%	7	4.464%	10	0.000%	0	0.000%	0	2.262%	20	6.824%	7	0.000%	0
		4	3.723%	13	1.865%	25	0.000%	0	0.000%	0	0.627%	75	2.570%	18	0.000%	0
		5	4.715%	9	2.929%	15	0.000%	0	0.000%	0	0.529%	82	4.211%	10	0.000%	0
		6	1.327%	33	1.319%	33	0.000%	0	0.000%	0	0.481%	91	1.325%	33	0.000%	0
	Arrowtooth	1			2.369%	5	0.000%	0					2.369%	5	0.000%	0
		2	14.500%	1	3.160%	4	0.000%	0					1.129%	11	0.000%	0
		6			2.276%	6	0.000%	0					2.276%	6	0.000%	0
		1	0.636%	116	2.337%	32	0.000%	0					2.415%	31	0.000%	0
		2	0.000%	0	5.555%	18	0.000%	0					6.122%	16	0.000%	0
		6	4.632%	23	6.903%	15	0.000%	0					7.232%	15	0.000%	0
	Midwater	1	0.000%		0.000%		0.000%								0.000%	
		2	0.000%		0.009%		0.000%								0.000%	
		3			0.000%	0	0.000%	0							0.000%	0
		4	0.000%	0	0.000%	0	0.000%	0							0.000%	0
		5	0.000%		0.241%		0.000%								0.000%	
		6	0.000%	0	0.001%	45,526	0.000%	0							0.000%	0
	Leftover	1	66.274%	1	11.500%	4	0.000%	0	0.000%	0	1.150%	37	6.900%	6	0.000%	18
		2	0.565%	111	2.750%	23	0.000%	0	0.000%	0	0.275%	228	1.650%	38	0.000%	114
		3	5.885%	10	5.000%	12	0.000%	0	0.000%	0	0.500%	118	3.000%	20	0.000%	59
		4	21.309%	3	10.750%	5	0.000%	0	0.000%	0	1.075%	50	6.450%	8	0.000%	25
		5	3.893%	14	4.250%	12	0.000%	0	0.000%	0	0.425%	124	2.550%	21	0.000%	62
		6	1.291%	30	5.650%	7	0.000%	0	0.000%	0	0.565%	68	3.390%	11	0.000%	34
Darkblotche	DTS	1	1.682%	41	0.656%	104	0.000%	0	0.000%	0	0.000%	0	1.127%	61	0.000%	76
		2	0.506%	136	0.564%	122	0.000%	0	0.000%	0	0.000%	0	1.047%	66	0.000%	71
		3	1.602%	45	2.374%	30	0.000%	0	0.000%	0	0.000%	0	1.930%	37	0.000%	50
		4	2.144%	28	1.570%	39	0.000%	0	0.000%	0	0.000%	0	1.139%	53	0.000%	89
		5	2.303%	32	0.825%	89	0.000%	0	0.000%	0	0.000%	0	1.325%	56	0.000%	64
		6	5.850%	12	0.408%	173	0.000%	0	0.000%	0	0.000%	0	2.483%	28	0.000%	30
	Flatfish	1	1.206%	38	1.804%	25	0.000%	0	0.000%	0	0.500%	92	1.764%	26	0.000%	0
		2	1.018%	41	1.983%	21	0.000%	0	0.000%	0	0.500%	83	1.909%	22	0.000%	0
		3	1.370%	33	3.170%	14	0.000%	0	0.000%	0	0.500%	91	3.006%	15	0.000%	0
		4	0.849%	55	3.701%	13	0.000%	0	0.000%	0	0.500%	94	3.258%	14	0.000%	0
		5	2.471%	18	3.264%	13	0.000%	0	0.000%	0	0.500%	87	2.149%	20	0.000%	0
		6	1.902%	23	1.141%	38	0.000%	0	0.000%	0	0.500%	88	0.973%	45	0.000%	0

TABLE 3.4-19. Average revenue of target species per pound of overfished species, based on 2002 harvest complex exvessel revenues and bycatch rates used for the 2003 fishery (Hastie, 2003). (Page 4 of 8)

			For All Depth Rates from 2001 Analysis		Based on Logbook Values Adjusted to Council Decisions for Modeling the 2002 Fishery											
							In Depths Shallower Than						In Depths Deeper Than			
Overfished Species	Trawl Target Complex	Per	EDCP (Rate)	EDCP (Rev/ Pounds)	All Depths (Rate)	Depths (Rev/ Pounds)	50 fm (Rate)	50 fm (Rev/ Pounds)	North: 75 fm; South: 70 fm (Rate)	fm; South: 70 fm (Rev/ Pounds)	100 fm (Rate)	100 fm (Rev/ Pounds)	150 fm (Rate)	150 fm (Rev/ Pounds)	250 fm (Rate)	250 fm (Rev/ Pounds)
	Arrowtooth	1			0.180%	67	0.000%	0					0.180%	67	0.000%	0
		2	0.000%	0	0.537%	23	0.000%	0					0.533%	23	0.000%	0
		6			0.500%	26	0.000%	0					0.500%	26	0.000%	0
	Petrale	1	3.662%	20	3.940%	19	0.000%	0					4.020%	18	0.000%	0
		2	0.000%	0	5.456%	18	0.000%	0					5.164%	19	0.000%	0
		6	1.971%	53	3.037%	35	0.000%	0					3.072%	34	0.000%	0
	Midwater	1	0.001%		0.030%		0.000%								0.000%	
		2	0.000%		0.030%		0.000%								0.000%	
		3			0.030%	1,564	0.000%	0						0	0.000%	0
		4	0.000%	0	0.030%	1,600	0.000%	0						0	0.000%	0
		5	0.000%		0.030%		0.000%								0.000%	
		6	0.000%	0	0.030%	1,518	0.000%	0						0	0.000%	0
	Leftover	1	2.713%	16	5.250%	8	0.000%	0	0.525%	81	1.050%	40	3.150%	13	0.000%	81
		2	0.000%	0	3.500%	18	0.000%	0	0.350%	179	0.700%	90	2.100%	30	0.000%	179
		3	0.000%	0	3.500%	17	0.000%	0	0.350%	169	0.700%	85	2.100%	28	0.000%	169
		4	4.879%	11	3.000%	18	0.000%	0	0.300%	178	0.600%	89	1.800%	30	0.000%	178
		5	0.346%	153	2.250%	24	0.000%	0	0.225%	235	0.450%	118	1.350%	39	0.000%	235
		6	4.919%	8	4.250%	9	0.000%	0	0.425%	90	0.850%	45	2.550%	15	0.000%	90
Widow RF	DTS	1	0.000%	0	0.401%	171	0.000%	0	15.467%	4	15.467%	4	0.311%	220	0.000%	0
		2	0.000%	0	0.152%	454	0.000%	0	0.200%	345	0.051%	1,353	0.152%	454	0.000%	0
		3	0.000%	0	0.198%	364	0.000%	0	0.000%	0	0.144%	500	0.158%	456	0.000%	0
		4	0.427%	143	0.303%	201	0.000%	0	0.576%	106	0.610%	100	0.132%	461	0.000%	0
		5	0.152%	486	0.259%	285	0.000%	0	3.484%	21	1.934%	38	0.149%	495	0.000%	0
		6	0.000%	0	0.051%	1,387	0.000%	0	0.000%	0	6.710%	11	0.041%	1,725	0.000%	0
	Flatfish	1	0.038%	1,204	0.220%	208	0.013%	3,520	0.000%	0	1.358%	34	0.185%	247	0.000%	0
		2	0.000%	0	0.146%	284	0.000%	0	0.015%	2,768	0.602%	69	0.095%	437	0.000%	0
		3	0.000%	0	0.200%	228	0.016%	2,854	0.210%	217	0.244%	187	0.137%	333	0.000%	0
		4	0.844%	56	0.471%	100	0.011%	4,275	0.126%	373	0.443%	106	0.174%	270	0.000%	0
		5	0.002%	21,692	0.108%	402	0.025%	1,735	0.013%	3,337	0.031%	1,400	0.059%	735	0.000%	0
		6	0.000%	0	0.098%	447	0.011%	3,978	0.001%	43,759	0.112%	391	0.003%	14,586	0.000%	0
	Arrowtooth	1			0.050%	242	0.000%	0					0.050%	242	0.000%	0
		2	0.000%	0	0.085%	143	0.000%	0					0.026%	468	0.000%	0
		6			0.030%	433	0.000%	0					0.030%	433	0.000%	0
	Petrale	1	0.000%	0	0.160%	461	0.000%	0					0.167%	442	0.000%	0
		2	0.000%	0	0.162%	602	0.000%	0					0.039%	2,502	0.000%	0
		6	0.000%	0	0.147%	717	0.000%	0					0.028%	3,763	0.000%	0

TABLE 3.4-19. Average revenue of target species per pound of overfished species, based on 2002 harvest complex exvessel revenues and bycatch rates used for the 2003 fishery (Hastie, 2003). (Page 5 of 8)

			For All Depth Rates from 2001 Analysis		Based on Logbook Values Adjusted to Council Decisions for Modeling the 2002 Fishery											
							In Depths Shallower Than						In Depths Deeper Than			
Overfished Species	Trawl Target Complex	Per	EDCP (Rate)	EDCP (Rev/ Pounds)	All Depths (Rate)	Depths (Rev/ Pounds)	50 fm (Rate)	50 fm (Rev/ Pounds)	North: 75 fm; South: 70 fm (Rate)	fm; South: 70 fm (Rev/ Pounds)	100 fm (Rate)	100 fm (Rev/ Pounds)	150 fm (Rate)	150 fm (Rev/ Pounds)	250 fm (Rate)	250 fm (Rev/ Pounds)
	Leftover	1	18.442%	2	10.000%	4	0.500%	85	4.000%	11	5.000%	8	1.000%	42	0.000%	0
		2	0.000%	0	0.700%	90	0.035%	1,790	0.280%	224	0.350%	179	0.070%	895	0.000%	0
		3	0.000%	0	1.000%	59	0.050%	1,185	0.400%	148	0.500%	118	0.100%	592	0.000%	0
		4	0.022%	2,432	1.600%	33	0.080%	669	0.640%	84	0.800%	67	0.160%	334	0.000%	0
		5	0.000%	0	1.400%	38	0.070%	756	0.560%	94	0.700%	76	0.140%	378	0.000%	0
		6	1.112%	35	0.800%	48	0.040%	960	0.320%	120	0.400%	96	0.080%	480	0.000%	0
South																
Bocaccio	Petrale	1					0.000%	0					0.080%	1,032	0.000%	0
		2					0.000%	0					1.000%	102	0.000%	0
		6					0.000%	0					0.000%	0	0.000%	0
	Flatfish	1			2.840%	15	0.000%	0	3.879%	11		0	0.504%	84	0.000%	0
		2			2.320%	20	1.548%	30	2.113%	22		0	0.105%	436	0.000%	0
		3			2.279%	22	0.373%	132	0.595%	83		0	1.724%	29	0.000%	0
		4			2.163%	17	0.000%	0	0.459%	81		0	0.021%	1,780	0.000%	0
		5			2.032%	19	0.000%	0	0.596%	65		0	0.503%	77	0.000%	0
		6			2.648%	18	0.000%	0	5.236%	9		0	0.204%	230	0.000%	0
	DTS	1			0.017%	3,358	0.000%	0					0.007%	8,156	0.000%	0
		2			0.066%	838	0.000%	0					0.026%	2,126	0.000%	0
		3			0.146%	407	0.000%	0					0.049%	1,212	0.000%	0
		4			0.067%	910	0.000%	0					0.002%	30,483	0.000%	0
		5			0.195%	302	0.000%	0					0.070%	840	0.000%	0
		6			0.007%	8,480	0.000%	0					0.003%	19,787	0.000%	0
	Leftover	1			1.400%	44	0.070%	889	0.280%	222		0	0.140%	444	0.000%	0
		2			0.050%	2,361	0.003%	39,354	0.010%	11,806		0	0.005%	23,612	0.000%	0
		3			21.193%		1.060%		4.239%				2.119%		0.000%	
		4			0.050%		0.003%		0.010%				0.005%		0.000%	
		5			0.619%		0.031%		0.124%				0.062%		0.000%	
		6			0.162%		0.008%		0.032%				0.016%		0.000%	
Lingcod	Petrale	1					0.000%	0					0.614%	134	0.000%	0
		2					0.000%	0					2.074%	49	0.000%	0
		6					0.000%	0					0.855%	127	0.000%	0

TABLE 3.4-19. Average revenue of target species per pound of overfished species, based on 2002 harvest complex exvessel revenues and bycatch rates used for the 2003 fishery (Hastie, 2003). (Page 6 of 8)

			For All Depth Rates from 2001 Analysis		Based on Logbook Values Adjusted to Council Decisions for Modeling the 2002 Fishery											
							In Depths Shallower Than						In Depths Deeper Than			
Overfished Species	Trawl Target Complex	Per	EDCP (Rate)	EDCP (Rev/ Pounds)	All Depths (Rate)	Depths (Rev/ Pounds)	50 fm (Rate)	50 fm (Rev/ Pounds)	North: 75 fm; South: 70 fm (Rate)	fm; South: 70 fm (Rev/ Pounds)	100 fm (Rate)	100 fm (Rev/ Pounds)	150 fm (Rate)	150 fm (Rev/ Pounds)	250 fm (Rate)	250 fm (Rev/ Pounds)
	Flatfish	1			0.131%	323	0.000%	0	0.075%	565		0	0.092%	461	0.000%	0
		2			0.246%	186	0.142%	322	0.166%	276		0	0.138%	332	0.000%	0
		3			0.746%	66	0.657%	75	0.384%	128		0	0.314%	157	0.000%	0
		4			0.603%	62	2.697%	14	0.322%	116		0	0.050%	748	0.000%	0
		5			0.512%	76	0.666%	58	0.105%	370		0	0.282%	138	0.000%	0
		6			0.471%	100	0.736%	64	0.714%	66		0	0.044%	1,066	0.000%	0
	DTS	1			0.012%	4,757	0.000%	0					0.012%	4,757	0.000%	0
		2			0.008%	6,910	0.000%	0					0.008%	6,910	0.000%	0
		3			0.053%	1,120	0.000%	0					0.016%	3,711	0.000%	0
		4			0.053%	1,150	0.000%	0					0.015%	4,064	0.000%	0
		5			0.083%	709	0.000%	0					0.065%	905	0.000%	0
		6			0.038%	1,562	0.000%	0					0.038%	1,562	0.000%	0
	Leftover	1			0.368%	169	0.074%	840	0.257%	242		0	0.074%	840	0.000%	0
		2			3.269%	36	0.654%	181	2.288%	52		0	0.654%	181	0.000%	0
		3			6.098%		1.220%		4.268%				1.220%		0.000%	
		4			0.000%		0.000%		0.000%				0.000%		0.000%	
		5			0.840%		0.168%		0.588%				0.168%		0.000%	
		6			0.858%		0.172%		0.601%				0.172%		0.000%	
Canary RF	Petrale	1					0.000%	0					0.000%	0	0.000%	0
		2					0.000%	0					0.000%	0	0.000%	0
		6					0.000%	0					0.000%	0	0.000%	0
	Flatfish	1			0.011%	3,852	0.000%	0	0.000%	0			0.000%	0	0.000%	0
		2			0.098%	467	0.000%	0	0.033%	1,387			0.000%	0	0.000%	0
		3			0.064%	771	0.000%	0	0.000%	0			0.000%	0	0.000%	0
		4			0.046%	813	0.000%	0	0.000%	0			0.000%	0	0.000%	0
		5			0.082%	474	0.000%	0	0.099%	393			0.000%	0	0.000%	0
		6			0.039%	1,202	0.000%	0	0.048%	977			0.000%	0	0.000%	0
	DTS	1			0.000%	0	0.000%	0					0.000%	0	0.000%	0
		2			0.020%	2,764	0.000%	0					0.000%	0	0.020%	0
		3			0.002%	29,687	0.000%	0					0.000%	0	0.000%	0
		4			0.015%	4,064	0.000%	0					0.000%	0	0.001%	0
		5			0.002%	29,412	0.000%	0					0.000%	0	0.000%	0
		6			0.000%	0	0.000%	0					0.000%	0	0.000%	0

TABLE 3.4-19. Average revenue of target species per pound of overfished species, based on 2002 harvest complex exvessel revenues and bycatch rates used for the 2003 fishery (Hastie, 2003). (Page 7 of 8)

			For All Depth Rates from 2001 Analysis		Based on Logbook Values Adjusted to Council Decisions for Modeling the 2002 Fishery											
							In Depths Shallower Than						In Depths Deeper Than			
Overfished Species	Trawl Target Complex	Per	EDCP (Rate)	EDCP (Rev/ Pounds)	All Depths (Rate)	All Depths (Rev/ Pounds)	50 fm (Rate)	50 fm (Rev/ Pounds)	North: 75 fm; South: 70 fm (Rate)	North: 75 fm; South: 70 fm (Rev/ Pounds)	100 fm (Rate)	100 fm (Rev/ Pounds)	150 fm (Rate)	150 fm (Rev/ Pounds)	250 fm (Rate)	250 fm (Rev/ Pounds)
	Leftover	1			0.010%	6,220	0.004%	15,549	0.008%	7,774			0.000%	0	0.000%	0
		2			0.010%	11,806	0.004%	29,515	0.008%	14,758			0.000%	0	0.000%	0
		3			0.010%		0.004%		0.008%				0.000%		0.000%	
		4			0.010%		0.004%		0.008%				0.000%		0.000%	
		5			0.010%		0.004%		0.008%				0.000%		0.000%	
		6			0.121%		0.048%		0.097%				0.000%		0.000%	
Darkblotched	Petrale	1					0.000%	0					11.487%	7	0.000%	0
		2					0.000%	0					8.399%	12	0.000%	0
		6					0.000%	0					7.161%	15	0.000%	0
	Flatfish	1					0.000%	0					1.426%	30	0.000%	0
		2					0.000%	0					1.055%	43	0.000%	0
		3					0.000%	0					2.058%	24	0.000%	0
		4					0.000%	0					1.089%	34	0.000%	0
		5					0.000%	0					1.833%	21	0.000%	0
		6					0.000%	0					3.187%	15	0.000%	0
	DTS	1			0.567%	101	0.000%	0					0.280%	204	0.000%	0
		2			0.596%	93	0.000%	0					0.298%	186	0.000%	0
		3			1.483%	40	0.000%	0					0.717%	83	0.000%	0
		4			0.563%	108	0.000%	0					0.279%	219	0.000%	0
		5			1.168%	50	0.000%	0					0.584%	101	0.000%	0
		6			0.731%	81	0.000%	0					0.365%	163	0.000%	0
	Leftover	1			3.675%	17	0.000%	0	0.184%	338			2.205%	28	0.000%	169
		2			2.450%	48	0.000%	0	0.123%	960			1.470%	80	0.000%	482
		3			2.450%		0.000%		0.123%				1.470%		0.000%	
		4			2.100%		0.000%		0.105%				1.260%		0.000%	
		5			1.575%		0.000%		0.079%				0.945%		0.000%	
		6			2.975%		0.000%		0.149%				1.785%		0.000%	
Widow RF	Petrale	1					0.000%	0					0.446%	185	0.000%	0
		2					0.000%	0					1.410%	73	0.000%	0
		6					0.000%	0					0.008%	13,552	0.000%	0
	Flatfish	1			0.112%	378	0.000%	0	0.043%	985			0.062%	683	0.000%	0
		2			0.059%	776	0.000%	0	0.017%	2,693			0.026%	1,761	0.000%	0
		3			0.900%	55	0.102%	484	0.073%	676			0.167%	295	0.000%	0
		4			1.191%	31	0.000%	0	1.174%	32			0.148%	253	0.000%	0
		5			0.255%	152	0.156%	249	0.163%	238			0.086%	452	0.000%	0
		6			0.791%	59	0.000%	0	0.000%	0			0.056%	837	0.000%	0

TABLE 3.4-19. Average revenue of target species per pound of overfished species, based on 2002 harvest complex exvessel revenues and bycatch rates used for the 2003 fishery (Hastie, 2003). (Page 8 of 8)

			For All Depth Rates from 2001 Analysis		Based on Logbook Values Adjusted to Council Decisions for Modeling the 2002 Fishery											
							In Depths Shallower Than						In Depths Deeper Than			
Overfished Species	Trawl Target Complex	Per	EDCP (Rate)	EDCP (Rev/ Pounds)	All Depths (Rate)	All Depths (Rev/ Pounds)	50 fm (Rate)	50 fm (Rev/ Pounds)	North: 75 fm; South: 70 fm (Rate)	North: 75 fm; South: 70 fm (Rev/ Pounds)	100 fm (Rate)	100 fm (Rev/ Pounds)	150 fm (Rate)	150 fm (Rev/ Pounds)	250 fm (Rate)	250 fm (Rev/ Pounds)
	DTS	1			0.006%	9,515	0.000%	0					0.006%	9,515	0.000%	0
		2			0.020%	2,764	0.000%	0					0.020%	2,764	0.000%	0
		3			0.283%	210	0.000%	0					0.141%	421	0.000%	0
		4			0.003%	20,322	0.000%	0					0.003%	20,322	0.000%	0
		5			0.009%	6,536	0.000%	0					0.009%	6,536	0.000%	0
		6			0.010%	5,936	0.000%	0					0.010%	5,936	0.000%	0
	Leftover	1			7.000%	9	0.350%	178	2.100%	30			0.700%	89	0.000%	0
		2			0.490%	241	0.025%	4,722	0.147%	803			0.049%	2,409	0.000%	0
		3			0.700%		0.035%		0.210%				0.070%		0.000%	
		4			1.120%		0.056%		0.336%				0.112%		0.000%	
		5			0.980%		0.049%		0.294%				0.098%		0.000%	
		6			0.560%		0.028%		0.168%				0.056%		0.000%	

TABLE 3.4-20. Target species trip revenue per pound of overfished species landed and average price per pound of fish landed on the trip, 1998, 2002 (based on bycatch rates where available[a/][b/]) (Page 1 of 4)

Trip Target	Trips	Total, All Species Landed: Weight (thousands)	Total, All Species Landed: Avg Price	Darkblotched Rockfish	Pacific Ocean Perch	Bocaccio	Canary Rockfish	Cowcod	Lingcod	Yelloweye Rockfish	Widow Rockfish	Whiting
1998												
North of Cape Mendocino												
Limited Entry Trawl, Whiting	1,326	198,999	0.03	676	73	-	2,792	-	9,358	-	7	0
Limited Entry Trawl, Arrowtooth	**257**	**12,068**	**0.30**	**1,657**	**9**	-	**8**	-	**80**	-	**5**	**342**
Limited Entry Trawl, Petrale Sole	**115**	**973**	**0.65**	**40**	**28**	-	**337**	-	**143**	-	**247**	**1,261**
Limited Entry Trawl, Flatfish	**957**	**9,375**	**0.43**	**25**	**25**	**2,521**	**228**	**85,116**	**45**	-	**299**	**76**
Limited Entry Trawl, Midwater	**255**	**3,638**	**0.40**	**1,794**	**778**	**4,731**	**56**	-	**168**	-	**1**	**773**
Limited Entry Trawl, DTS	**1,627**	**20,193**	**0.50**	**63**	**60**	**1,748**	**279**	-	**117**	**14,080**	**322**	**261**
Limited Entry Trawl, Pacific Ocean Perch	14	163	0.41	-	1	-	25	-	66	-	8	-
Limited Entry Trawl, Slope Rockfish	212	3,032	0.44	-	2	276	18	-	54	-	5	359
Limited Entry Trawl, Yellowtail	93	883	0.45	-	10	4,115	5	-	31	-	10	-
Limited Entry Trawl, Canary	35	362	0.44	-	11	17,708	1	-	27	-	3	74
Limited Entry Trawl, Widow	144	3,722	0.43	-	9	225	8	-	77	16,844	1	200
Limited Entry Trawl, Other Rockfish	165	3,239	0.43	-	6	172	5	-	49	6,112	3	-
Limited Entry Trawl, Lingcod	2	1	0.59	-	-	-	15	-	1	-	-	-
Limited Entry Trawl, Leftover	**106**	**1,241**	**0.27**	**41**	**21**	**1,285**	**325**	-	**75**	-	**76**	**2**
Open Access Trawl, Other, >50% Groundfish	43	500	0.35	-	9	2,185	10	-	64	-	1	-
Limited Entry Fixed Gear Sablefish, Slope	436	1,369	1.15	-	677	-	12,438	-	6,965	-	-	-
Limited Entry Fixed Gear Sablefish, Shelf	182	645	1.10	-	1,190	50,754	197	-	675	355,275	3,158	-
Limited Entry Fixed Gear Sablefish, Nearshore	6	3	1.05	-	-	-	115	-	19	-	-	-
Limited Entry Fixed Gear Sablefish, No Strata	600	1,370	1.09	-	371,961	-	78,308	-	-	-	371,961	-
Limited Entry Fixed Gear, Other Groundfish, Slop	7	6	1.01	-	5	-	23	-	83	-	706	-
Limited Entry Fixed Gear, Other Groundfish, Shel	313	364	0.81	-	45	176	2	-	13	80	29	-
Limited Entry Fixed Gear, Other Groundfish, Near	215	118	1.01	-	1,476	5,197	19	-	10	98	2,780	-
Open Access, Whiting	1	0	0.04	-	-	-	-	-	-	-	-	0
Open Access, Sablefish, Slope	109	851	1.27	-	34,728	-	134,572	-	24,468	-	-	-
Open Access, Sablefish, Shelf	94	152	1.31	-	6,401	-	127	-	181	-	12,402	-
Open Access, Sablefish, Nearshore	7	2	1.07	-	-	-	1,046	-	-	-	-	-
Open Access, Sablefish, No Strata	462	307	1.04	-	-	-	-	-	-	-	-	-
Open Access, Slope	11	4	0.47	-	3	-	33	-	8	57	22	-
Open Access, Shelf	1,265	813	0.68	-	125	474	2	-	9	160	7	-
Open Access, Nearshore	2,201	568	0.88	-	16,623	7,124	74	-	16	228	178	-
Other Groundfish (plurality, but <50%)	179	319	0.76	-	175	179	5	-	48	2,009	32	4
Groundfish/Shrimp Combinations	11	34	0.48	-	7	-	17	-	22	-	18	-
Pink Shrimp	1,105	9,642	0.52	-	386	413,401	215	-	349	-	512	1,200
Prawns	6	2	5.14	-	-	-	-	-	-	-	-	-
Pacific Halibut	214	491	1.54	-	35,978	-	1,168	-	240	-	16,425	-
California Halibut	3	15	1.39	-	-	-	5,049	-	631	-	-	-
Salmon	4,027	2,079	1.33	-	8,057	-	578	-	404	-	4,011	-
Sea Urchins	246	349	0.44	-	-	-	-	-	-	-	-	-
Gillnet Complex	11	6	0.41	-	-	-	-	-	-	-	-	-
Squid	3	9	0.21	-	-	-	-	-	-	-	-	-
CPS Plan Species	22	274	0.24	-	-	-	-	-	-	-	-	-
HMS Plan Species	1,533	25,104	0.63	-	236,838	-	193,514	-	3,173,635	-	1,983,522	-
Dungeness Crab	15,336	22,629	1.70	-	-	-	9,631,695	-	143,757	-	38,526,779	-
Other Crustaceans	2,060	442	3.22	-	678	-	674	-	495	-	6,376	-
Other Species	1,428	4,691	1.97	-	308,721	6,254	2,152	-	1,328	-	1,679	2,551
No Landing Weight or 2 Equal Weights	186	65	0.68	-	-	-	261	-	283	-	-	-

TABLE 3.4-20 Target species trip revenue per pound of overfished species landed and average price per pound of fish landed on the trip, 1998, 2002 (based on bycatch rates where available[a/b/]). (Page 2 of 4)

Trip Target	Total, All Species Landed: Trips	Total, All Species Landed: Weight (thousands)	Total, All Species Landed: Avg Price	Darkblotched Rockfish	Pacific Ocean Perch	Bocaccio	Canary Rockfish	Cowcod	Lingcod	Yelloweye Rockfish	Widow Rockfish	Whiting
1998												
South of Cape Mendocino												
Limited Entry Trawl, Petrale Sole	**41**	**148**	**0.78**	**19**	-	**285**	**1,018**	-	**103**	-	**383**	-
Limited Entry Trawl, Flatfish	**386**	**2,757**	**0.42**	**35**	-	**27**	**970**	-	**120**	**230,264**	**96**	-
Limited Entry Trawl, Midwater	16	191	0.46	-	-	48	47	755	52	2,576	1	-
Limited Entry Trawl, DTS	**548**	**7,187**	**0.48**	**70**	-	**681**	**14,916**	**14,787**	**1,302**	**15,456**	**1,179**	**28,704**
Limited Entry Trawl, Slope Rockfish	316	4,994	0.36	223,987	-	103	227	2,159	135	8,827	13	885
Limited Entry Trawl, Chilipepper	111	1,665	0.45	-	-	37	244	739	78	2,451	8	-
Limited Entry Trawl, Yellowtail	3	24	0.47	-	-	15	2	-	24	114	58	-
Limited Entry Trawl, Canary	5	67	0.43	-	-	23	1	-	30	-	3	-
Limited Entry Trawl, Widow	29	599	0.44	-	-	55	12	8,853	73	1,071	1	-
Limited Entry Trawl, Other Rockfish	141	1,885	0.45	-	-	49	21	2,406	65	422	5	-
Limited Entry Trawl, Lingcod	1	0	1.23	-	-	-	-	-	6	-	-	-
Limited Entry Trawl, Leftover	12	103	0.37	53	-	262	5,460	-	111	-	115	-
Open Access Trawl, Prawn, >50% Groundfish	38	33	2.55	-	-	27	-	2,366	117	-	1,469	-
Open Access Trawl, Halibut, >50% Groundfish	284	78	1.23	-	-	2,902	-	-	1,520	3,547	-	-
Open Access Trawl, Sea Cucumber, >50% Groundfi	2	1	0.74	-	-	-	-	-	-	-	-	-
Open Access Trawl, Other, >50% Groundfish	129	37	0.77	-	-	74	-	67	69	-	31	-
Limited Entry Fixed Gear, Whiting	7	1	1.96	-	-	-	-	-	-	-	-	4
Limited Entry Fixed Gear Sablefish, Slope	690	566	1.18	-	-	95,594	95,594	223,053	2,848	66,916	111,527	4,056
Limited Entry Fixed Gear Sablefish, Shelf	27	23	1.02	-	-	490	44	-	33	28	636	-
Limited Entry Fixed Gear Sablefish, Nearshore	8	3	1.18	-	-	-	-	-	253	-	-	-
Limited Entry Fixed Gear Sablefish, No Strata	223	106	0.93	-	-	-	-	-	-	-	-	1,212
Limited Entry Fixed Gear, Other Groundfish, Slope	830	736	0.88	-	-	3,706	14,412	46,325	2,040	-	1,316	1,043
Limited Entry Fixed Gear, Other Groundfish, Shelf	312	362	0.97	-	-	24	23	108	25	46	28	-
Limited Entry Fixed Gear, Other Groundfish, Nearsh	169	72	2.24	-	-	-	50	-	50	277	22,949	-
Open Access, Sablefish, Slope	58	17	0.83	-	-	4,593	-	-	-	-	-	-
Open Access, Sablefish, Shelf	22	17	0.61	-	-	-	499	-	140	283	-	-
Open Access, Sablefish, Nearshore	1	1	2.03	-	-	-	-	-	-	-	-	-
Open Access, Sablefish, No Strata	522	137	1.01	-	-	-	-	-	-	-	-	-
Open Access, Slope	166	149	0.58	-	-	16	154	227	76	-	-	-
Open Access, Shelf	2,441	2,392	0.69	-	-	13	29	98	30	125	6	37,618
Open Access, Nearshore	6,201	1,001	2.56	12,736	-	4,317	278	13,473	54	5,614	11,327	-
Other Groundfish (plurality but <50%)	333	187	1.30	-	-	118	555	430	106	763	60	-
Groundfish/Shrimp Combinations	1	1	0.44	-	-	-	10	-	37	-	-	-
Pink Shrimp	70	473	0.69	-	-	24,918	1,580	-	8,525	-	159	-
Prawns	3,132	1,335	4.67	-	-	1,199	62,356	5,124	4,165	54,223	-	93,069
Pacific Halibut	3	3	1.55	-	-	-	-	-	54	-	-	-
California Halibut	3,194	925	1.98	-	-	36,589	76,228	-	508	-	3,674	-
Salmon	7,526	2,099	1.43	-	-	10,398	47,698	-	5,328	3,004,940	73,291	-
Sea Cucumber	947	776	0.60	-	-	38,802	-	-	-	-	-	-
Sea Urchins	7,981	10,432	0.76	-	-	-	-	-	658,166	-	-	-
California Sheephead	860	254	2.74	-	-	23,196	-	139,176	1,034	-	-	-
Gillnet Complex	2,272	772	1.51	-	-	1,714	-	583,665	1,215	-	116,733	291,832
Squid	328	6,331	0.25	-	-	-	-	-	-	-	-	-
CPS Plan Species	2,768	147,290	0.05	-	-	278,906	446,250	-	1,338,750	-	-	-
HMS Plan Species	2,783	40,436	0.60	-	-	3,473,735	-	-	2,026,346	-	-	-
Dungeness Crab	3,786	3,278	2.36	-	-	-	275,798	-	16,751	-	-	-
Other Crustaceans	9,856	3,209	2.25	-	-	7,214,809	-	-	87,986	-	-	-
Other Species	3,114	8,012	0.40	-	-	8,751	15,979	41,176	6,224	-	84,519	291,973
No Landing Weight or 2 Equal Weights	605	125	1.88	-	-	3,362	4,279	-	787	47,065	-	-

TABLE 3.4-20. Target species trip revenue per pound of overfished species landed and average price per pound of fish landed on the trip, 1998, 2002 (based on bycatch rates where available)[a/b/] (Page 3 of 4)

Trip Target	Landed Trips	Landed Weight (thousand s)	Landed Avg Price	Darkblotche d Rockfish	Pacific Ocean Perch	Bocaccio	Canary Rockfish	Cowcod	Lingcod	Yelloweye Rockfish	Widow Rockfish	Whiting
2002												
North of Cape Mendocino												
Limited Entry Trawl, Whiting	632	101,001	0.05	209,774	9,907	603,100	5,052	-	10,136	-	412	0
Limited Entry Trawl, Arrowtooth	**184**	**7,481**	**0.31**	**217**	**27**	**-**	**87**	**-**	**73**	**234,570**	**56**	**-**
Limited Entry Trawl, Petrale Sole	**229**	**2,481**	**0.63**	**39**	**49**	**-**	**509**	**-**	**106**	**26,179**	**590**	**2,746**
Limited Entry Trawl, Flatfish	**1,275**	**11,007**	**0.45**	**27**	**28**	**14,633**	**157**	**-**	**34**	**10,474**	**276**	**91**
Limited Entry Trawl, Midwater	**63**	**1,317**	**0.46**	**1,543**	**-**	**-**	**103**	**-**	**1,264**	**-**	**1**	**3,184**
Limited Entry Trawl, DTS	**1,020**	**11,555**	**0.65**	**114**	**90**	**325,103**	**3,737**	**-**	**369**	**35,949**	**481**	**948**
Limited Entry Trawl, Slope Rockfish	19	163	0.67	33	15	1,721	206	-	137	-	977	-
Limited Entry Trawl, Yellowtail	10	20	0.45	-	4,628	-	15	-	28	-	-	-
Limited Entry Trawl, Canary	1	0	0.49	83	9	-	1	-	-	-	-	-
Limited Entry Trawl, Other Rockfish	1	4	0.55	-	-	-	4	-	2	-	-	-
Limited Entry Trawl, Lingcod	8	5	0.85	52	-	-	-	-	2	-	325	-
Limited Entry Trawl, Leftover	**158**	**1,403**	**0.35**	**89**	**59**	**-**	**867**	**-**	**170**	**-**	**149**	**6**
Open Access Trawl, Other, >50% Groundfish	135	1,033	0.49	156	1,081	-	100	-	47	-	18	-
Limited Entry Fixed Gear Sablefish, Slope	316	1,200	1.72	6,545	5,057	-	689,424	-	984	413,654	-	-
Limited Entry Fixed Gear Sablefish, Shelf	105	514	1.76	9,428	19,258	-	1,509	-	142	-	26,621	-
Limited Entry Fixed Gear Sablefish, Nearshore	4	8	1.00	-	-	-	-	-	-	-	-	-
Limited Entry Fixed Gear Sablefish, No Strata	233	578	1.79	-	-	-	-	-	-	-	-	-
Limited Entry Fixed Gear, Other Groundfish, Slope	21	43	0.82	-	-	-	-	-	39	-	-	-
Limited Entry Fixed Gear, Other Groundfish, Shelf	52	924	0.24	-	-	-	77	-	115	-	56,336	-
Limited Entry Fixed Gear, Other Groundfish, Nearshc	185	82	2.11	-	-	-	-	-	27	-	14,504	-
Open Access, Sablefish, Slope	216	699	1.57	35,492	-	-	23,410	-	3,916	44,011	-	-
Open Access, Sablefish, Shelf	128	201	1.55	-	-	-	854	-	86	-	103,898	-
Open Access, Sablefish, Nearshore	7	5	1.68	-	-	-	-	-	38	-	-	-
Open Access, Sablefish, No Strata	535	406	1.60	-	-	-	-	-	-	-	-	-
Open Access, Slope	2	1	1.06	37	-	-	-	-	-	-	-	-
Open Access, Shelf	381	76	1.27	24,022	-	-	167	-	2	96,087	769	-
Open Access, Nearshore	4,229	752	2.00	136,495	57,748	-	21,760	-	27	375,361	5,287	-
Other Groundfish (plurality but <50%)	336	429	1.85	37,675	-	-	34,399	-	149	-	395,584	-
Pink Shrimp	1,963	54,995	0.27	11,601	212,582	1,886,662	5,638	-	1,100	1,257,775	39,306	-
Prawns	1	1	2.58	-	-	-	-	-	-	-	-	-
Pacific Halibut	379	857	1.83	-	120,349	-	6,985	-	183	3,508	-	-
California Halibut	115	7	2.56	-	-	-	-	-	2,699	-	-	-
Salmon	8,390	5,862	1.22	-	-	-	7,278	-	832	-	151,910	-
Sea Urchins	342	823	0.43	-	-	-	-	-	-	-	-	-
Gillnet Complex	1	1	0.25	-	-	-	-	-	-	-	-	-
Squid	2	5	0.21	-	-	-	-	-	-	-	-	-
CPS Plan Species	1,139	87,051	0.06	-	-	-	-	-	-	-	-	-
HMS Plan Species	1,490	18,553	0.65	-	-	-	-	-	-	-	-	-
Dungeness Crab	13,725	29,660	1.64	-	-	-	-	-	1,217,672	-	-	-
Other Crustaceans	1,636	389	4.30	-	-	-	-	-	-	-	-	-
Other Species	3,880	13,131	0.59	17,189	189,917	-	16,710	-	3,064	-	50,893	19
No Landing Weight or 2 Equal Weights	8	1	1.95	-	-	-	-	-	9	-	-	-

TABLE 3.4-20. Target species trip revenue per pound of overfished species landed and average price per pound of fish landed on the trip, 1998, 2002 (based on bycatch rates where available). a/b/ (Page 4 of 4)

Trip Target	Trips	Landed: Round Wt (thous)	Landed: Avg Price	Darkblotched Rockfish	Pacific Ocean Perch	Bocaccio	Canary Rockfish	Cowcod	Lingcod	Yelloweye Rockfish	Widow Rockfish	Whiting
2002												
South of Cape Mendocino												
Limited Entry Trawl, Petrale Sole	**53**	**348**	**0.83**	**17**	-	**870**	-	-	**144**	**71,993**	**434**	-
Limited Entry Trawl, Flatfish	**369**	**1,982**	**0.52**	**38**	-	**26**	**1,121**	**19,351**	**156**	**24,419**	**141**	-
Limited Entry Trawl, Midwater	2	2	0.61	-	-	-	-	-	-	-	1	-
Limited Entry Trawl, DTS	**625**	**7,425**	**0.58**	**73**	-	**668**	**10,412**	**225,225**	**1,359**	**1,069,819**	**1,168**	-
Limited Entry Trawl, Slope Rockfish	53	501	0.50	14	-	4,918	3,175	-	557	12,541	267	-
Limited Entry Trawl, Chillipepper	54	244	0.57	353	-	29	90	137,730	34	-	70	-
Limited Entry Trawl, Widow	1	6	0.64	-	-	-	196	-	-	-	1	-
Limited Entry Trawl, Other Rockfish	28	359	0.54	-	-	66	32,331	-	612	-	151	4,850
Limited Entry Trawl, Lingcod	6	3	1.21	-	-	5	-	-	2	-	-	-
Limited Entry Trawl, Leftover	**3**	**40**	**0.27**	**84**	-	**244**	-	-	**384**	-	**49**	-
Open Access Trawl, Prawn, >50% Groundfish	2	0	2.16	-	-	-	-	-	-	-	-	-
Open Access Trawl, Halibut, >50% Groundfish	25	4	1.83	-	-	-	-	-	-	-	-	-
Open Access Trawl, Other, >50% Groundfish	29	22	1.36	4,901	-	204	-	-	-	-	14,703	-
Limited Entry Fixed Gear Sablefish, Slope	695	416	1.48	-	-	-	-	15,336	23,593	-	-	1,820
Limited Entry Fixed Gear Sablefish, Shelf	4	3	1.49	-	-	-	-	-	58	-	-	-
Limited Entry Fixed Gear Sablefish, Nearshore	4	4	2.30	-	-	-	-	-	-	-	-	9,963
Limited Entry Fixed Gear Sablefish, No Strata	171	115	1.26	-	-	-	-	-	-	-	-	-
Limited Entry Fixed Gear, Other Groundfish, Slope	746	450	1.65	-	-	5,927	-	-	6,736	-	-	4,973
Limited Entry Fixed Gear, Other Groundfish, Shelf	32	15	1.95	-	-	78	-	-	9	-	1,261	-
Limited Entry Fixed Gear, Other Groundfish, Nearsh	43	17	3.04	-	-	-	-	-	103	-	-	-
Open Access, Whiting	1	0	1.06	-	-	-	-	-	-	-	-	1
Open Access, Sablefish, Slope	281	146	1.23	25,764	-	1,982	-	-	3,220	-	-	1,187
Open Access, Sablefish, Shelf	7	3	1.24	-	-	-	-	-	5	-	-	-
Open Access, Sablefish, Nearshore	5	2	2.16	-	-	-	-	-	-	-	-	-
Open Access, Sablefish, No Strata	979	354	1.42	-	-	-	-	-	-	-	-	41,983
Open Access, Slope	269	217	0.86	10,927	-	3,149	-	-	2,903	-	-	16,888
Open Access, Shelf	928	170	1.47	1,909	-	44	10,875	-	12	-	424	-
Open Access, Nearshore	3,838	413	4.26	70,418	-	293,407	17,430	-	52	25,149	-	-
Other Groundfish (plurality, but <50%)	180	120	1.42	-	-	199	34,029	-	222	-	-	-
Pink Shrimp	57	865	0.40	-	-	-	-	-	-	-	-	-
Prawns	2,083	900	4.43	-	-	72,546	65,411	-	332,504	-	-	-
California Halibut	4,326	689	2.62	-	-	24,394	-	-	1,036	-	6,078	-
Salmon	8,117	5,313	1.33	-	-	415,192	-	-	6,826	-	-	-
Sea Cucumber	1,177	926	0.85	-	-	-	-	-	35,931	-	-	-
Sea Urchins	9,719	13,476	0.73	-	-	-	-	-	149,179	-	-	-
California Sheephead	387	110	3.45	-	-	37,845	-	-	1,496	-	-	-
Gillnet Complex	2,767	840	1.78	-	-	99,698	-	-	8,172	-	1,495,473	19,940
Squid	2,857	158,856	0.11	-	-	-	-	-	-	-	-	-
CPS Plan Species	2,969	148,005	0.05	-	-	1,435,110	-	-	398,642	-	-	-
HMS Plan Species	1,966	8,965	1.00	-	-	-	-	-	52,769	-	-	-
Dungenes Crab	3,249	3,734	2.06	-	-	-	-	-	-	-	-	-
Other Crustaceans	8,526	2,732	2.34	-	-	1,599,999	-	-	65,306	-	-	-
Other Species	3,651	7,816	0.39	-	-	84,126	-	-	16,371	-	-	-
No Landing Weight or 2 Equal Weights	143	12	56.45	-	-	22,621	-	-	1,845	-	-	-

a/ Bolded lines are those for which a bycatch rate was used to estimate at least some of the landings for the indicated target fishery.

b/ Zero values indicate more than zero, but less than $0.5.

TABLE 3.4-21. Bycatch of overfished groundfish species in the West Coast Pacific whiting fishery, 1998 through 2001. (Page 1 of 1)

Whiting Fishery Sector	Year	Estimated Bycatch (mt)						
		Canary	Darkblotched	Lingcod	POP	Widow	Whiting	Yelloweye
At-Sea	1998	0.55[a/]	2.44[a/]	0.16[a/]	2.82[a/]	307	120,452	NA
	1999	3.85[a/]	3.87[a/]	0.01[a/]	2.70[a/]	149	115,259	NA
	2000	1.42	2.93[a/]	0.18[a/]	9.61	221	114,655	4.04[a/]
	2001	1.61	6.36[a/]	0.15[a/]	19.74	169	94,451	NA
Shoreside	1998	0.38	3.97	0.44	27.26	366	87,626	0.05
	1999	0.61	0.42	0.61	7.47	192	83,272	0.02
	2000	0.52	1.21	0.83	0.22	76	85,652	0.00
	2001	0.45	0.81	0.76	0.04	42	73,326	0.00
Tribal	1998	NA	NA	NA	NA	14	24,509	NA
	1999	NA	NA	NA	NA	37	25,844	NA
	2000	NA	NA	NA	NA	10	6,251	NA
	2001	NA	NA	NA	NA	NA	NA	NA

a/ Estimates reflect only landed catch from PacFIN.

TABLE 3.4-22. Catch and bycatch in the gillnet fishery, 1996 through 2000, by depth strata, number of fish or number of pounds (information on average weight per fish is required to sum the number of fish and pounds rows, generating a single number to represent bycatch). (Page 1 of 2)

Year	Unit	Bocaccio	California halibut	California sheephead	Canary rockfish	Chilipepper rockfish	Cowcod	CPS	Dungeness crab	Gillnet complex	HMS	HMS shark	Lingcod	Monitored HMS	Nearshore rockfish	Ocean whitefish	Other crustacean	Other fish	Other flatfish	Other nearshore sp.	Other shark	Other shelf flatfish	Other shelf sp.	Pacific whiting	Petrale sole	Sablefish	Shelf rockfish	Slope rockfish	Unspecified rockfish	Widow rockfish
		Species Caught (in thousands of the specified unit)																												
		No Depth Reported																												
'96	Number	1.7	36.2	0.0	–	–	–	1.6	0.0	0.2	–	0.0	8.9	0.3	0.2	–	0.6	0.4	0.4	0.0	3.3	–	–	–	0.0	0.1	0.3	–	3.2	–
	Lbs	0.0	10.4	–	–	–	–	2.8	–	0.3	–	0.1	0.0	0.4	0.2	–	0.4	0.9	0.1	–	12.7	–	–	–	–	–	1.4	–	1.4	–
'97	Number	0.0	10.5	0.0	–	–	–	0.2	0.0	1.0	–	0.1	0.0	0.0	0.1	–	0.2	1.1	0.3	0.0	2.7	–	0.1	–	0.0	–	–	–	0.1	–
	Lbs	–	–	4.5	–	–	–	0.5	0.3	0.0	–	0.5	–	0.1	0.4	–	0.0	0.2	10.0	0.3	10.1	–	–	–	0.0	–	–	–	0.2	–
'99	Number	–	3.6	0.0	–	–	–	0.0	–	0.8	0.0	0.3	0.0	0.0	0.2	0.0	0.0	4.0	0.1	0.0	1.4	–	–	–	–	–	–	–	0.0	–
	Lbs	–	12.7	0.0	–	–	–	4.4	–	10.2	–	0.4	0.0	0.2	0.0	–	0.5	0.2	0.1	–	5.3	–	–	–	–	–	–	–	–	–
'00	Number	–	2.9	0.0	–	–	–	–	–	0.3	–	0.0	–	0.0	0.1	–	–	–	0.3	0.0	0.7	–	0.1	–	–	–	–	–	–	–
	Lbs	–	1.9	–	–	–	–	2.1	–	6.5	–	–	–	–	–	–	0.0	0.2	–	–	0.6	–	2.2	–	–	–	–	–	–	–
		1-20 fathoms																												
'96	Number	–	6.3	0.0	–	–	–	0.0	–	0.2	–	0.1	0.0	5.6	0.3	–	0.0	0.3	0.1	0.0	1.5	–	–	0.0	–	–	–	–	0.1	–
	Lbs	–	1.7	0.0	–	–	–	4.9	–	15.4	–	–	–	0.4	0.0	–	0.2	0.7	0.1	–	8.9	–	–	0.0	–	–	–	–	–	–
'97	Number	0.5	13.2	0.1	–	5.6	–	1.8	0.1	1.4	–	0.2	1.1	0.6	0.6	0.0	0.4	1.1	0.4	0.1	3.3	–	0.1	–	0.1	–	–	–	0.1	0.8
	Lbs	–	0.0	–	–	–	–	11.8	–	25.2	–	–	–	–	0.2	–	0.2	0.7	0.0	–	17.3	–	–	–	–	–	–	–	–	–
'98	Number	–	7.8	0.1	–	–	–	–	0.1	1.0	–	0.2	0.0	0.5	0.3	0.0	0.2	1.7	0.1	0.0	2.4	–	1.1	–	–	–	–	–	0.1	–
	Lbs	–	5.9	0.0	–	–	–	–	–	0.5	–	0.2	–	1.2	0.5	–	0.8	0.6	–	–	8.6	–	–	–	–	–	–	–	0.0	–
'99	Number	–	18.4	0.1	–	–	–	2.6	–	2.8	–	0.6	–	1.1	0.7	0.0	0.6	1.0	0.2	0.0	3.5	–	0.3	–	0.0	–	–	–	0.1	–
	Lbs	–	7.3	–	–	–	–	6.1	–	9.5	–	3.1	0.0	0.9	0.4	–	0.3	0.5	0.0	–	6.6	–	–	–	–	–	–	–	0.2	–
'00	Number	–	4.8	0.0	–	–	–	0.7	–	0.6	–	0.0	–	0.1	0.0	–	–	0.0	0.1	–	1.8	–	0.0	–	–	–	–	–	0.0	–
	Lbs	–	1.3	–	–	–	–	0.6	–	2.8	–	–	–	0.1	0.0	–	–	0.1	–	–	1.1	–	–	–	–	–	–	–	–	–
		20-150 fathoms																												
'96	Number	2.3	13.6	0.0	–	0.0	0.0	2.1	0.1	2.4	–	0.4	0.8	3.1	0.3	0.0	0.0	3.8	0.4	0.1	3.2	0.0	–	0.0	0.0	0.0	–	–	15.8	–
	Lbs	6.3	21.3	0.0	–	2.7	0.1	25.9	–	20.8	–	0.7	2.2	0.7	0.3	0.0	0.3	4.5	0.5	–	2.8	0.3	–	0.1	0.1	0.3	0.2	–	183.7	0.2
'97	Number	8.9	29.9	0.1	–	14.5	–	7.6	0.5	10.1	–	0.8	11.0	3.5	3.9	0.1	0.1	7.5	0.8	0.0	2.6	0.1	0.0	–	0.0	0.4	1.4	–	9.4	10.5
	Lbs	2.4	–	0.0	–	0.1	–	6.1	0.1	4.4	–	–	0.0	0.0	1.5	0.1	0.0	0.9	2.0	–	0.2	–	–	–	–	–	–	–	112.2	0.0
'98	Number	4.9	17.0	0.1	0.0	2.1	0.2	1.3	0.1	2.7	–	0.7	0.4	1.9	0.3	0.1	0.6	10.7	0.4	0.0	4.2	–	4.5	0.0	0.0	0.1	9.1	–	17.2	–
	Lbs	8.4	0.1	–	–	0.5	–	1.6	–	1.7	–	0.1	–	2.0	0.8	0.0	0.3	8.5	0.2	–	1.6	–	–	–	–	–	0.1	0.3	105.3	–
'99	Number	0.4	20.2	0.0	–	1.0	–	5.5	0.4	3.2	–	0.8	0.1	3.4	0.5	0.0	0.5	3.5	0.7	0.0	3.8	–	4.0	0.3	0.0	–	–	–	0.6	–
	Lbs	0.8	39.0	–	–	1.3	0.2	0.7	–	12.4	–	0.5	0.1	2.4	0.2	–	0.2	5.8	0.0	–	2.9	–	0.0	–	–	–	0.6	0.8	11.0	–
'00	Number	–	4.9	0.0	–	–	–	0.1	0.1	1.9	–	0.1	–	0.3	0.0	–	0.3	0.1	0.4	–	1.5	–	0.0	0.0	–	–	–	–	0.0	–
	Lbs							0.1		27.6							0.0													

TABLE 3.4-22. Catch and bycatch in the gillnet fishery, 1996 through 2000, by depth strata, number of fish or number of pounds (information on average weight per fish is required to sum the number of fish and pounds rows, generating a single number to represent bycatch). (Page 2 of 2)

Year	Unit	Species Caught (in thousands of the specified unit)																												
		Bocaccio	California halibut	California sheephead	Canary rockfish	Chilipepper rockfish	Cowcod	CPS	Dungeness crab	Gillnet complex	HMS	HMS shark	Lingcod	Monitored HMS	Nearshore rockfish	Ocean whitefish	Other crustacean	Other fish	Other flatfish	Other nearshore sp.	Other shark	Other shelf flatfish	Other shelf sp.	Pacific whiting	Petrale sole	Sablefish	Shelf rockfish	Slope rockfish	Unspecified rockfish	Widow rockfish
													1-50 fathoms																	
'96	Number	0.8	19.8	0.0	_	0.0	0.0	1.7	0.1	2.5	_	0.4	0.4	6.3	0.5	0.0	0.0	3.0	0.4	0.1	4.5	_	_	0.0	0.0	0.0	_	_	0.2	_
	Lbs	0.6	22.9	0.0	_	_	_	30.8	_	36.2	_	0.5	0.5	1.1	0.3	0.0	0.6	4.0	0.5	_	11.7	0.0	_	0.1	_	_	0.0	_	0.6	_
'97	Number	0.5	43.0	0.2	_	5.6	_	9.2	0.6	11.5	_	0.9	1.2	1.9	4.6	0.1	0.5	4.1	1.0	0.1	5.7	_	0.1	_	0.1	_	_	_	0.4	0.8
	Lbs	_	0.0	_	_	_	_	17.8	0.1	29.7	_	_	_	_	1.6	0.1	0.3	1.6	2.0	_	17.5	_	_	_	_	_	_	_	_	_
'98	Number	_	24.7	0.2	_	_	_	1.3	0.2	3.6	_	0.8	0.0	1.6	0.6	0.0	0.8	11.9	0.5	0.0	6.5	_	5.6	0.0	0.0	0.0	_	_	0.4	_
	Lbs	_	6.0	0.0	_	_	_	1.6	_	2.2	_	0.2	_	2.0	1.3	_	1.1	8.8	0.1	_	9.9	_	_	_	_	_	_	_	0.2	_
'00	Number	_	9.7	0.0	_	_	_	0.7	0.1	2.5	_	0.1	_	0.3	0.1	_	0.3	0.2	0.5	_	3.3	_	0.0	0.0	_	_	_	_	0.0	_
	Lbs	_	1.3	_	_	_	_	0.7	_	30.3	_	_	_	0.1	0.0	_	0.0	0.1	_	_	1.1	_	_	_	_	_	_	_	_	_
													50-150 fathoms																	
'96	Number	1.5	0.1	_	_	_	0.0	0.4	_	0.0	_	0.1	0.4	2.4	0.1	_	_	1.0	0.1	_	0.2	0.0	_	_	_	_	_	_	15.6	_
	Lbs	5.7	_	_	_	2.7	0.1	0.0	_	0.0	_	0.2	1.7	0.0	_	_	_	1.2	_	_	0.1	0.2	_	_	0.1	0.3	0.2	_	183.2	0.2
'97	Number	8.9	0.1	_	_	14.5	_	0.1	_	_	_	0.1	10.9	2.2	0.0	0.0	_	4.5	0.1	_	0.1	0.1	_	_	_	0.4	1.4	_	9.2	10.5
	Lbs	2.4	_	0.0	_	0.1	_	0.1	_	_	_	_	0.0	0.0	_	0.0	_	_	0.0	_	0.0	_	_	_	_	_	_	_	112.2	0.0
'98	Number	4.9	0.1	_	0.0	2.1	0.2	_	_	0.1	_	0.1	0.4	0.8	0.0	0.0	_	0.4	0.1	_	0.1	_	_	_	_	0.1	9.1	_	17.0	_
	Lbs	8.4	_	_	_	0.5	_	_	_	_	_	0.1	_	1.2	_	0.0	_	0.3	0.0	_	0.3	_	_	_	_	_	0.1	0.3	105.1	_
'99	Number	0.4	0.2	_	_	1.0	_	_	_	0.1	_	0.1	0.0	1.7	0.0	_	_	0.0	_	_	0.0	_	0.8	_	_	_	_	_	0.4	_
	Lbs	0.8	_	_	_	1.3	0.2	_	_	_	_	0.1	0.1	1.1	_	_	0.2	2.4	_	_	0.1	_	_	_	_	_	0.6	0.8	11.0	_
'00	Number	_	0.0	_	_	_	_	_	_	_	_	_	_	0.0	_	_	_	_	_	_	_	_	_	_	_	_	_	_	_	_
	Lbs	_	_	_	_	_	_	_	_	0.2	_	_	_	_	_	_	_	_	_	_	_	_	_	_	_	_	_	_	_	_
													150+ fathoms																	
'96	Number	0.7	_	_	_	0.5	_	_	_	_	_	0.0	0.5	0.0	_	_	_	0.2	0.0	_	0.0	0.0	_	_	_	0.3	_	_	0.6	_
	Lbs	0.9	_	_	_	0.4	_	_	_	_	_	_	_	_	_	_	_	0.0	0.0	_	0.0	0.1	_	_	_	1.1	_	_	5.4	_
'97	Number	_	_	_	_	_	_	_	_	_	_	_	_	_	_	_	_	_	_	_	_	_	_	_	_	_	_	3.0	1.4	_
	Lbs	_	_	_	_	_	_	_	_	_	_	_	_	_	_	_	_	_	_	_	_	_	_	_	_	_	_	_	25.4	_
'98	Number	_	0.0	_	_	_	_	_	_	0.0	_	0.0	0.0	_	_	_	_	_	_	_	0.0	_	_	_	_	_	_	_	_	_
	Lbs	1.1	_	_	_	0.4	_	_	_	_	_	_	_	_	_	_	_	3.3	_	_	_	_	_	_	_	_	_	0.7	_	_
'99	Number	_	0.0	_	_	_	_	0.4	_	_	_	0.0	_	0.0	0.0	_	_	0.0	_	_	0.1	_	_	_	_	_	_	_	_	_
	Lbs													0.2																

NOTE: "0.0" indicates more than one but less than fifty.

TABLE 3.4-23. Summary of pink shrimp Log CPUE for south of Cape Mendocino. (Page 1 of 1)

	Number of Boats	Pounds	Hours	Average CPUE
Depth <=20 Fathoms				
1996	0	0	0.0	0.0
1997	0	0	0.0	0.0
1998	0	0	0.0	0.0
1999	0	0	0.0	0.0
2000	0	0	0.0	0.0
Depth between 20 - 150 Fathoms				
1996	10	527,410	1317.8	434.4
1997	15	408,769	827.1	464.6
1998	13	204,693	466.3	322.9
1999	6	89,740	262.9	223.9
2000	2	5,325	44.9	234.7
Depth <=50 Fathoms				
1996	0	0	0.0	0.0
1997	2	3,235	13.0	194.1
1998	0	0	0.0	0.0
1999	0	0	0.0	0.0
2000	0	0	0.0	0.0
Depth between 50 - 150 Fathoms				
1996	10	527,410	1317.8	434.4
1997	15	405,534	814.1	465.2
1998	13	204,693	466.3	322.9
1999	6	89,740	262.9	223.9
2000	2	5,325	44.9	234.7
Depth > 150 Fathoms				
1996	1	0	1.50	0.00
1997	2	3,900	7.22	571.85
1998	1	1,715	8.78	202.33
1999	0	0	0.00	0.00
2000	0	0	0.00	0.00

TABLE 3.4-24. Estimated bycatch (mt) of overfished groundfish fisheries in the Oregon pink shrimp trawl fishery with and without Bycatch Reduction Devices (BRDs) or fish excluders based on 1995-1999 average landings and a fish excluder study conducted in 1995 (Hannah *et al.* 1996). (Page 1 of 1)

Species	Bycatch Without BRDs	Bycatch With BRDs	Bycatch Reduction Rate Using BRDs[a/]
Canary Rockfish	12.70	0.19	98.5%
Darkblotched Rockfish	3.10	1.10	65.0%
Pacific Ocean Perch	0.31	0.01	98.5%
Lingcod	20.30	0.41	98.0%
Widow Rockfish	4.03	0.07	98.5%
Pacific Whiting Adults	3,294	494	85.0%
Pacific Whiting Juveniles[b/]	1,581	1,522	35.0%

a/ Data from Hannah *et al.* (1996).
b/ Juvenile whiting (≤33 cm) are rare off Oregon but were high in 1995 when the Hannah et al. (1996) study was done.

TABLE 3.4-25. Incidental overfished groundfish landings (lbs) in non-Indian commercial salmon troll fisheries by salmon management area for 2000 and 2001.[a/] (Page 1 of 1)

Port Area/Year	Lingcod	Bocaccio	Species Canary	Darkblotched	Widow	Yelloweye[b/]	All Groundfish[c/]
Neah Bay-La Push							
2000	NA	NA	469	NA	65	205	5,788
2001	NA	NA	175	NA	40	101	5,900
Westport-Astoria							
2000	NA	NA	119	NA	15	-	2,399
2001	NA	NA	97	NA	-	-	835
Central Oregon							
2000	NA	NA	2,332	NA	102	132	18,250
2001	NA	NA	1,264	NA	136	99	18,274
Oregon KMZ							
2000	NA	NA	167	NA	9	4	1,693
2001	NA	NA	185	NA	70	9	1,867
California KMZ							
2000	-	NA	-	-	-	-	249
2001	40	NA	-	-	-	-	64
Fort Bragg							
2000	50	12	91	-	-	NA	711
2001	121	9	61	-	22	NA	470
San Francisco							
2000	455	106	115	-	6	NA	2,971
2001	439	2	51	-	-	NA	807
Monterey-Conception							
2000	183	311	65	-	-	NA	2,308
2001	-	16	8	-	-	NA	166
Total							
2000	688	429	3,357	-	197	341	34,369
2001	600	27	1,841	-	268	209	28,382
Total (mt)							
2000	0.31	0.20	1.53	0.00	0.09	0.16	15.62
2001	0.27	0.01	0.84	0.00	0.12	0.10	12.90

a/ Salmon troll landings are defined as those for which salmon represents at least 50% by weight of the total ticketed landing. N/A indicates that individual species estimates were not made. Data from PacFIN.

b/ Yelloweye rockfish were not separated on landing tickets, so a proxy of shelf rockfish with an exvessel value of >$1.00/lb was used for areas north of Cape Mendocino. For areas south of Cape Mendocino yelloweye catch was not estimated, however landings are assumed negligible because of species distribution, the absence of commercial landings in the area between Cape Mendocino and the OR/CA border, and the scarcity of recreational landings in California.

c/ All Groundfish category includes species where individual estimates were not available.

TABLE 3.4-26. Expanded logbook data from the spot prawn trawl and trap fisheries south of Cape Mendocino, by depth strata, 1996 through 2000 (includes overfished species bycatch). (Page 1 of 1)

Trawls

Depth strata	Number of boats					Pounds targeted spp landed				
	1996	1997	1998	1999	2000	1996	1997	1998	1999	2000
≤20 fm	0	0	0	2	0	0	0	0	160	0
≤50 fm	1	1	0	4	2	0	0	0	225	15
>20 - ≤150 fm	18	29	28	26	18	213468	278113	275377	221878	100447
>50 - ≤150 fm	18	29	28	26	18	213468	278113	275377	221813	100432
>150 fm	14	26	21	21	10	12689	102278	181914	87947	17904

	Total hours					Fleet average CPUE for targeted spp				
	1996	1997	1998	1999	2000	1996	1997	1998	1999	2000
≤20 fm	0.0	0.0	0.0	7.1	0.0	0.0	0.0	0.0	19.2	0.0
≤50 fm	1.0	5.5	0.0	12.1	1.8	0.0	0.0	0.0	11.1	8.6
>20 - ≤150 fm	4953.0	6021.2	6611.9	7542.5	3355.6	44.1	44.1	35.8	37.9	31.4
>50 - ≤150 fm	4952.0	6015.7	6611.9	7537.5	3353.8	49.2	44.1	35.8	37.9	31.4
>150 fm	234.3	1793.2	3797.3	2582.5	556.8	38.4	48.0	46.9	32.7	33.5

Traps

Depth strata	Number of boats					Pounds targeted spp landed				
	1996	1997	1998	1999	2000	1996	1997	1998	1999	2000
>50 - ≤150 fm	22	26	29	33	32	83845	122184	180730	165500	134251
>150 fm	6	4	13	8	9	5560	5793	13331	23104	10898

	Trap days					Fleet average CPUE for targeted spp				
	1996	1997	1998	1999	2000	1996	1997	1998	1999	2000
>50 - ≤150 fm	309762	377167	647690	941967	791121	0.265	0.397	0.359	0.237	0.525
>150 fm	27554	32627	76256	122231	71454	8.038	0.267	0.343	0.285	0.207

TABLE 3.4-27. Estimated bycatch of overfished groundfish species in spot prawn trawl and trap fisheries south of Cape Mendocino. Estimates from Reilly and Geibel (2002) for the October 2000 through September 2001 period. (Page 1 of 1)

Species	Pounds of Bycatch/1,000 Pounds of Prawns	Estimated Total Catch (lbs)
	Trawls	
South of Pt. Conception		
Bocaccio	0.8	1,223
Cowcod	< 0.1	62
Darkblotched	0.2	249
Pacific Whiting	4,569	209,260
North of Pt. Conception		
Bocaccio	31.11	4,381
Canary	0.32	45
Cowcod	6.95	978
Darkblotched	99.86	14,060
Lingcod	212.63	29,938
Pacific Whiting	1,741	267,813
Widow	33.03	4,651
Yelloweye	0.64	90
	Traps	
South of Pt. Conception		
Bocaccio	4.0	574
Cowcod	3.0	370
Lingcod	37.0	4,982
North of Pt. Conception		
Cowcod	0.20	5
Darkblotched	0.10	2
Lingcod	4.40	104
Widow	0.30	7
Yelloweye	0.60	15

TABLE 3.4-28 Summary of Ridgeback Prawn Trawl Log CPUE. (Page 1 of 1)

	Number of Boats	Pounds	Hours	Average CPUE
Depth <=20 Fathoms				
1996	4	886	16.5	55.7
1997	0	0	0.0	0.0
1998	0	0	0.0	0.0
1999	1	2,050	10.7	194.5
2000	1	1,700	5.0	340.0
Depth between 20 - 150 Fathoms				
1996	224	405,092	4,666.6	99.8
1997	19	281,755	3,867.5	73.0
1998	19	333,741	3,274.3	115.8
1999	26	1,247,104	5,837.7	225.1
2000	34	1,296,475	8,057.2	168.1
Depth <=50 Fathoms				
1996	20	139,127	1,603.7	107.4
1997	9	8,112	339.4	25.2
1998	7	1,333	43.6	47.5
1999	16	52,610	279.3	205.2
2000	28	212,888	1,724.0	123.8
Depth between 50 - 150 Fathoms				
1996	24	266,851	3,079.4	99.3
1997	18	273,643	3,528.1	77.1
1998	19	332,408	3,230.7	117.3
1999	26	1,196,544	5,569.1	226.3
2000	34	1,085,287	6,338.2	176.3
Depth > 150 Fathoms				
1996	1	0	2.0	0.0
1997	2	41	6.7	6.3
1998	3	10	19.3	0.3
1999	1	260	2.0	130.0
2000	2	553	19.4	158.3

Information on bycatch and whether or not an excluder was used is not recorded in logbooks.

TABLE 3.4-29. Expanded logbook data from the sea cucumber trawl fishery, by depth strata, 1996 through 2000 (includes overfished species bycatch). (Page 1 of 1)

Depth strata	Number of boats					Pounds targeted spp landed				
	1996	1997	1998	1999	2000	1996	1997	1998	1999	2000
≤20 fm	5	1	1	3	0	1,504	810	2,061	2,129	0
≤50 fm	15	7	16	12	9	120,001	60,630	134,149	104,345	57,495
>20 - ≤150 fm	16	9	21	13	12	221,305	60,004	162,507	148,066	59,585
>50 - ≤150 fm	13	2	14	10	7	102,808	184	30,419	45,850	2,090
>150 fm	0	0	2	1	0	0	0	2,745	235	0
0 or no depths	5	0	2	5	1	317	0	562	1,899	0

Depth strata	Total hours					Fleet average CPUE for targeted spp				
	1996	1997	1998	1999	2000	1996	1997	1998	1999	2000
≤20 fm	37.6	4.7	34.6	11	0	33.7	173.5	43.3	19.2	0
≤50 fm	1054.1	369.5	1557.2	1026	426	112.8	180.8	109.2	102.7	134.1
>20 - ≤150 fm	1875.6	395.7	2137.4	1857.9	582.8	113.7	141.8	108.4	95.1	100.5
>50 - ≤150 fm	859.2	30.8	614.8	824.9	156.8	91.8	5	53.1	40.5	41.7
>150 fm	0	0	78.4	17.8	0	0	0	33.1	13.2	0

Depth strata	Pounds bycatch of bocaccio					Pounds bycatch of canary rockfish				
	1996	1997	1998	1999	2000	1996	1997	1998	1999	2000
≤20 fm	0	0	0	0	0	0	0	0	0	0
≤50 fm	0	0	0	0	0	0	0	0	0	0
>20 - ≤150 fm	10	0	0	20	0	0	0	0	0	0
>50 - ≤150 fm	10	0	0	20	0	0	0	0	0	0
>150 fm	0	0	0	0	0	0	0	0	0	0

Depth strata	Pounds bycatch of cowcod					Pounds bycatch of yelloweye rockfish				
	1996	1997	1998	1999	2000	1996	1997	1998	1999	2000
≤20 fm	0	0	0	0	0	0	0	0	0	0
≤50 fm	0	0	0	0	0	0	0	0	0	0
>20 - ≤150 fm	0	0	0	0	0	0	0	0	0	0
>50 - ≤150 fm	0	0	0	0	0	0	0	0	0	0
>150 fm	0	0	0	0	0	0	0	0	0	0

Depth strata	Pounds bycatch of lingcod					Pounds bycatch of unspecified rockfish				
	1996	1997	1998	1999	2000	1996	1997	1998	1999	2000
≤20 fm	0	0	0	0	0	30	0	0	0	0
≤50 fm	52	0	0	0	0	2341	0	168	325	16
>20 - ≤150 fm	82	0	0	0	0	3824	0	207	390	16
>50 - ≤150 fm	30	0	0	0	0	1513	0	39	65	0
>150 fm	0	0	0	0	0	0	0	0	0	0

Depth strata	Pounds bycatch of CA halibut					Bycatch rate (lbs bocaccio/lbs target spp)				
	1996	1997	1998	1999	2000	1996	1997	1998	1999	2000
≤20 fm	502	74	93	0	0	0	0	0	0	0
≤50 fm	3461	1081	4518	195	262	0	0	0	0	0
>20 - ≤150 fm	3783	1007	5458	368	262	tr	0	0	tr	0
>50 - ≤150 fm	824	0	1033	173	0	tr	0	0	tr	0
>150 fm	0	0	367	0	0		0	0	0	0
0 or no depths			33							

Depth strata	Bycatch rate (lbs canary/lbs target spp)				
	1996	1997	1998	1999	2000
≤20 fm	0	0	0	0	0
≤50 fm	0	0	0	0	0
>20 - ≤150 fm	0	0	0	0	0
>50 - ≤150 fm	0	0	0	0	0
>150 fm	0	0	0	0	0

Depth strata	Bycatch rate (lbs cowcod/lbs target spp)				
	1996	1997	1998	1999	2000
≤20 fm	0	0	0	0	0
≤50 fm	0	0	0	0	0
>20 - ≤150 fm	0	0	0	0	0
>50 - ≤150 fm	0	0	0	0	0
>150 fm	0	0	0	0	0

TABLE 3.4-30. Catch and bycatch in the market squid fishery from vessel logbooks. (Page 1 of 1)

			Fleet Average CPUE														
						Pounds of Bycatch						Pounds of Bycatch per Pound of Targeted Species					
Geographic Area	Depth	Year	Number of Sets	Pounds of Targeted Species Landed	Catch Per Set of Targeted Species	Bocaccio	Canary	Cowcod	Yelloweye	Lingcod	Unspecified Rockfish	Bocaccio	Canary	Cowcod	Yelloweye	Lingcod	Unspecified Rockfish
North	<20 fm	1999	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
		2000	386	5,288,000	13,699	0	0	0	0	0	500	0	0	0	0	0	0
		2001	356	9,362,000	26,298	0	0	0	0	0	0	0	0	0	0	0	0
		2002	645	14,598,000	22,633	0	0	0	0	0	0	0	0	0	0	0	0
	>20 and <150 fm	1999	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
		2000	8	226,000	28,250	0	0	0	0	0	0	0	0	0	0	0	0
		2001	31	700,000	22,581	0	0	0	0	0	0	0	0	0	0	0	0
		2002	246	5,436,000	22,098	0	0	0	0	0	0	0	0	0	0	0	0
		1999	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
		2000	7	120,000	17,143	0	0	0	0	0	0	0	0	0	0	0	0
		2001	18	412,000	22,889	0	0	0	0	0	0	0	0	0	0	0	0
		2002	15	550,000	36,667	0	0	0	0	0	0	0	0	0	0	0	0
	>10 and <150 fm	1999	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
		2000	387	5,394,000	13,938	0	0	0	0	0	500	0	0	0	0	0	0
		2001	369	9,650,000	26,152	0	0	0	0	0	0	0	0	0	0	0	0
		2002	876	19,484,000	22,242	0	0	0	0	0	0	0	0	0	0	0	0
South	<20 fm	1999	6	496,000	82,667	0	0	0	0	0	0	0	0	0	0	0	0
		2000	1,512	58,664,000	38,799	0	0	0	0	0	0	0	0	0	0	0	0
		2001	1,159	44,280,000	38,205	0	0	0	0	0	0	0	0	0	0	0	0
		2002	497	15,498,000	31,183	0	0	0	0	0	0	0	0	0	0	0	0
	>20 and <150 fm	1999	27	2,168,000	80,296	0	0	0	0	0	0	0	0	0	0	0	0
		2000	1,085	48,262,000	44,481	0	0	0	0	0	0	0	0	0	0	0	0
		2001	1,020	42,486,000	41,653	0	0	0	0	0	0	0	0	0	0	0	0
		2002	554	20,946,000	37,809	0	0	0	0	0	0	0	0	0	0	0	0
	<10 fm	1999	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		2000	19	692,000	36,421	0	0	0	0	0	0	0	0	0	0	0	0
		2001	26	796,000	30,615	0	0	0	0	0	0	0	0	0	0	0	0
		2002	3	36,000	12,000	0	0	0	0	0	0	0	0	0	0	0	0
	>10 and <150 fm	1999	33	2,664,000	80,727	0	0	0	0	0	0	0	0	0	0	0	0
		2000	2,578	106,234,000	41,208	0	0	0	0	0	0	0	0	0	0	0	0
		2001	2,153	85,970,000	39,930	0	0	0	0	0	0	0	0	0	0	0	0
		2002	1,048	36,408,000	34,740	0	0	0	0	0	0	0	0	0	0	0	0

TABLE 3.4-31. Annual coastwide and area participation in the Highly Migratory Species gillnet fishery by open-access vessels, with associated groundfish on the same landing day, 1990 through 2001. (Page 1 of 2)

Area/Landings	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
CA: N of Cape Mendocino											
Metric tons											
HMS gillnet		1	11	28	1	5	5	14	4	12	1
Groundfish		0	0	0	0	0	0	0	0	0	0
% of HMS gillnet		0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Number of vessels											
HMS gillnet		1	13	15	2	9	8	13	6	5	2
with groundfish		0	0	0	0	0	0	0	0	0	0
Percent of HMS gillnet		0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Number of trips											
HMS gillnet		3	17	27	3	16	13	25	11	14	4
with groundfish		0	0	0	0	0	0	0	0	0	0
Percent of HMS gillnet		0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
CA: Cape Mendocino - Pt Conception											
Metric tons											
HMS gillnet	1	2	14	40	58	93	89	67	62	25	73
Groundfish	0	0	0	0	0	0	0	0	0	0	0
Percent of HMS gillnet	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Number of vessels											
HMS gillnet	6	12	31	43	52	54	54	45	34	26	20
with groundfish	0	0	0	0	1	1	3	2	0	0	3
Percent of HMS gillnet	0%	0%	0%	0%	2%	2%	6%	4%	0%	0%	15%
Number of trips											
HMS gillnet	6	15	51	82	148	160	204	149	101	68	52
with groundfish	0	0	0	0	1	1	3	2	0	0	4
Percent of HMS gillnet	0%	0%	0%	0%	1%	1%	1%	1%	0%	0%	8%
CA: S of Pt. Conception											
Metric tons											
HMS gillnet	0	0	3	11	79	24	55	110	73	75	75
with Groundfish	0	0	0	1	0	1	4	10	12	6	3
Percent of HMS gillnet	0%	0%	8%	13%	0%	4%	6%	9%	16%	8%	4%
Number of vessels											
HMS gillnet	3	3	24	56	71	75	74	101	88	78	64
with groundfish	0	0	4	6	8	17	24	32	30	38	16
Percent of HMS gillnet	0%	0%	17%	11%	11%	23%	32%	32%	34%	49%	25%
Number of trips											
HMS gillnet	3	4	37	115	219	251	412	769	499	548	223
with groundfish	0	0	7	6	13	38	110	228	129	116	47

TABLE 3.4-31. Annual coastwide and area participation in the Highly Migratory Species gillnet fishery by open-access vessels, with associated groundfish on the same landing day, 1990 through 2001. (Page 2 of 2)

Area/Landings	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Percent of HMS gillnet	0%	0%	19%	5%	6%	15%	27%	30%	26%	21%	21%
Coastwide											
Metric tons											
HMS gillnet	1	3	27	79	138	122	150	192	141	113	149
with Groundfish	0	0	0	1	0	1	4	10	12	6	3
Percent of HMS gillnet	0%	0%	1%	2%	0%	1%	3%	5%	8%	5%	2%
Number of vessels											
HMS gillnet	9	14	53	84	95	104	103	110	105	86	71
with groundfish	0	0	4	6	9	18	27	34	31	38	19
Percent of HMS gillnet	0%	0%	8%	7%	9%	17%	26%	31%	30%	44%	27%
Number of trips											
HMS gillnet	9	22	105	224	371	430	631	953	615	630	279
with groundfish	0	0	7	6	14	39	113	230	130	116	51
Percent of HMS gillnet	0%	0%	7%	3%	4%	9%	18%	24%	21%	18%	18%

TABLE 3.4.2-32. Annual coastwide and area participation in the Highly Migratory Species seine fishery by open-access vessels, with associated groundfish on the same landing day, 1990 through 2001. (Page 1 of 1)

Area/Landings	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
CA: Cape Mendocino - Pt. Conception												
Metric tons												
HMS seine			0					0		98		110
with groundfish			0					0		0		0
Percent of HMS seine			0%					0%		0%		0%
Number of vessels												
HMS seine			1					1		3		4
with groundfish			0					0		0		0
Percent of HMS seine			0%					0%		0%		0%
Number of trips												
HMS seine			1					1		10		13
with groundfish			0					0		0		0
Percent of HMS seine			0%					0%		0%		0%
CA: S of Pt. Conception												
Metric tons												
HMS seine	9,977	5,938	3,804	3,145	5,713	9,014	12,448	12,742	11,085	5,175	2,167	776
with groundfish	0	0	0	0	0	0	0	0	0	0	0	0
% of HMS seine	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Number of vessels												
HMS seine	30	17	27	26	25	21	23	33	35	12	18	13
with groundfish	0	0	1	1	0	0	0	0	0	0	0	0
Percent of HMS seine	0%	0%	4%	4%	0%	0%	0%	0%	0%	0%	0%	0%
Number of trips												
HMS seine	151	70	119	95	129	150	192	148	127	38	52	40
with groundfish	0	0	1	1	0	0	0	0	0	0	0	0
Percent of HMS seine	0%	0%	1%	1%	0%	0%	0%	0%	0%	0%	0%	0%
Coastwide												
Metric tons												
HMS seine	9,977	5,938	3,804	3,145	5,713	9,014	12,448	12,742	11,085	5,273	2,167	885
with groundfish	0	0	0	0	0	0	0	0	0	0	0	0
Percent of HMS seine	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Number of vessels												
HMS seine	30	17	28	26	26	21	23	35	35	14	18	15
with groundfsih	0	0	1	1	0	0	0	0	0	0	0	0
Percent of HMS seine	0%	0%	4%	4%	0%	0%	0%	0%	0%	0%	0%	0%
Number of trips												
HMS seine	151	70	120	95	130	150	192	150	127	48	52	53
with groundfish	0	0	1	1	0	0	0	0	0	0	0	0
Percent of HMS seine	0%	0%	1%	1%	0%	0%	0%	0%	0%	0%	0%	0%

TABLE 3.4-33. Baseline OYs and landed catch for West Coast groundfish fisheries, 1998 and 2002 (at-sea deliveries included, except for nonwhiting tribal catch in 1998, for recreational fisheries only overfished species catch is provided). (Page 1 of 2)

	1998							2002						2003
			Reported Landings/ Catches (All Areas)						Reported Landings/ Catches (All Areas)					
	Area	Nontriba Com Tota Catch OY	Com Lndg (mt)	Com Lndg Rev	Rec Catch	Tribal Lndg	Area	Nontriba Com Tota Catch OY	Com Lndg	Com Lndg Rev	Rec Catch	Triba Lndg	Area	Nontriba Com Tota Catch OY
Lingcod	Coastwide	[redacted]	503	715	412	2	Coastwide	[redacted]	194	488	655	11	Coastwide	[redacted]
Pacific Cod	Vanc/Col	[redacted]	518	488		2	Vanc/Col	[redacted]	693	779		58	Vanc/Col	[redacted]
Whiting	Coastwide	[redacted]				24,487	Coastwide	[redacted]				20,805	Coastwide	[redacted]
Whiting, At-Sea	Coastwide	[redacted]	142,810	8,186			Coastwide	[redacted]	62,603	6,763			Coastwide	[redacted]
Whiting, Shoreside	Coastwide	[redacted]	89,591	4,945			Coastwide	[redacted]	45,766	4,568			Coastwide	[redacted]
Sablefish, North	Coastwide	[redacted]				-	Coastwide	[redacted]				-	Coastwide	[redacted]
Sablefish, North, LE TWL	Landed =	[redacted]	2,069	5,070		1	Landed =	[redacted]	1,539	3,603		11	Landed =	[redacted]
Sablefish, North, LE FG	Landed =	[redacted]	1,655	4,454		443	Landed =	[redacted]	1,644	6,018		424	Landed =	[redacted]
Sablefish, North, OA	Landed =	[redacted]	13	35		2	Landed =	[redacted]	18	60		-	Landed =	[redacted]
Sablefish, South	Conc	[redacted]					Conc	[redacted]					Conc	[redacted]
Sablefish, South, LE TWL		[redacted]	112	195		-		[redacted]	49	108		-		[redacted]
Sablefish, South, LE FG		[redacted]	98	330		-		[redacted]	134	490		-		[redacted]
Sablefish, South, Open Access		[redacted]	1	1		-		[redacted]	6	19		-		[redacted]
POP	Vanc/Col (Landed)	[redacted]	1,212	980		-	Vanc/Col/Eur	[redacted]	150	145	0	0	Vanc/Col/Eur	[redacted]
Shortbelly RF	Coastwide	[redacted]	24	11		-	Coastwide	[redacted]	0	0		-	Coastwide	[redacted]
Widow RF	Coastwide	[redacted]	4,334	3,513	45	0	Coastwide	[redacted]	320	264	2	32	Coastwide	[redacted]
Canary RF	Vanc/Col	[redacted]	1,299	1,479	85	0	Coastwide	[redacted]	46	47	19	6	Coastwide	[redacted]
Chilipepper RF, South	Eur/Mont/Conc	[redacted]	1,338	1,254		-	Mont/Conc	[redacted]	154	183		-	Mont/Conc	[redacted]
Bocaccio RF, South	Eur/Mont/Conc	[redacted]	139	160	52	-	Mont/Conc	[redacted]	21	32	82	-	Mont/Conc	[redacted]
Splitnose, South		[redacted]	1,356	744		-	Mont/Conc	[redacted]	50	38		-	Mont/Conc	[redacted]
Yellowtail RF, North	Vanc/Col	[redacted]	3,047	2,452		6	Vanc/Col/Eur	[redacted]	763	765		438	Vanc/Col/Eur	[redacted]
Thds, Shortspine	Coastwide	[redacted]	1,247	2,318		4	Coastwide	[redacted]	770	2,145		5	Coastwide	[redacted]
Thds, Shortspine	Conc N of Pt Conc	[redacted]						[redacted]						[redacted]
Thds, Longspine, North	Coastwide	[redacted]	2,232	3,130		0	N or Conc Area	[redacted]	1,887	3,566		-	N or Conc Area	[redacted]
Thds, Longspine, South	Conc N of Pt Conc	[redacted]	11	58		-	Conc	[redacted]	13	68		-	Conc	[redacted]
Thds, Other		[redacted]	49	164		-		[redacted]	61	157		-		[redacted]
Cowcod, South		[redacted]	2	6	3	-	Conc	[redacted]	0	0	1	-	Conc	[redacted]
Cowcod, North		[redacted]	18	21		-	Mont	[redacted]	0	0		-	Mont	[redacted]
Darkblotched RF		[redacted]	898	751		-	Coastwide	[redacted]	103	100		2	Coastwide	[redacted]
Yelloweye RF, North		[redacted]	62	100	34	-	N or Conc Area	[redacted]	1	1	6	0	N or Conc Area	[redacted]
Yelloweye RF, South		[redacted]	14	42		-		[redacted]	0	0	1	-		[redacted]
Black Rf, North		[redacted]	264	278		-		[redacted]	210	511		-		[redacted]
Bocaccio RF, North		[redacted]	259	209		0		[redacted]	6	6		1		[redacted]
Chilipepper RF, Eureka		[redacted]	69	47		-		[redacted]	6	5		-		[redacted]
Redstripe RF, North		[redacted]	123	86		0		[redacted]	5	3		2		[redacted]

TABLE 3.4-33. Baseline OYs and landed catch for West Coast groundfish fisheries, 1998 and 2002 (at-sea deliveries included, except for nonwhiting tribal catch in 1998, for recreational fisheries only overfished species catch is provided). (Page 2 of 2)

	1998						2002						2003	
			Reported Landings/ Catches (All Areas)						Reported Landings/ Catches (All Areas)					
	Area	Nontriba Com Tota Catch OY	Corr Lndg (mt)	Corr Lndg Rev	Rec Catch	Triba Lndg	Area	Nontriba Com Tota Catch OY	Corr Lndg	Corr Lndg Rev	Rec Catch	Triba Lndg	Area	Nontribal Com Tota Catch OY
Sharpchin RF, North			108	65		0			5	5		0		
Silvergrey RF, North			472	381		-			3	3		0		
Splitnose RF, North			157	94		-			16	7		0		
Yellowmouth RF, North			44	35		-			2	1		-		
Bank RF, South			563	628		-			235	285		-		
Blackgill RF, South			225	307		-			117	243		-		
Sharpchin RF, South			10	6		-			1	1		-		
Yellowtail RF, South			316	374		-			2	3		-		
Other Rockfish North	Vanc/Col/Eur	7,057	1,485	1,500		30	Vanc/Col/Eur	3,115	208	604		24	Vanc/Col/Eur	3,056
Other Rockfish South	Mont/Conc	8,439	1,037	3,638		-	Mont/Conc	2,015	306	1,555		-	Mont/Conc	894
Dover Sole	Coastwide	9,426	8,296	6,213		2	Coastwide	7,368	6,291	5,052		16	Coastwide	7,440
English Sole			1,182	910		1			1,138	881		40		
Petrale Sole			1,500	3,127		1			1,776	3,584		21		
Arrowtooth Flounder			4,120	927		0			2,138	512		3		
Sanddabs			777	507		-			818	661		9		
Other Flatfish			944	842		1			882	1,020		11		
Other Groundfish			1,613	2,456		1			1,359	1,772		1		
Total			278,218	64,233		24,983			132,507	47,117		21,923		

TABLE 3.4-34. Number of vessels by vessel primary port and species group for the base period (November 2000 through October 2001). (Page 1 of 3)

	Vessels with Limited Entry Trawl Permits						Vessels with Fixed Gear Limited Entry Permits (No Trawl Permit)					Open Access Vessels with More than 5% Revenue from Groundfish					Open Access Vessels with Less than 5% Revenue from Groundfish					Total for All Groundfish	Vessels Participating in Other Fisheries							
	Whiting	Sablefish	Nearshore Spp	Shelf Spp	Slope Spp	Total	Sablefish	Nearshore Spp	Shelf Spp	Slope Spp	Total	Sablefish	Nearshore Spp	Shelf Spp	Slope Spp	Total	Sablefish	Nearshore Spp	Shelf Spp	Slope Spp	Total		Halibut (Pac & CA)	Shrimp/Prawns	Crabs	Salmon	HMS	CPS	Other	Total
Blaine	2	4	4	4	4	4	-	-	-	-	-	-	-	-	-	-	1	-	-	-	1	5	-	-	11	-	-	-	117	119
Bellingham	1	5	5	5	5	5	19	2	14	17	19	-	-	1	-	1	-	-	-	-	-	25	13	-	14	-	5	2	203	210
Point Roberts	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	6	6
Friday Harbor	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3	3
Anacortes	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	74	74
LaConner	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	1	1	-	1	1	1	2	2	-	3	-	-	-	25	25
Everett	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	51	51
Seattle	-	-	-	-	-	-	2	-	-	2	2	-	-	-	-	-	-	-	1	-	1	3	3	-	12	1	7	1	75	93
Tacoma	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	1	1	1	1	1	1	1	1	1	2	-	26	27
Shelton	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4	4
Centralia	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	14	14
Puget Sound Total	**3**	**9**	**9**	**9**	**9**	**9**	**21**	**2**	**14**	**19**	**21**	**1**	**0**	**1**	**0**	**2**	**3**	**1**	**3**	**2**	**4**	**36**	**19**	**1**	**42**	**3**	**14**	**3**	**598**	**626**
Port Townsend	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	23	23
Quilcene	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	2
Sequim	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	10	10
Port Angeles	-	3	3	3	3	3	14	1	13	14	15	12	6	17	8	20	-	-	4	1	4	42	19	-	1	11	2	-	25	58
Neah Bay	-	3	3	3	3	3	-	-	-	-	-	-	-	2	-	2	-	-	-	-	-	5	2	-	-	-	-	-	3	5
La Push	-	-	-	-	-	-	2	1	2	2	2	3	1	2	2	3	-	-	-	-	-	5	1	-	6	-	2	-	4	10
NW Olympic Peninsula Total	**0**	**6**	**6**	**6**	**6**	**6**	**16**	**2**	**15**	**16**	**17**	**15**	**7**	**21**	**10**	**25**	**0**	**0**	**4**	**1**	**4**	**52**	**22**	**0**	**7**	**11**	**5**	**0**	**67**	**108**
Copalis	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	10	10
Aberdeen	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	1	-	-	-	2
Westport (WA)	5	11	5	12	11	12	11	-	9	11	11	6	-	4	4	6	7	1	21	3	22	51	16	13	100	40	58	9	44	178
Central WA Coast Total	**5**	**11**	**5**	**12**	**11**	**12**	**11**	**0**	**9**	**11**	**11**	**6**	**0**	**4**	**4**	**6**	**7**	**1**	**21**	**3**	**22**	**51**	**16**	**13**	**101**	**41**	**58**	**9**	**54**	**190**
Tokeland	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3	-	4	2	4	4	-	4	20	-	2	-	35	57
Ilwaco	1	4	2	4	4	4	3	3	4	3	4	5	-	2	2	5	15	2	22	8	29	42	25	7	51	35	96	7	61	163
Pacific County	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	46	47
Columbia River	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	1	-	-	173	173
South WA Coast Total	**1**	**4**	**2**	**4**	**4**	**4**	**3**	**3**	**4**	**3**	**4**	**5**	**0**	**2**	**2**	**5**	**18**	**2**	**26**	**10**	**33**	**46**	**25**	**11**	**72**	**36**	**98**	**8**	**315**	**440**
Astoria	4	31	18	31	30	31	11	-	9	7	11	11	3	9	7	12	17	4	16	9	19	73	21	23	66	27	68	19	43	164
Gearhart-Seaside	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-	-	-	2
Cannon Beach	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-	-	-	2
Nehalem Bay	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-	-	-	-	2
Garibaldi (Tillamook)	-	3	3	3	3	3	-	-	-	-	-	-	7	5	-	7	2	12	21	2	27	37	18	-	18	47	26	1	14	71
Pacific City	-	-	-	-	-	-	-	-	-	-	-	-	17	13	-	17	-	-	-	-	-	17	-	-	2	8	5	-	2	21
Astoria-Tillamook Total	**4**	**34**	**21**	**34**	**33**	**34**	**11**	**0**	**9**	**7**	**11**	**11**	**27**	**27**	**7**	**36**	**19**	**16**	**37**	**11**	**46**	**127**	**39**	**23**	**88**	**86**	**99**	**20**	**59**	**262**
Depoe Bay	-	-	-	-	-	-	-	-	-	-	-	-	3	3	-	3	1	1	1	1	2	5	2	-	5	4	3	-	8	12
Newport	15	26	12	25	25	26	13	3	11	10	14	7	5	8	2	9	24	10	87	24	90	139	94	21	89	157	157	13	50	267
Waldport	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	6	-	-	-	-	6

TABLE 3.4-34. Number of vessels by vessel primary port and species group for the base period (November 2000 through October 2001). (Page 2 of 3)

	Vessels with Limited Entry Trawl Permits						Vessels with Fixed Gear Limited Entry Permits (No Trawl Permit)					Open Access Vessels with More than 5% Revenue from Groundfish					Open Access Vessels with Less than 5% Revenue from Groundfish					Total for All Groundfish	Vessels Participating in Other Fisheries							
	Whiting	Sablefish	Nearshore Spp	Shelf Spp	Slope Spp	Total	Sablefish	Nearshore Spp	Shelf Spp	Slope Spp	Total	Sablefish	Nearshore Spp	Shelf Spp	Slope Spp	Total	Sablefish	Nearshore Spp	Shelf Spp	Slope Spp	Total		Halibut (Pac & CA)	Shrimp/Prawns	Crabs	Salmon	HMS	CPS	Other	Total
Newport Total	**15**	**26**	**12**	**25**	**25**	**26**	**13**	**3**	**11**	**10**	**14**	**7**	**8**	**11**	**2**	**12**	**25**	**11**	**88**	**25**	**92**	**144**	**96**	**21**	**100**	**161**	**160**	**13**	**58**	**285**
Florence	-	-	-	-	-	-	3	-	1	1	3	-	1	1	1	1	1	1	8	-	8	12	7	-	10	27	15	1	3	30
Winchester	-	-	-	-	-	-	3	-	3	-	3	1	-	-	-	1	-	3	9	-	10	14	6	1	12	25	14	-	4	35
Charleston (Coos Bay)	4	26	17	29	27	29	8	-	7	3	9	12	15	16	7	21	5	14	30	3	34	93	18	25	59	84	77	3	47	146
Bandon	-	-	-	-	-	-	-	-	-	-	-	-	2	1	-	2	-	1	2	-	2	4	-	-	2	4	2	-	-	8
Coos Bay Total	**4**	**26**	**17**	**29**	**27**	**29**	**14**	**0**	**11**	**4**	**15**	**13**	**18**	**18**	**8**	**25**	**6**	**19**	**49**	**3**	**54**	**123**	**31**	**26**	**83**	**140**	**108**	**4**	**54**	**219**
Port Orford	-	-	-	-	-	-	11	14	14	14	14	8	35	36	33	37	-	7	5	2	7	58	12	-	30	27	11	-	53	67
Gold Beach	-	-	-	-	-	-	-	-	-	-	-	-	20	19	17	20	-	2	2	2	2	22	-	-	1	3	1	-	23	23
Brookings	-	4	3	4	4	4	3	1	2	1	3	1	25	25	9	28	1	9	9	-	12	47	3	3	33	28	20	-	34	71
Brookings Total	**0**	**4**	**3**	**4**	**4**	**4**	**14**	**15**	**16**	**15**	**17**	**9**	**80**	**80**	**59**	**85**	**1**	**18**	**16**	**4**	**21**	**127**	**15**	**3**	**64**	**58**	**32**	**0**	**110**	**161**
Crescent City	**2**	**20**	**14**	**20**	**20**	**20**	**8**	**4**	**5**	**2**	**9**	**7**	**35**	**35**	**7**	**37**	**4**	**8**	**15**	**3**	**19**	**85**	**11**	**21**	**118**	**31**	**45**	**4**	**44**	**141**
Orick	-	-	-	-	-	-	-	-	-	-	-	1	8	8	1	8	-	-	1	-	1	9	1	-	4	7	2	-	-	12
Trinidad	-	-	-	-	-	-	-	-	-	-	-	-	5	6	-	6	-	1	1	-	1	7	-	-	23	2	1	-	3	27
Eureka Area	1	16	15	16	16	16	4	2	4	4	4	13	13	12	8	17	2	1	1	-	2	39	7	5	51	33	17	1	36	78
Fields Landing	3	10	7	10	10	10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	10	2	1	7	2	-	1	8	14
Eureka Total	**4**	**26**	**22**	**26**	**26**	**26**	**4**	**2**	**4**	**4**	**4**	**14**	**26**	**26**	**9**	**31**	**2**	**2**	**3**	**0**	**4**	**65**	**10**	**6**	**85**	**44**	**20**	**2**	**47**	**131**
Fort Bragg	-	12	5	12	12	12	3	1	3	3	4	27	36	34	6	57	4	5	3	1	8	81	3	3	26	49	19	1	56	130
Albion	-	-	-	-	-	-	-	-	-	-	-	2	6	5	-	7	-	1	1	-	2	9	-	-	2	2	1	-	12	17
Point Arena	-	-	-	-	-	-	-	-	-	-	-	-	4	3	1	4	-	3	2	1	4	8	-	-	5	3	1	-	11	19
Fort Bragg Total	**0**	**12**	**5**	**12**	**12**	**12**	**3**	**1**	**3**	**3**	**4**	**29**	**46**	**42**	**7**	**68**	**4**	**9**	**6**	**2**	**14**	**98**	**3**	**3**	**33**	**54**	**21**	**1**	**79**	**166**
Bodega Bay	-	-	-	-	-	-	2	2	2	1	2	1	21	23	7	26	1	1	11	1	11	39	14	-	44	125	28	1	24	171
Cloverdale	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3	2	-	3	3	4	-	6	4	1	-	17	24
Yountville	-	-	-	-	-	-	-	-	-	-	-	-	1	1	-	1	1	-	-	-	1	2	1	-	10	2	-	-	9	15
Tomales Bay	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	1	-	-	-	1
Point Reyes	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	6	-	6	8	1	-	-	10
Sausilito	-	-	-	-	-	-	-	-	-	-	-	1	-	1	1	1	-	4	5	-	5	6	7	-	4	21	6	1	39	53
Oakland	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	1
Alameda	-	-	-	-	-	-	-	-	-	-	-	-	2	1	1	2	-	-	-	-	-	2	-	-	-	1	-	-	2	3
Berkeley	-	-	-	-	-	-	-	-	-	-	-	1	8	9	3	10	-	-	-	-	-	10	5	-	-	4	2	-	8	15
Richmond	-	-	-	-	-	-	-	-	-	-	-	-	-	1	1	2	-	-	1	-	1	3	3	1	-	5	-	-	1	10
San Francisco	-	6	6	6	6	6	6	6	8	7	9	9	22	21	12	27	1	5	7	1	9	51	33	3	29	59	17	2	86	155
Princeton	1	6	8	8	7	8	3	2	2	3	3	8	39	36	8	44	1	6	6	3	11	66	34	2	56	74	30	10	43	135
San Francisco Total	**1**	**12**	**14**	**14**	**13**	**14**	**11**	**10**	**12**	**11**	**14**	**20**	**93**	**93**	**33**	**113**	**4**	**19**	**32**	**5**	**41**	**182**	**108**	**6**	**155**	**304**	**85**	**14**	**230**	**593**
Gilroy	-	-	-	-	-	-	-	-	-	-	-	-	10	8	2	10	-	-	-	-	-	10	-	-	1	-	1	-	8	10
Santa Cruz	-	2	2	2	2	2	-	-	-	-	-	9	11	11	10	18	1	5	4	1	6	26	18	-	7	31	19	3	19	46
Moss Landing	-	8	6	8	8	8	11	2	6	11	11	19	24	23	13	38	1	2	2	1	6	63	27	2	6	71	42	7	38	132
Monterey	-	2	2	2	2	2	-	1	-	1	1	1	25	23	6	26	2	3	1	3	6	35	23	5	1	50	10	5	42	81
Monterey Total	**0**	**12**	**10**	**12**	**12**	**12**	**11**	**3**	**6**	**12**	**12**	**29**	**70**	**65**	**31**	**92**	**4**	**10**	**7**	**5**	**18**	**134**	**68**	**7**	**15**	**152**	**72**	**15**	**107**	**269**

TABLE 3.4-34. Number of vessels by vessel primary port and species group for the base period (November 2000 through October 2001). (Page 3 of 3)

	Vessels with Limited Entry Trawl Permits						Vessels with Fixed Gear Limited Entry Permits (No Trawl Permit)					Open Access Vessels with More than 5% Revenue from Groundfish					Open Access Vessels with Less than 5% Revenue from Groundfish					Total for All Groundfish	Vessels Participating in Other Fisheries							
	Whiting	Sablefish	Nearshore Spp	Shelf Spp	Slope Spp	Total	Sablefish	Nearshore Spp	Shelf Spp	Slope Spp	Total	Sablefish	Nearshore Spp	Shelf Spp	Slope Spp	Total	Sablefish	Nearshore Spp	Shelf Spp	Slope Spp	Total		Halibut (Pac & CA)	Shrimp/Prawns	Crabs	Salmon	HMS	CPS	Other	Total
San Simeon	-	-	-	-	-	-	-	-	-	-	-	-	6	6	-	6	-	-	-	-	-	6	-	-	-	-	-	-	3	6
Morro Bay	-	2	2	2	2	2	-	1	2	-	2	2	56	49	10	57	2	16	13	7	20	81	26	9	19	36	68	6	55	122
Avila	1	5	2	5	5	5	-	-	1	1	1	-	50	47	2	50	-	10	8	1	10	66	32	5	17	9	31	3	46	78
San	**1**	**7**	**4**	**7**	**7**	**7**	**0**	**1**	**3**	**1**	**3**	**2**	**112**	**102**	**12**	**113**	**2**	**26**	**21**	**8**	**30**	**153**	**58**	**14**	**36**	**45**	**99**	**9**	**104**	**206**
Santa Barbara	-	-	-	-	-	-	-	-	-	-	-	-	31	16	11	31	-	25	13	10	29	60	32	15	46	4	20	10	111	136
Santa Cruz Island	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	1	-	-	1
Ventura	-	-	-	-	-	-	1	-	1	1	1	2	9	8	9	12	1	9	8	7	10	23	15	8	17	1	16	8	29	43
Oxnard	-	-	-	-	-	-	6	4	6	6	6	2	14	8	9	14	-	14	5	10	17	37	13	8	19	-	14	3	58	64
Port Hueneme	-	-	-	-	-	-	-	-	1	-	1	-	-	-	-	-	-	-	-	-	-	1	-	-	-	2	3	31	9	31
Santa Barbara Total	**0**	**0**	**0**	**0**	**0**	**0**	**7**	**4**	**8**	**7**	**8**	**4**	**54**	**32**	**29**	**57**	**1**	**48**	**26**	**27**	**56**	**121**	**61**	**31**	**82**	**7**	**54**	**52**	**207**	**275**
Terminal Island	-	-	-	-	-	-	1	1	1	1	1	2	19	9	10	19	1	9	6	2	12	32	35	7	28	2	47	26	100	126
San Pedro	-	-	-	-	-	-	-	-	-	-	-	-	7	8	3	10	-	17	12	5	18	28	16	2	18	1	51	53	59	112
Willmington	-	-	-	-	-	-	1	1	1	1	1	-	-	-	-	-	-	-	-	-	-	1	1	-	1	-	1	1	1	2
Catalina Island	-	-	-	-	-	-	-	-	-	-	-	2	6	2	4	8	-	3	2	1	4	12	10	3	15	-	12	9	26	41
Long Beach	-	-	-	-	-	-	-	-	-	-	-	-	2	3	1	3	-	-	-	-	-	3	4	-	1	-	4	1	4	6
Newport Beach	-	-	-	-	-	-	4	2	3	4	5	1	1	2	2	2	1	1	-	-	2	9	3	3	8	-	4	5	11	18
Dana Point	-	-	-	-	-	-	-	1	-	-	1	-	1	1	-	1	-	2	-	-	2	4	-	3	26	-	4	-	18	33
Los Angeles Total	**0**	**0**	**0**	**0**	**0**	**0**	**6**	**5**	**5**	**6**	**8**	**5**	**36**	**25**	**20**	**43**	**2**	**32**	**20**	**8**	**38**	**89**	**69**	**18**	**97**	**3**	**123**	**95**	**219**	**338**
North Shore	-	-	-	-	-	-	-	-	-	-	-	1	3	8	5	8	1	6	9	6	10	18	5	5	26	-	18	7	30	49
San Diego	-	-	-	-	-	-	-	1	1	-	1	1	7	6	5	10	1	5	4	1	7	18	6	2	30	-	37	11	41	65
Oceanside	-	-	-	-	-	-	5	1	2	5	5	-	1	3	2	3	-	4	2	2	4	12	2	3	9	-	15	2	14	26
San Diego Total	**0**	**0**	**0**	**0**	**0**	**0**	**5**	**2**	**3**	**5**	**6**	**2**	**11**	**17**	**12**	**21**	**2**	**15**	**15**	**9**	**21**	**48**	**13**	**10**	**65**	**0**	**70**	**20**	**85**	**140**
Other California	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-	-	-	8	10
At-Sea Only	**28**	**20**	**2**	**28**	**23**	**28**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	**28**	**11**	-	**2**	**26**	**9**	**28**	**25**	**28**
Grand Total	68	229	146	242	232	243	158	57	138	136	178	179	623	601	252	771	104	237	389	126	517	1,709	675	214	1,247	1,202	1,172	297	2,470	4,588

NOTE: The Primary port is the port at which the vessel made more landings than any other port, as measured in terms of exvessel value. Vessels in the "at-sea only" row are those that made no shoreside landings. Vessels delivering at-sea that had some shoreside landings were assigned to a primary port based on their shoreside landings.
Source: Derived from PacFIN monthly vessel summary files.

TABLE 3.4-35. Number of vessels by length class and fisheries category making landings of different species groups caught in different INPFC areas during November 2000 through October 2001. (Page 1 of 3)

Gear and Species	<40'	40'-50'	50'-60'	60'-70'	70'-150'	>150'	Unspecified	Total
			Vessel Length Category					
			Vancouver INPFC Area					
Limited Entry Trawl								
Whiting	0	0	1	3	13	0	0	17
Sablefish	1	10	17	22	31	0	0	81
Nearshore Species	1	6	10	9	9	0	0	35
Shelf Species	1	10	16	23	31	0	0	81
Slope Species	1	10	16	22	30	0	0	79
Limited Entry Fixed Gear								
Sablefish	9	17	6	1	3	0	0	36
Nearshore Species	1	2	1	0	0	0	0	4
Shelf Species	10	14	5	0	2	0	0	31
Slope Species	8	16	5	1	3	0	0	33
Open Access >5% Revenue from Groundfish								
Sablefish	13	3	1	0	0	0	1	18
Nearshore Species	26	0	0	0	0	0	0	26
Shelf Species	0	5	0	0	0	0	1	6
Slope Species	7	4	0	0	0	0	1	12
Open Access <5% Revenue from Groundfish								
Sablefish	0	1	2	1	1	0	0	5
Shelf Species	2	11	3	1	1	0	0	18
Slope Species	0	1	0	0	0	0	0	1
Nongroundfish Fisheries								
Halibut	13	26	7	0	3	0	0	49
Shrimps and Prawns	0	0	2	3	3	0	0	8
Crabs	7	11	26	7	6	0	0	57
Salmon	13	20	2	1	4	0	0	40
HMS	2	3	2	3	5	0	0	15
CPS	0	2	6	1	15	0	0	24
Other	3	12	13	13	27	0	0	68
			Columbia INPFC Area					
Limited Entry Trawl								
Whiting	-	2	1	8	35	0	6	52
Sablefish	3	10	21	38	51	0	4	127
Nearshore Species	1	10	17	19	15	0	0	62
Shelf Species	3	12	21	38	60	0	6	140
Slope Species	3	10	20	38	54	0	4	129
Limited Entry Fixed Gear								
Sablefish	12	27	14	6	2	0	1	62
Nearshore Species	3	3	2	0	0	0	0	8
Shelf Species	14	24	8	5	0	0	0	51
Slope Species	8	20	8	5	1	0	0	42
Open Access >5% Revenue from Groundfish								
Sablefish	25	12	4	2	1	0	2	46
Nearshore Species	55	5	1	0	0	0	0	61
Shelf Species	57	8	2	1	0	0	1	69
Slope Species	8	4	2	1	0	0	2	17
Open Access <5% Revenue from Groundfish								
Sablefish	19	16	10	17	17	0	0	79
Nearshore Species	35	7	2	4	3	0	0	51
Shelf Species	120	47	15	22	18	0	0	222
Slope Species	16	6	7	12	11	0	0	52
Nongroundfish Fisheries								
Halibut	104	73	24	8	12	0	1	222
Shrimps and Prawns	0	2	17	43	36	0	0	98
Crabs	167	135	90	42	32	0	0	466
Salmon	340	123	20	7	30	0	5	525
HMS	162	223	117	57	37	0	1	597
CPS	2	10	16	10	41	0	6	85
Other	51	32	40	42	58	0	7	230

TABLE 3.4-35. Number of vessels by length class and fisheries category making landings of different species groups caught in different INPFC areas during November 2000 through October 2001. (Page 2 of 3)

Gear and Species	<40'	40'-50'	50'-60'	60'-70'	70'-150'	>150'	Unspecified	Total
			Vessel Length Category					
			Eureka INPFC Area					
Limited Entry Trawl								
Whiting	0	2	0	2	12	0	0	16
Sablefish	1	14	29	27	28	0	0	99
Nearshore Species	1	11	21	13	7	0	0	53
Shelf Species	2	14	29	25	30	0	0	100
Slope Species	2	14	31	28	29	0	0	104
Limited Entry Fixed Gear								
Sablefish	19	8	3	0	0	0	0	30
Nearshore Species	19	3	2	0	0	0	0	24
Shelf Species	22	6	2	0	0	0	0	30
Slope Species	20	4	1	0	0	0	0	25
Open Access >5% Revenue from Groundfish								
Sablefish	24	2	0	0	0	0	0	26
Nearshore Species	138	3	1	0	0	0	1	143
Shelf Species	133	3	1	0	0	0	0	137
Slope Species	76	1	0	0	0	0	0	77
Open Access <5% Revenue from Groundfish								
Sablefish	2	1	0	0	0	0	0	3
Nearshore Species	23	1	1	0	2	0	0	27
Shelf Species	20	4	1	5	3	0	0	33
Slope Species	5	0	0	2	1	0	0	8
Nongroundfish Fisheries								
Halibut	10	9	6	1	2	0	0	28
Shrimps and Prawns	1	6	10	12	8	0	0	37
Crabs	160	74	38	9	11	0	0	292
Salmon	74	23	1	0	3	0	0	101
HMS	39	33	27	9	7	1	0	116
CPS	1	0	1	2	11	0	0	15
Other	154	23	33	23	23	0	1	257
			Monterey INPFC Area					
Limited Entry Trawl								
Whiting	0	0	0	1	1	0	0	2
Sablefish	1	5	22	17	11	0	0	56
Nearshore Species	1	7	12	8	5	0	0	33
Shelf Species	1	7	23	18	12	0	0	61
Slope Species	1	7	24	18	12	0	0	62
Limited Entry Fixed Gear								
Sablefish	15	12	3	1	0	0	0	31
Nearshore Species	12	4	1	0	0	0	0	17
Shelf Species	16	8	3	0	0	0	0	27
Slope Species	17	10	3	1	0	0	0	31
Open Access >5% Revenue from Groundfish								
Sablefish	62	20	3	0	0	0	0	85
Nearshore Species	218	12	5	1	0	0	7	243
Shelf Species	207	13	4	2	0	0	5	231
Slope Species	59	12	3	0	0	0	0	74
Open Access <5% Revenue from Groundfish								
Sablefish	8	3	0	0	0	0	1	12
Nearshore Species	31	3	0	0	0	0	0	34
Shelf Species	35	12	0	1	0	0	0	48
Slope Species	7	3	1	1	0	0	0	12
Nongroundfish Fisheries								
Halibut	152	16	11	3	3	0	0	185
Shrimps and Prawns	5	1	8	4	4	0	0	22
Crabs	138	65	22	8	4	0	0	237
Salmon	505	141	24	1	0	0	0	671
HMS	112	72	40	9	9	0	0	242
CPS	13	10	10	4	6	0	1	44
Other	361	35	22	16	11	0	4	449

TABLE 3.4-35. Number of vessels by length class and fisheries category making landings of different species groups caught in different INPFC areas during November 2000 through October 2001. (Page 3 of 3)

Gear and Species	Vessel Length Category <40'	40'-50'	50'-60'	60'-70'	70'-150'	>150'	Unspecified	Total
Conception INPFC Area								
Limited Entry Trawl								
Whiting	0	0	0	0	1	0	0	1
Sablefish	0	0	5	6	2	0	0	13
Nearshore Species	0	0	4	1	0	0	0	5
Shelf Species	0	0	5	7	2	0	0	14
Slope Species	0	0	4	7	2	0	0	13
Limited Entry Fixed Gear								
Sablefish	15	4	0	0	0	0	0	19
Nearshore Species	10	3	1	0	0	0	0	14
Shelf Species	15	4	1	0	0	0	0	20
Slope Species	16	4	0	0	0	0	0	20
Open Access >5% Revenue from Groundfish								
Sablefish	6	4	0	0	0	0	0	10
Nearshore Species	208	22	1	2	0	0	1	234
Shelf Species	170	16	1	1	1	0	0	189
Slope Species	57	14	0	2	1	0	0	74
Open Access <5% Revenue from Groundfish								
Sablefish	4	2	1	0	0	0	0	7
Nearshore Species	95	26	4	0	0	0	0	125
Shelf Species	62	17	3	2	3	0	0	87
Slope Species	36	9	3	3	2	0	0	53
Nongroundfish Fisheries								
Halibut	157	33	5	6	0	0	0	201
Shrimps and Prawns	39	19	8	8	5	0	0	79
Crabs	238	36	7	2	1	0	0	284
HMS	221	78	34	17	50	0	0	400
CPS	69	37	41	12	20	0	0	179
Other	487	83	24	9	33	0	1	637
All Ocean Areas (Council Managed 0-200 Miles)								
Limited Entry Trawl								
Whiting	0	4	1	10	40	0	6	61
Sablefish	4	26	61	54	73	0	4	222
Nearshore Species	3	28	48	36	31	0	0	146
Shelf Species	4	30	61	54	80	0	6	235
Slope Species	4	27	60	54	76	0	4	225
Limited Entry Fixed Gear								
Sablefish	61	61	23	8	4	0	1	158
Nearshore Species	39	13	5	0	0	0	0	57
Shelf Species	65	50	16	5	2	0	0	138
Slope Species	63	48	15	7	3	0	0	136
Open Access >5% Revenue from Groundfish								
Sablefish	128	39	7	2	1	0	2	179
Nearshore Species	566	39	7	3	0	0	8	623
Shelf Species	542	41	7	4	1	0	6	601
Slope Species	207	34	5	3	1	0	2	252
Open Access <5% Revenue from Groundfish								
Sablefish	33	23	11	18	17	0	1	103
Nearshore Species	183	37	7	4	5	0	0	236
Shelf Species	234	84	20	28	22	0	0	388
Slope Species	64	19	11	17	14	0	0	125
Nongroundfish Fisheries								
Halibut	431	149	49	18	20	0	1	668
Shrimps and Prawns	44	28	38	58	45	0	0	213
Crabs	692	302	147	59	46	0	0	1,246
Salmon	855	252	43	8	31	0	5	1,194
HMS	511	324	160	75	94	1	1	1,666
CPS	85	51	60	23	63	0	7	289
Other	1,005	165	107	67	111	0	13	1,468

TABLE 3.4-36. Share of total exvessel revenue derived from landings of the designated species group caught in different INPFC areas for vessels in Table 3.3-3 during November 2000 through October 2001. (Page 1 of 3)

			Vessel Length Category					
Gear and Species	<40'	40'-50'	50'-60'	60'-70'	70'-150'	>150'	Unspecified	Total
			Vancouver INPFC Area					
Limited Entry Trawl								
Whiting	-	-	0.90	0	0.55	-	-	0.44
Sablefish	0.23	0.29	0.18	0	0.13	-	-	0.17
Nearshore Species	0.08	0.01	0.01	0	0.01	-	-	0.01
Shelf Species	0.49	0.60	0.53	0	0.30	-	-	0.35
Slope Species	0.20	0.09	0.13	0	0.26	-	-	0.28
Limited Entry Fixed Gear								
Sablefish	0.94	0.84	0.82	1	0.95	-	-	0.87
Nearshore Species	0.00	0.00	0.00	-	-	-	-	0.00
Shelf Species	0.03	0.07	0.16	-	0.01	-	-	0.09
Slope Species	0.01	0	0.01	0	0.01	-	-	0.01
Open Access >5% Revenue from Groundfish								
Sablefish	0.96	0.27	1.00	-	-	-	0.20	0.58
Nearshore Species	0.04	-	-	-	-	-	-	0.04
Shelf Species	-	0.01	-	-	-	-	0.09	0.03
Slope Species	0.01	0.00	-	-	-	-	0.71	0.09
Open Access <5% Revenue from Groundfish								
Sablefish	-	0.02	0.03	0	0.01	-	-	0.01
Shelf Species	0.05	0.03	0.01	0	0.01	-	-	0.01
Slope Species	-	0.01	-	-	-	-	-	0.01
Nongroundfish Fisheries								
Halibut	0.06	0.05	0.03	-	0.01	-	-	0.04
Shrimps and Prawns	-	-	0.51	0	0.51	-	-	0.24
Crabs	1.00	0.70	0.99	1	0.60	-	-	0.82
Salmon	0.85	0.48	0.05	0	0.00	-	-	0.09
HMS	0.19	1.00	1.00	0	1.00	-	-	0.60
CPS	-	0.03	0.01	0	0.01	-	-	0.01
Other	0.00	0.01	0.02	0	0.03	-	-	0.02
			Columbia INPFC Area					
Limited Entry Trawl								
Whiting	-	0.01	0.35	0	0.71	-	0.83	0.60
Sablefish	0.08	0.20	0.28	0	0.10	-	0.00	0.15
Nearshore Species	0.28	0.02	0.02	0	0.01	-	-	0.01
Shelf Species	0.22	0.25	0.18	0	0.12	-	0.17	0.16
Slope Species	0.02	0.20	0.28	0	0.15	-	0.00	0.19
Limited Entry Fixed Gear								
Sablefish	0.37	0.38	0.36	0	0.57	-	1.00	0.40
Nearshore Species	0.01	0.08	0.00	-	-	-	-	0.04
Shelf Species	0.01	0.00	0.00	0	-	-	-	0.00
Slope Species	0.01	0.00	0.00	0	0.00	-	-	0.00
Open Access >5% Revenue from Groundfish								
Sablefish	0.12	0.18	0.23	0	0.71	-	0.32	0.15
Nearshore Species	0.29	0.00	0.02	-	-	-	-	0.12
Shelf Species	0.02	0.00	0.02	0	-	-	0.09	0.02
Slope Species	0.00	0.00	0.00	0	-	-	0.59	0.04
Open Access <5% Revenue from Groundfish								
Sablefish	0.02	0.01	0.01	0	0.01	-	-	0.01
Nearshore Species	0.00	0.00	0.00	0	0.00	-	-	0.00
Shelf Species	0.00	0.00	0.00	0	0.01	-	-	0.01
Slope Species	0.00	0.00	0.00	0	0.00	-	-	0.00
Nongroundfish Fisheries								
Halibut	0	0	0.05	0	0.01	-	0.00	0.03
Shrimps and Prawns	-	0.23	0.35	0	0.51	-	-	0.46
Crabs	0.84	0.72	0.62	0	0.33	-	-	0.61
Salmon	0.57	0.25	0.08	0	0.00	-	0.00	0.20
HMS	0.32	0.43	0.39	0	0.18	-	0.59	0.34
CPS	0.00	0.74	0.40	0	0.11	-	0.00	0
Other	0.31	0.02	0.01	0	0.01	-	0.03	0

TABLE 3.4-36. Share of total exvessel revenue derived from landings of the designated species group caught in different INPFC areas for vessels in Table 3.3-3 during November 2000 through October 2001. (Page 2 of 3)

Gear and Species	<40'	40'-50'	Vessel Length Category 50'-60'	60'-70'	70'-150'	>150'	Unspecified	Total
			Eureka INPFC Area					
Limited Entry Trawl								
Whiting	-	0.00	-	0.50	0.31	-	-	0.23
Sablefish	0.12	0.13	0.19	0.23	0.21	-	-	0.20
Nearshore Species	0.33	0.08	0.03	0.00	0.02	-	-	0.03
Shelf Species	0.46	0.23	0.16	0.15	0.14	-	-	0.16
Slope Species	0.05	0.20	0.35	0.44	0.34	-	-	0.35
Limited Entry Fixed Gear								
Sablefish	0	0	0.30	-	-	-	-	0.32
Nearshore Species	0.25	0.18	0.90	-	-	-	-	0.26
Shelf Species	0.04	0.04	0.02	-	-	-	-	0.04
Slope Species	0.00	0.00	0.00	-	-	-	-	0.00
Open Access >5% Revenue from Groundfish								
Sablefish	0.21	0.62	-	-	-	-	-	0.24
Nearshore Species	0.41	0.15	0.88	-	-	-	0.84	0.40
Shelf Species	0.06	0.02	0.09	-	-	-	-	0.06
Slope Species	0.01	0.01	-	-	-	-	-	0.01
Open Access <5% Revenue from Groundfish								
Sablefish	0.00	0.02	-	-	-	-	-	0.01
Nearshore Species	0.01	0.00	0.00	-	0.00	-	-	0.00
Shelf Species	0.01	0.00	0.02	0.00	0.00	-	-	0.00
Slope Species	0.00	-	-	0.00	0.00	-	-	0.00
Nongroundfish Fisheries								
Halibut	0.02	0.00	0.01	0.00	0.00	-	-	0.01
Shrimps and Prawns	0.00	0.03	0.09	0.31	0.29	-	-	0.21
Crabs	0.68	0.69	0.45	0.50	0.35	-	-	0.58
Salmon	0.17	0.15	1.00	-	0.01	-	-	0.15
HMS	0.08	0.28	0.32	0.40	0.27	1.00	-	0.26
CPS	0.16	-	0.00	0.00	0.00	-	-	0.01
Other	0.18	0.06	0.03	0.02	0.01	-	0.16	0.07
			Monterey INPFC Area					
Limited Entry Trawl								
Whiting	-	-	-	0.00	0.00	-	-	0.00
Sablefish	0.02	0.04	0.16	0.14	0.14	-	-	0.14
Nearshore Species	0.41	0.14	0.07	0.19	0.17	-	-	0.14
Shelf Species	0.13	0.16	0.22	0.23	0.25	-	-	0.22
Slope Species	0.02	0.05	0.33	0.36	0.35	-	-	0.32
Limited Entry Fixed Gear								
Sablefish	0.40	0.46	0.58	0.91	-	-	-	0.47
Nearshore Species	0.22	0.06	0.10	-	-	-	-	0.17
Shelf Species	0.08	0.04	0.01	-	-	-	-	0.05
Slope Species	0.12	0.19	0.04	0.09	-	-	-	0.11
Open Access >5% Revenue from Groundfish								
Sablefish	0.40	0.59	0	-	-	-	-	0.47
Nearshore Species	0.56	0.28	0.04	0.00	-	-	0.90	0.52
Shelf Species	0.10	0.11	0.24	1.00	-	-	0.08	0.11
Slope Species	0.01	0.03	0.03	-	-	-	-	0.02
Open Access <5% Revenue from Groundfish								
Sablefish	0.02	0.01	-	-	-	-	0.02	0.02
Nearshore Species	0.01	0.00	-	-	-	-	-	0
Shelf Species	0.00	0.00	-	0.00	-	-	-	0.00
Slope Species	0.00	0.00	0.00	0.00	-	-	-	0.00
Nongroundfish Fisheries								
Halibut	0.16	0.13	0.11	0.40	0.16	-	-	0.17
Shrimps and Prawns	0.91	0.00	0.31	0.98	0.41	-	-	0.48
Crabs	0.60	0.77	0.48	0.27	0.26	-	-	0.58
Salmon	0.47	0.43	0.22	1.00	-	-	-	0.43
HMS	0.10	0.28	0.18	0.57	0.43	-	-	0.24
CPS	0.08	0.60	0.65	0.46	0.80	-	0.01	0.63
Other	0.68	0.08	0.01	0.01	0.01	-	0.22	0

TABLE 3.4-36. Share of total exvessel revenue derived from landings of the designated species group caught in different INPFC areas for vessels in Table 3.3-3 during November 2000 through October 2001. (Page 3 of 3)

Gear and Species	<40'	40'-50'	50'-60'	60'-70'	70'-150'	>150'	Unspecified	Total
			Vessel Length Category					
			Conception INPFC Area					
Limited Entry Trawl								
Whiting	-	-	-	-	0.00	-	-	0.00
Sablefish	-	-	0.02	0.16	0.21	-	-	0.09
Nearshore Species	-	-	0.01	0.00	-	-	-	0.01
Shelf Species	-	-	0.26	0.26	0.23	-	-	0.25
Slope Species	-	-	0.09	0.47	0.43	-	-	0.26
Limited Entry Fixed Gear								
Sablefish	0.39	0.11	-	-	-	-	-	0.32
Nearshore Species	0.04	0.07	0.99	-	-	-	-	0.05
Shelf Species	0.06	0.05	0.01	-	-	-	-	0.06
Slope Species	0.55	0.48	-	-	-	-	-	0.53
Open Access >5% Revenue from Groundfish								
Sablefish	0.55	0.11	-	-	-	-	-	0.18
Nearshore Species	0.53	0.18	0.07	0.06	-	-	0.99	0.44
Shelf Species	0.04	0.01	1.00	0.01	0.03	-	-	0.04
Slope Species	0.02	0.06	-	0.01	0.05	-	-	0.03
Open Access <5% Revenue from Groundfish								
Sablefish	0.01	0.00	0.00	-	-	-	-	0.00
Nearshore Species	0.01	0.01	0.00	-	-	-	-	0.01
Shelf Species	0.01	0.00	0.02	0.01	0.00	-	-	0.01
Slope Species	0.00	0	0.00	0.00	0.00	-	-	0.00
Nongroundfish Fisheries								
Halibut	0.06	0.15	0.11	0.43	-	-	-	0.10
Shrimps and Prawns	0.51	0.52	0.70	0.95	0.71	-	-	0.58
Crabs	0.56	0.30	0.07	0.10	0.00	-	-	0.47
HMS	0.20	0.60	0.48	0.23	0.66	-	-	0.50
CPS	0.18	0.80	0.93	0.97	0.94	-	-	0.86
Other	0.56	0.24	0.04	0.01	0.01	-	0.01	0.33
			All Ocean Areas (Council Managed 0-200 Miles)					
Limited Entry Trawl								
Whiting	-	0.01	0.58	0.18	0.63	-	0.83	0.52
Sablefish	0.07	0.16	0.20	0.19	0.12	-	0.00	0.16
Nearshore Species	0.32	0.06	0.03	0.03	0.03	-	-	0.03
Shelf Species	0.21	0.27	0.21	0.22	0.17	-	0.17	0.20
Slope Species	0.03	0.16	0.29	0.33	0.20	-	0.00	0.25
Limited Entry Fixed Gear								
Sablefish	0.40	0.43	0.44	0.51	0.64	-	1.00	0.44
Nearshore Species	0.18	0.08	0.07	-	-	-	-	0.13
Shelf Species	0.04	0.02	0.03	0.00	0.01	-	-	0.03
Slope Species	0	0	0.01	0.00	0.01	-	-	0.06
Open Access >5% Revenue from Groundfish								
Sablefish	0.27	0.29	0.33	0.07	0.71	-	0.28	0.28
Nearshore Species	0.48	0.15	0.03	0.06	-	-	0.91	0.41
Shelf Species	0.06	0.03	0.14	0.03	0.03	-	0.09	0.05
Slope Species	0.01	0.03	0.02	0.00	0.05	-	0.62	0.02
Open Access <5% Revenue from Groundfish								
Sablefish	0.02	0.01	0.01	0.01	0.01	-	0.02	0.01
Nearshore Species	0.01	0.01	0.00	0.00	0.00	-	-	0.00
Shelf Species	0.01	0.00	0.01	0.01	0.01	-	-	0.01
Slope Species	0.00	0.00	0.00	0.00	0.00	-	-	0.00
Nongroundfish Fisheries								
Halibut	0.06	0.05	0.05	0.10	0.02	-	0.00	0.05
Shrimps and Prawns	0.55	0.30	0.32	0.36	0.44	-	-	0.39
Crabs	0.65	0.64	0.54	0.42	0.29	-	-	0.55
Salmon	0.42	0.24	0.09	0.03	0.00	-	0.00	0.22
HMS	0.20	0.39	0.34	0.27	0.48	1.00	0.59	0.35
CPS	0.17	0.75	0.77	0.61	0.48	-	0.00	0.59
Other	1	0.10	0.02	0.01	0.01	-	0.04	0

TABLE 3.4-37. Number of buyers and groundfish buyers[a/] on the West Coast in the year 2000 (excluding at-sea whiting deliveries). (Page 1 of 1)

Buyers' Total Expenditures on West Coast Harvest (Groundfish and Nongroundfish)	All Buyers	Nongroundfish Buyers	Groundfish Buyers	Groundfish Buyers as % of Category	Trawl-Caught Groundfish Buyers	Nontrawl-Only Groundfish Buyers
>$2 Million	21	2	19	90%	17	2
$1-$2 Million	33	14	19	58%	11	8
$300 Thousand - $1 Million	98	36	62	63%	33	29
$100-$300 Thousand	121	49	72	60%	23	49
$20-$100 Thousand	273	123	150	55%	19	131
$5 Thousand-$20 Thousand	372	224	148	40%	11	137
<$5 Thousand	862	600	262	30%	11	251
Total	1,780	1,048	732	41%	125	607

a/ Data for West Coast ocean area landings made to West Coast ports derived from PacFIN monthly vessel summary files.

TABLE 3.4-38. Value of purchases ($1,000) by West Coast buyers (groundfish and nongroundfish) in the year 2000. (Page 1 of 1)

	All Buyers	Groundfish Buyers					
		All Species (All West Coast Purchases by All Groundfish Buyers)			Groundfish (All West Coast Purchases)		
	Total Purchases	Total Purchases	As % of All West Coast Purchases	Cumulative Percent of All West Coast Purchases	Groundfish Purchases	Percent of Total Groundfish	Cumulative Percent of Total Groundfish
>$2 Million	95,742	90,762	38%	38%	28,680	53%	53%
$1-$2 Million	45,343	25,851	11%	49%	8,585	16%	68%
$300 Thousand-$1 Million	56,115	36,527	15%	65%	11,278	21%	89%
$100-$300 Thousand	21,427	12,543	5%	70%	3,269	6%	95%
$20-$100 Thousand	12,881	7,297	3%	73%	2,023	4%	99%
$5 Thousand-$ 20 Thousand	3,989	1,519	1%	74%	501	1%	100%
<$5 Thousand	1,278	426	0%	74%	218	0%	100%
Total	236,775	174,926			54,554		

Source: Derived from PacFIN monthly vessel summary files.

TABLE 3.4-39. Groundfish buyers' expenditures on all species and groundfish ($1,000) in the year 2000 (excludes at-sea whiting). (Page 1 of 1)

	Buying Groundfish from Limited Entry **Trawl** Vessels						Buying Groundfish from Nontrawl Only				All Buyers
			Trawl Expenditure		Nontrawl Expenditures						
	Number	Total Expenditures (All Species)		As a % of Grand Total Trawl Expenditures		As a % of Grand Total Nontrawl Expenditures	Number	Total Expenditures	Nontrawl Expenditures	As a % of Grand Total Nontrawl Expenditures	Grand Total Nontrawl Expenditures
>$2 Million	17	80,726	22,904	60%	5,773	35%	2	10,036	3	0%	5,776
$1-2 Million	11	15,874	6,898	18%	699	4%	8	9,976	988	6%	1,686
$300 Thousand-$1 Million	33	20,226	6,419	17%	2,957	18%	29	16,301	1,902	12%	4,859
$100-$300 Thousand	23	3,765	1,515	4%	235	1%	49	8,778	1,519	9%	1,754
$20-$100 Thousand	19	990	234	1%	249	2%	131	6,307	1,540	9%	1,789
$5 Thousand-$20 Thousand	11	132	80	0%	16	0%	137	1,386	405	2%	421
<$5 Thousand	11	24	20	0%	0	0%	251	402	197	1%	197
	125	121,739	38,071	100%	9,929	60%	607	53,187	6,554	40%	**16,483**

Source: Derived from PacFIN monthly vessel summary files.

TABLE 3.4-40. Number of buyers[a/] by amounts of purchases, and proportions of purchases that are groundfish, from trawl vessels, from nontrawl vessels in the year 2000 (excludes at-sea whiting deliveries). (Page 1 of 1)

Buyers Total Expenditures on West Coast Harvest (Groundfish and Nongroundfish)	Number of		Percent of Purchases That Are: Groundfish						Groundfish Caught with Limited Entry Trawl Gear						Groundfish Caught With Other Gear					
	All Buyers	Groundfish Buyers	None	<5%	5%-35%	35%-65%	65%-95%	>95%	None	<5%	5%-35%	35%-65%	65%-95%	>95%	None	<5%	5%-35%	35%-65%	65%-95%	>95%
Number of Buyers (All)																				
>$2 Million	21	19	2	4	8	5	2	0	Same as below						2	9	10	0	0	0
$1-$2 Million	33	19	14	4	9	3	3	0							15	12	5	1	0	0
$300 Thousand-$1 Million	98	62	36	26	15	6	10	5							44	34	12	3	3	2
$100-$300 Thousand	121	72	49	37	12	10	6	7							56	41	12	6	3	3
$33-$100 Thousand	183	100	83	56	19	5	5	15							86	56	19	4	4	14
$5-$33 Thousand	462	198	264	80	43	16	21	38							274	81	43	16	18	30
<$5 Thousand	862	262	600	50	42	29	24	117							610	51	42	26	24	109
Total	1,780	732	1,048	257	148	74	71	182							1,087	284	143	56	52	158
Buyers Buying from Trawl Vessels																				
>$2 Million	17	17	0	2	8	5	2	0	-	3	10	4	0	0	0	7	10	0	0	0
$1-$2 Million	11	11	0	0	6	2	3	0	-	1	5	2	3	0	1	8	2	0	0	0
$300 Thousand-$1 Million	33	33	0	6	9	5	10	3	-	11	9	5	7	1	8	14	6	2	3	0
$100-$300 Thousand	23	23	0	6	4	5	4	4	-	10	2	4	3	4	7	10	4	1	1	0
$33-$100 Thousand	13	13	0	2	4	2	3	2	-	6	5	0	1	1	3	2	4	1	2	1
$5-$33 Thousand	17	17	0	1	4	1	3	8	-	2	4	1	4	6	10	2	4	1	0	0
<$5 Thousand	11	11	0	0	0	3	0	8	-	0	0	3	0	8	10	1	0	0	0	0
Buyers NOT Buying from Trawl Vessels																				
>$2 Million	4	2	2	2	0	0	0	0	4	-	-	-	-	-	Same as to far left					
$1-$2 Million	22	8	14	4	3	1	0	0	22	-	-	-	-	-						
$300 Thousand-$1 Million	65	29	36	20	6	1	0	2	65	-	-	-	-	-						
$100-$300 Thousand	98	49	49	31	8	5	2	3	98	-	-	-	-	-						
$33-$100 Thousand	170	87	83	54	15	3	2	13	170	-	-	-	-	-						
$5-$33 Thousand	445	181	264	79	39	15	18	30	445	-	-	-	-	-						
<$5 Thousand	851	251	600	50	42	26	24	109	851	-	-	-	-	-						

a/ Each unique combination of buyer license and PacFIN port is counted as a separate buyer. In some cases, a particular buyer may have a presence in a port (be buying through a port), but have no facilities at that port. Source: Derived from PacFIN monthly vessel summary files.

TABLE 3.4-41. Number buyers[a/] (groundfish and nongroundfish) by number of months of buying and exvessel value of purchases in the year 2000 (excluding at-sea whiting deliveries). (Page 1 of 1)

	Number of Months During Which Purchases Were Made												
	1	2	3	4	5	6	7	8	9	10	11	12	Total
Number of Buyers NOT Buying Groundfish													
>$2 Million	0	0	0	0	0	0	0	0	0	0	0	2	2
$1-$2 Million	0	0	0	0	0	0	1	0	1	3	6	3	14
$300 Thousand-$1 Million	0	0	3	3	2	3	3	4	3	3	5	7	36
$100-$300 Thousand	1	4	6	4	3	4	2	4	7	4	4	6	49
$20-$100 Thousand	15	23	21	10	11	14	3	2	7	8	4	5	123
$5 Thousand-$20 Thousand	54	45	36	25	19	11	5	7	7	5	4	6	224
<$5 Thousand	388	113	59	16	9	7	2	2	0	1	1	2	600
Total	458	185	125	58	44	39	16	19	25	24	24	31	1,048
Groundfish Buyers that Buy from Groundfish Limited Entry Trawl Vessels													
>$2 Million	0	0	0	0	0	0	0	0	0	0	1	16	17
$1-$2 Million	0	0	0	0	0	0	0	0	0	1	2	8	11
$300 Thousand-$1 Million	0	0	0	2	0	3	1	4	1	0	7	15	33
$100-$300 Thousand	0	0	1	6	2	1	0	5	0	1	5	2	23
$20-$100 Thousand	0	4	4	2	0	1	0	1	0	1	2	4	19
$5 Thousand-$20 Thousand	2	3	0	1	1	2	0	0	0	0	0	2	11
<$5 Thousand	7	2	2	0	0	0	0	0	0	0	0	0	11
Total	9	9	7	11	3	7	1	10	1	3	17	47	125
Groundfish Buyers that Do Not Buy from Groundfish Limited Entry Trawl Vessels													
>$2 Million	0	0	0	0	0	0	0	0	0	0	0	2	2
$1-$2 Million	0	0	0	0	0	0	0	0	0	2	2	4	8
$300 Thousand-$1 Million	0	2	0	0	2	0	3	1	2	1	5	13	29
$100-$300 Thousand	0	0	0	0	1	3	4	0	6	5	7	23	49
$20-$100 Thousand	3	6	10	7	9	18	12	9	10	7	12	28	131
$5 Thousand-$20 Thousand	8	21	22	14	13	11	15	12	6	4	8	3	137
<$5 Thousand	118	54	28	17	10	8	8	6	0	1	1	0	251
Total	129	83	60	38	35	40	42	28	24	20	35	73	607
Grand Total	596	277	192	107	82	86	59	57	50	47	76	151	1,780

a/ Each unique combination of buyer license and PacFIN port is counted as a separate buyer. In some cases, a particular buyer may have a presence in a port (be buying through a port), but have no facilities at that port. Source: Derived from PacFIN monthly vessel summary files.

TABLE 3.4-42. Number of groundfish buyers[a/] by seasonality of activity and amounts of purchases (exvessel value) for the year 2000 (excludes at-sea deliveries). (Page 1 of 1)

Month During Which Any Species Was Purchased (Groundfish and Nongroundfish)	Groundfish Buyers Total Expenditures on West Coast Landings							
	>$2 Million	$1-$2 Million	$300 Thousand - $1 Million	$100-$300 Thousand	$33-$100 Thousand	$5-$33 Thousand	<$5 Thousand	Totals
	Number of Processors							
Year Round	**18**	**12**	**28**	**25**	**32**	**5**	**0**	**120**
11 Month	**1**	**4**	**12**	**12**	**14**	**8**	**1**	**52**
10 Month	**-**	**3**	**1**	**6**	**8**	**4**	**1**	**23**
9 Month	**-**	**-**	**3**	**6**	**10**	**6**	**0**	**25**
7-8 Month	**-**	**-**	**9**	**9**	**22**	**27**	**14**	**81**
4-6 Month	**-**	**-**	**7**	**13**	**37**	**42**	**35**	**134**
1-3 Month	**-**	**-**	**2**	**1**	**27**	**56**	**211**	**297**
	19	**19**	**62**	**72**	**150**	**148**	**262**	**732**
Percent processing 10 or more months a year	100%	100%	66%	60%	36%	11%	1%	27%
	Number of 10 and 11 Month Buyers Not Buying in Each Month							
January			1	3	6	2	1	13
February		2		4	4	4		14
March		2		1	7	2		12
April			3	1	1			5
May					1			1
June						1		1
July				1	1		1	3
August				1		1		2
September			2	1	1	2		6
October		2	1	1	2	3		9
November	1	3	7	5	6	1		22
December		1		6	1	1	1	10

a/ Each unique combination of buyer license and PacFIN port is counted as a separate buyer. In some cases, a particular buyer may have a presence in a port (be buying through a port), but have no facilities at that port. Source: Derived from PacFIN monthly vessel summary files.

TABLE 3.4-43. Number of processors/buyers by primary port for the base period (November 2000 through October 2001). (Page 1 of 4)

	Processors/Buyers Buying from Vessels with Limited Entry Trawl Permits						Processors/Buyers Buying from Vessels with Fixed Gear Limited Entry Permits (No Trawl Permit)					Processors/Buyers Buying from Open Access Vessels with More than 5% Revenue from Groundfish					Processors/Buyers Buying from Open Access Vessels with Less than 5% Revenue from Groundfish						Processors/Buyers Buying from Vessels Participating in Other Fisheries							
	Whiting	Sablefish	Nearshore Spp	Shelf Spp	Slope Spp	Total	Sablefish	Nearshore Spp	Shelf Spp	Slope Spp	Total	Sablefish	Nearshore Spp	Shelf Spp	Slope Spp	Total	Sablefish	Nearshore Spp	Shelf Spp	Slope Spp	Total	Total for All Groundfish	Halibut (Pac & CA)	Shrimp/Prawns	Crabs	Salmon	HMS	CPS	Other	Total
Blaine	1	1	1	2	1	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-	-	1	-	-	1	5	5
Bellingham	1	1	1	3	1	3	2	1	2	2	2	-	-	-	-	-	1	-	1	1	1	4	2	-	9	-	1	1	40	40
Point Roberts	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	8	8
Friday Harbor	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	8	8
Anacortes	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-	-	-	14	14
LaConner	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	14	14
Everett	-	-	-	-	-	-	1	-	1	1	1	-	-	-	-	-	-	-	-	-	-	1	1	-	1	1	-	-	11	11
Seattle	-	-	-	-	-	-	1	-	-	1	1	-	-	1	-	1	-	-	1	-	1	2	2	-	7	2	9	-	32	39
Tacoma	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	1	-	25	26
Olympia	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	1	-	-	9	10
Shelton	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	12	12
Centralia	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-	-	8	9
Puget Sound Total	**2**	**2**	**2**	**5**	**2**	**5**	**4**	**1**	**3**	**4**	**4**	**0**	**0**	**1**	**0**	**1**	**1**	**0**	**2**	**1**	**2**	**9**	**5**	**0**	**23**	**8**	**11**	**3**	**186**	**196**
Port Townsend	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	13	13
Quilcene	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	15	15
Sequim	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-	-	-	5	5
Port Angeles	-	1	-	2	1	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3	-	-	1	5	2	-	28	29
Neah Bay	-	7	6	7	7	7	1	-	-	1	1	1	-	1	-	2	-	-	-	-	-	7	4	-	-	3	-	-	7	8
La Push	-	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	-	-	1	1	1	1	2	-	1	1	2	-	3	4
Quillayute	-	1	-	1	1	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	1	-	1	2	1	-	2	4
NW Olympic Peninsula Total	**0**	**10**	**7**	**11**	**10**	**12**	**2**	**1**	**1**	**2**	**2**	**2**	**1**	**2**	**1**	**3**	**0**	**0**	**1**	**1**	**1**	**12**	**7**	**0**	**5**	**11**	**6**	**0**	**73**	**78**
Copalis	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	1	-	-	-	1	2
Aberdeen	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	3	1	-	2	5
Westport (WA)	1	2	1	2	2	2	4	-	2	3	4	2	-	2	1	3	1	-	5	1	5	6	5	1	16	10	10	3	10	22
Central WA Coast Total	**1**	**2**	**1**	**2**	**2**	**2**	**4**	**0**	**2**	**3**	**4**	**2**	**0**	**2**	**1**	**3**	**1**	**0**	**5**	**1**	**5**	**6**	**6**	**1**	**18**	**13**	**11**	**3**	**13**	**29**
Tokeland	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	1	2	-	3	3	3	3	1	2	10	-	1	-	14	17
Ilwaco	1	2	2	2	2	2	1	1	1	1	2	1	-	1	1	1	2	1	4	2	4	5	8	2	7	5	9	2	16	19
Pacific County	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	1	-	1	21	22
Columbia River	-	-	-	-	-	-	-	-	-	-	-	-	2	2	-	2	-	1	1	1	1	2	1	-	-	2	1	-	23	23
South WA Coast Total	**1**	**2**	**2**	**2**	**2**	**2**	**1**	**1**	**1**	**1**	**2**	**1**	**2**	**4**	**1**	**4**	**4**	**2**	**8**	**6**	**8**	**10**	**10**	**4**	**19**	**8**	**11**	**3**	**74**	**81**

TABLE 3.4-43. Number of processors/buyers by primary port for the base period (November 2000 through October 2001). (Page 2 of 4)

	Processors/Buyers Buying from Vessels with Limited Entry Trawl Permits						Processors/Buyers Buying from Vessels with Fixed Gear Limited Entry Permits (No Trawl Permit)					Processors/Buyers Buying from Open Access Vessels with More than 5% Revenue from Groundfish					Processors/Buyers Buying from Open Access Vessels with Less than 5% Revenue from Groundfish						Processors/Buyers Buying from Vessels Participating in Other Fisheries							
	Whiting	Sablefish	Nearshore Spp	Shelf Spp	Slope Spp	Total	Sablefish	Nearshore Spp	Shelf Spp	Slope Spp	Total	Sablefish	Nearshore Spp	Shelf Spp	Slope Spp	Total	Sablefish	Nearshore Spp	Shelf Spp	Slope Spp	Total	Total for All Groundfish	Halibut (Pac & CA)	Shrimp/Prawns	Crabs	Salmon	HMS	CPS	Other	Total
Astoria	2	4	3	5	5	5	6	2	3	4	6	2	5	5	3	5	4	2	5	4	6	8	8	4	9	9	6	7	8	19
Gearhart-Seaside	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-	-	-	2
Cannon Beach	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	1
Nehalem Bay	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	1	1
Garibaldi (Tillamook)	-	1	2	1	1	2	2	1	2	-	2	-	3	4	-	4	1	4	6	-	6	9	10	1	9	10	5	-	10	25
Netarts	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-	-	-	-	2
Pacific City	-	-	-	-	-	-	-	-	-	-	-	-	3	3	-	3	-	-	-	-	-	3	1	-	3	3	3	-	1	5
Astoria-Tillamook Total	**2**	**5**	**5**	**6**	**6**	**7**	**8**	**3**	**5**	**4**	**8**	**2**	**11**	**12**	**3**	**12**	**5**	**6**	**11**	**4**	**12**	**20**	**19**	**5**	**24**	**25**	**14**	**7**	**20**	**55**
Siletz Bay	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	1
Depoe Bay	-	-	-	-	-	-	-	-	-	-	-	-	2	2	-	2	1	1	1	-	2	2	2	-	3	2	1	-	2	3
Newport	4	7	5	7	7	9	6	6	8	4	11	4	6	11	2	12	5	5	15	3	16	24	25	3	25	44	33	4	9	63
Waldport	-	-	-	-	-	-	-	-	-	-	-	-	1	1	-	1	-	-	-	-	-	1	-	-	6	1	1	-	1	6
Newport Total	**4**	**7**	**5**	**7**	**7**	**9**	**6**	**6**	**8**	**4**	**11**	**4**	**9**	**14**	**2**	**15**	**6**	**6**	**16**	**3**	**18**	**27**	**27**	**3**	**35**	**47**	**35**	**4**	**12**	**73**
Florence	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4	-	4	4	2	-	7	10	7	-	-	15
Winchester	-	-	-	-	-	-	-	-	2	-	2	-	-	-	-	-	-	2	2	-	2	3	4	-	6	5	12	1	3	16
Charleston (Coos Bay)	1	2	3	4	4	5	3	-	2	1	4	2	2	4	1	4	2	5	7	2	7	9	6	2	7	17	25	1	7	33
Bandon	-	-	-	1	-	1	-	-	-	-	-	-	2	2	1	2	-	1	1	1	1	2	1	-	3	7	5	-	1	10
Coos Bay Total	**1**	**2**	**3**	**5**	**4**	**6**	**3**	**0**	**4**	**1**	**6**	**2**	**4**	**6**	**2**	**6**	**2**	**8**	**14**	**3**	**14**	**18**	**13**	**2**	**23**	**39**	**49**	**2**	**11**	**74**
Port Orford	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	1	-	1	-	-	1
Gold Beach	-	-	1	1	-	1	1	1	1	1	1	1	1	1	1	1	-	1	1	1	1	1	1	-	1	1	1	-	1	1
Brookings	1	4	2	3	4	4	2	2	3	1	4	1	8	7	5	8	1	3	3	1	3	10	1	3	8	9	12	1	7	16
Brookings Total	**1**	**4**	**3**	**4**	**4**	**5**	**3**	**3**	**4**	**2**	**5**	**2**	**9**	**8**	**6**	**9**	**1**	**4**	**4**	**2**	**4**	**11**	**3**	**3**	**10**	**10**	**14**	**1**	**8**	**18**
Crescent City	**2**	**4**	**3**	**5**	**4**	**5**	**4**	**6**	**8**	**4**	**8**	**4**	**13**	**14**	**7**	**15**	**3**	**3**	**7**	**3**	**7**	**17**	**3**	**7**	**20**	**7**	**13**	**5**	**11**	**31**
Orick	-	-	-	-	-	-	-	-	-	-	-	-	4	4	1	4	-	-	-	-	-	4	1	-	1	3	1	-	-	4
Trinidad	-	-	-	1	-	1	-	-	-	-	-	-	4	4	-	4	-	-	-	-	-	4	-	1	5	1	2	-	1	7
Eureka Area	-	1	-	2	2	2	2	4	4	2	4	3	4	4	3	4	1	2	1	-	2	5	-	2	10	7	6	-	6	21
Eureka Total	**0**	**1**	**0**	**3**	**2**	**3**	**2**	**4**	**4**	**2**	**4**	**3**	**12**	**12**	**4**	**12**	**1**	**2**	**1**	**0**	**2**	**13**	**1**	**3**	**16**	**11**	**9**	**0**	**7**	**32**
Fort Bragg	-	-	1	-	1	2	1	1	1	1	1	1	9	9	3	10	-	3	2	1	3	11	-	-	5	7	12	-	7	22
Albion	-	-	-	-	-	-	-	-	1	-	1	-	-	-	-	-	-	-	-	-	-	1	-	-	1	-	-	-	-	1
Point Arena	-	-	-	-	-	-	-	-	1	-	1	1	1	-	-	1	-	1	3	1	3	3	-	1	2	6	2	-	1	6
Elk	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	1
Fort Bragg Total	**0**	**0**	**1**	**0**	**1**	**2**	**1**	**1**	**3**	**1**	**3**	**2**	**10**	**9**	**3**	**11**	**0**	**4**	**5**	**2**	**6**	**15**	**0**	**1**	**8**	**13**	**14**	**0**	**9**	**30**

TABLE 3.4-43. Number of processors/buyers by primary port for the base period (November 2000 through October 2001). (Page 3 of 4)

	Processors/Buyers Buying from Vessels with Limited Entry Trawl Permits						Processors/Buyers Buying from Vessels with Fixed Gear Limited Entry Permits (No Trawl Permit)					Processors/Buyers Buying from Open Access Vessels with More than 5% Revenue from Groundfish					Processors/Buyers Buying from Open Access Vessels with Less than 5% Revenue from Groundfish						Processors/Buyers Buying from Vessels Participating in Other Fisheries							
	Whiting	Sablefish	Nearshore Spp	Shelf Spp	Slope Spp	Total	Sablefish	Nearshore Spp	Shelf Spp	Slope Spp	Total	Sablefish	Nearshore Spp	Shelf Spp	Slope Spp	Total	Sablefish	Nearshore Spp	Shelf Spp	Slope Spp	Total	Total for All Groundfish	Halibut (Pac & CA)	Shrimp/Prawns	Crabs	Salmon	HMS	CPS	Other	Total
Bodega Bay	-	2	2	2	2	2	1	1	4	3	4	1	10	13	6	14	-	3	6	2	6	18	5	2	10	24	10	1	10	44
Cloverdale	-	-	-	-	-	-	-	1	-	-	1	-	-	-	-	-	-	2	2	-	3	3	3	-	4	4	2	-	4	8
Yountville	-	-	-	-	-	-	-	-	-	-	-	-	1	1	-	1	2	1	1	-	3	4	1	-	6	2	-	1	11	13
Tomales Bay	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	1	-	-	-	1
Point Reyes	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	1	1	-	-	-	1
Sausilito	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-	2	2	2	-	2	6	3	-	5	9
Alameda	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	1	-	-	-	-	-	1	-	-	1	2	-	-	1	3
Berkeley	-	-	-	-	-	-	-	-	-	-	-	-	3	3	1	4	-	-	-	1	1	5	2	-	1	3	1	-	1	6
Richmond	-	-	-	-	-	-	1	1	1	1	1	1	1	2	2	3	-	1	1	1	1	3	2	1	1	5	1	1	2	8
San Francisco	-	3	4	5	5	6	2	11	12	4	13	5	20	19	12	24	-	6	5	1	8	31	14	6	11	13	6	2	34	48
Princeton	1	5	6	5	5	6	1	5	5	2	7	4	20	19	5	23	1	5	3	1	6	29	13	2	30	30	19	6	18	59
San Francisco Total	**1**	**10**	**12**	**12**	**12**	**14**	**5**	**19**	**22**	**10**	**26**	**11**	**56**	**57**	**26**	**70**	**3**	**18**	**20**	**6**	**30**	**96**	**44**	**11**	**67**	**91**	**42**	**11**	**86**	**200**
Gilroy	-	-	-	-	-	-	-	-	-	-	-	-	3	3	-	3	-	-	-	-	-	3	-	-	-	-	-	-	2	3
Santa Cruz	-	4	5	5	4	5	1	1	1	2	2	4	12	9	6	12	1	5	4	-	6	14	12	-	9	14	12	4	9	24
Moss Landing	1	2	1	2	2	2	4	4	4	6	8	3	8	6	6	9	2	2	3	3	7	14	11	4	6	20	15	2	7	30
Monterey	1	1	2	2	1	2	-	1	-	1	1	1	7	7	3	7	3	3	3	2	7	10	4	4	3	5	4	3	8	13
Monterey Total	**2**	**7**	**8**	**9**	**7**	**9**	**5**	**6**	**5**	**9**	**11**	**8**	**30**	**25**	**15**	**31**	**6**	**10**	**10**	**5**	**20**	**41**	**27**	**8**	**18**	**39**	**31**	**9**	**26**	**70**
San Simeon	-	-	-	-	-	-	-	-	-	-	-	-	2	2	-	2	-	-	-	-	-	2	-	-	-	1	-	1	2	2
Morro Bay	-	3	1	4	4	4	2	1	1	2	2	2	7	4	4	8	1	5	6	3	7	11	7	3	6	8	17	3	8	21
Avila	-	1	2	1	-	2	-	1	2	-	2	-	7	7	1	7	-	3	2	-	4	9	4	1	3	2	6	1	7	12
San Luis Obispo Total	**0**	**4**	**3**	**5**	**4**	**6**	**2**	**2**	**3**	**2**	**4**	**2**	**16**	**13**	**5**	**17**	**1**	**8**	**8**	**3**	**11**	**22**	**11**	**4**	**9**	**11**	**23**	**5**	**17**	**35**
Santa Barbara	-	1	1	2	1	2	-	-	-	-	-	-	4	4	2	4	1	9	7	5	13	17	13	14	20	3	7	8	25	37
Ventura	-	1	1	1	1	1	4	2	3	4	4	2	11	9	9	12	1	12	9	10	14	17	13	11	21	-	12	7	18	27
Oxnard	-	-	-	-	-	-	7	6	6	7	11	2	10	7	6	11	-	8	7	7	11	16	10	7	16	-	11	3	16	27
Port Hueneme	1	1	1	1	1	1	1	-	1	1	1	1	2	2	1	2	-	2	1	1	2	2	3	2	2	2	3	8	3	8
Santa Barbara Total	**1**	**3**	**3**	**4**	**3**	**4**	**12**	**8**	**10**	**12**	**16**	**5**	**27**	**22**	**18**	**29**	**2**	**31**	**24**	**23**	**40**	**52**	**39**	**34**	**59**	**5**	**33**	**26**	**62**	**99**
Terminal Island	-	-	-	-	-	-	-	-	-	-	-	2	9	3	4	9	2	3	4	2	4	10	6	3	9	-	7	10	23	31
San Pedro	-	-	-	-	-	-	2	3	2	2	4	1	5	4	3	6	-	9	7	3	10	14	9	-	12	2	21	10	26	34
Wilmington	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	1	1
Catalina Island	-	-	-	-	-	-	2	2	2	2	3	1	5	3	3	7	-	5	1	-	5	10	5	4	10	-	7	4	14	17
Long Beach	-	-	-	-	-	-	-	-	-	-	-	-	2	1	1	2	1	1	-	1	1	2	2	1	3	-	-	2	4	4
Newport Beach	-	-	-	-	-	-	2	2	2	2	2	1	1	1	1	1	1	4	1	-	5	5	4	5	10	-	4	3	7	12
Dana Point	-	-	-	-	-	-	1	-	-	1	1	1	3	3	2	3	-	1	-	-	1	3	1	2	10	-	4	1	6	13
Los Angeles Total	**0**	**0**	**0**	**0**	**0**	**0**	**7**	**7**	**6**	**7**	**10**	**6**	**25**	**15**	**14**	**28**	**4**	**23**	**13**	**6**	**26**	**44**	**27**	**15**	**55**	**2**	**43**	**30**	**81**	**112**

TABLE 3.4-43. Number of processors/buyers by primary port for the base period (November 2000 through October 2001). (Page 4 of 4)

	Processors/Buyers Buying from Vessels with Limited Entry Trawl Permits						Processors/Buyers Buying from Vessels with Fixed Gear Limited Entry Permits (No Trawl Permit)					Processors/Buyers Buying from Open Access Vessels with More than 5% Revenue from Groundfish					Processors/Buyers Buying from Open Access Vessels with Less than 5% Revenue from Groundfish						Processors/Buyers Buying from Vessels Participating in Other Fisheries							
	Whiting	Sablefish	Nearshore Spp	Shelf Spp	Slope Spp	Total	Sablefish	Nearshore Spp	Shelf Spp	Slope Spp	Total	Sablefish	Nearshore Spp	Shelf Spp	Slope Spp	Total	Sablefish	Nearshore Spp	Shelf Spp	Slope Spp	Total	Total for All Groundfish	Halibut (Pac & CA)	Shrimp/Prawns	Crabs	Salmon	HMS	CPS	Other	Total
North Shore	-	-	-	-	-	-	-	-	-	-	-	1	4	7	5	8	2	6	8	5	9	11	6	4	12	2	8	5	10	16
San Diego	-	-	-	-	-	-	-	2	1	-	2	-	6	5	3	7	1	4	4	2	5	10	2	1	18	-	12	6	15	23
Oceanside	-	-	-	-	-	-	-	1	-	-	1	-	3	2	2	4	-	4	1	2	4	5	2	1	5	1	3	2	4	8
San Diego Total	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**3**	**1**	**0**	**3**	**1**	**13**	**14**	**10**	**19**	**3**	**14**	**13**	**9**	**18**	**26**	**10**	**6**	**35**	**3**	**23**	**13**	**29**	**47**
Other California	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3	-	-	-	7	10
At-Sea Only	**12**	**11**	**1**	**12**	**12**	**12**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**12**	**8**	**-**	**1**	**11**	**6**	**12**	**13**	**13**
Grand Totals	**30**	**74**	**59**	**92**	**82**	**103**	**69**	**71**	**90**	**68**	**127**	**57**	**238**	**230**	**118**	**285**	**43**	**139**	**162**	**78**	**224**	**451**	**260**	**107**	**448**	**354**	**388**	**134**	**745**	**1,283**

Source: Derived from PacFIN monthly vessel summary files.

TABLE 3.4-44 . Number of buyers/processors in each port area[a/] by purchase value of raw product (exvessel value) for the base period (November 2000 through October 2001). (Page 1 of 1)

	Total Exvessel Value of Purchases						
	<$5,000	$5,000-$20,000	$20,000-$100,000	$100,000-$300,000	$300,000-$1,000,000	>$1,000,000	Total
Puget Sound	51	40	52	18	19	16	196
NW Olympic Peninsula	35	14	15	6	4	4	78
Central WA Coast	9	6	6	1	2	5	29
South WA Coast	31	25	15	4	3	3	81
Astoria-Tillamook	25	8	10	1	7	4	55
Newport	34	17	14	1	3	4	73
Coos Bay	36	26	5	5	*	*	74
Brookings	4	3	6	1	*	*	18
Crescent City	11	11	1	1	3	4	31
Eureka	17	9	3	3	0	0	32
Fort Bragg	16	6	4	*	*	*	30
San Francisco	104	39	28	13	13	3	200
Monterey	40	12	8	6	2	2	70
San Luis Obispo	16	9	4	2	2	2	35
Santa Barbara	32	19	21	15	8	4	99
Los Angeles	37	17	23	16	10	10	113
San Diego	13	10	11	9	*	*	47
At-Sea Only	*	-	-	*	*	*	13
Total	492	254	223	100	76	60	1,283

a/ Processors were assigned to the primary port area where more of its West coast purchases were made than any other West coast port area. Total purchases include value of all species landed in any area, including Alaska, Puget Sound and Columbia River.

* Values omitted to preserve confidentiality.

TABLE 3.4-45. Number of buyers buying fish caught by the indicated fleet segment from the indicated INPFC area, by species groups and processor's total purchases. (Page 1 of 3)

	Level of Puchases in Exvessel Value (All Fish Product Landed on West Coast Fishtickets)						
Gear and Species	<$5,000	$5,000-$20,000	$20,000-$100,000	$100,000-$300,000	$300,000-$1,000,000	$>1,000,000	Total
			Vancouver INPFC Area				
Limited Entry Trawl							
Whiting	0	0	0	0	1	5	6
Sablefish	0	0	3	3	3	11	20
Nearshore Species	0	0	4	2	1	6	13
Shelf Species	1	1	5	2	3	14	26
Slope Species	0	1	4	2	3	10	20
Limited Entry Fixed Gear							
Sablefish	0	0	0	1	2	7	10
Nearshore Species	0	0	0	0	0	2	2
Shelf Species	0	0	0	1	0	6	7
Slope Species	0	0	0	1	2	6	9
Open Access >5% Revenue from Groundfish							
Sablefish	0	0	0	1	0	4	5
Nearshore Species	0	0	0	0	0	1	1
Shelf Species	0	0	0	0	2	2	4
Slope Species	0	0	0	0	0	2	2
Open Access <5% Revenue from Groundfish							0
Sablefish	0	0	0	0	0	2	2
Shelf Species	0	0	0	0	1	4	5
Slope Species	0	0	0	0	0	2	2
Nongroundfish Fisheries							
Halibut	1	1	1	1	4	8	16
Shrimps and Prawns	0	0	0	0	0	2	2
Crabs	1	1	6	1	7	9	25
Salmon	1	4	4	2	4	7	22
HMS	2	3	4	2	1	4	16
CPS	0	0	0	1	3	4	8
Other	0	0	4	2	2	11	19
			Columbia INPFC Area				
Limited Entry Trawl							
Whiting	0	0	0	2	10	11	23
Sablefish	0	0	2	3	12	18	35
Nearshore Species	1	1	1	1	3	12	19
Shelf Species	0	0	3	4	13	19	39
Slope Species	0	0	3	5	13	17	38
Limited Entry Fixed Gear							
Sablefish	1	1	4	1	2	15	24
Nearshore Species	2	1	2	0	1	3	9
Shelf Species	2	2	2	3	1	12	22
Slope Species	1	0	0	0	0	15	16
Open Access >5% Revenue from Groundfish							
Sablefish	0	0	1	1	1	9	12
Nearshore Species	3	2	10	2	4	5	26
Shelf Species	3	7	10	2	5	11	38
Slope Species	0	0	0	1	0	6	7
Open Access <5% Revenue from Groundfish							
Sablefish	0	1	0	2	5	11	19
Nearshore Species	1	0	6	3	4	7	21
Shelf Species	7	4	14	6	7	16	54
Slope Species	0	1	1	1	2	10	15
Nongroundfish Fisheries							
Halibut	10	18	20	5	12	21	86
Shrimps and Prawns	0	0	0	1	4	11	16
Crabs	34	28	29	7	18	24	140
Salmon	49	26	31	10	17	21	154
HMS	33	43	27	8	9	16	136
CPS	1	0	1	4	15	12	33

TABLE 3.4-45. Number of buyers buying fish caught by the indicated fleet segment from the indicated INPFC area, by species groups and processor's total purchases. (Page 2 of 3)

Gear and Species	Level of Puchases in Exvessel Value (All Fish Product Landed on West Coast Fishtickets) <$5,000	$5,000-$20,000	$20,000-$100,000	$100,000-$300,000	$300,000-$1,000,000	$>1,000,000	Total
Other	13	6	11	7	19	18	74
Eureka INPFC Area							
Limited Entry Trawl							
Whiting	0	0	0	0	1	5	6
Sablefish	0	0	0	2	3	9	14
Nearshore Species	0	0	0	0	2	7	9
Shelf Species	0	0	3	3	5	11	22
Slope Species	0	0	1	2	4	9	16
Limited Entry Fixed Gear							
Sablefish	0	0	1	2	2	9	14
Nearshore Species	0	0	4	5	3	5	17
Shelf Species	0	0	3	6	3	8	20
Slope Species	0	0	0	2	1	9	12
Open Access >5% Revenue from Groundfish							
Sablefish	0	0	0	2	2	7	11
Nearshore Species	8	5	8	4	4	6	35
Shelf Species	7	4	8	5	5	7	36
Slope Species	1	0	4	3	3	7	18
Open Access <5% Revenue from Groundfish							
Sablefish	0	1	0	0	1	1	3
Nearshore Species	0	1	2	1	3	4	11
Shelf Species	0	2	3	1	3	7	16
Slope Species	0	0	1	0	2	4	7
Nongroundfish Fisheries							
Halibut	1	1	3	1	1	6	13
Shrimps and Prawns	0	2	1	1	2	5	11
Crabs	14	10	10	6	8	10	58
Salmon	9	6	10	3	4	8	40
HMS	11	13	6	2	1	11	44
CPS	0	1	0	0	2	4	7
Other	2	1	7	7	10	13	40
Monterey INPFC Area							
Limited Entry Trawl							
Whiting	0	0	0	2	0	0	2
Sablefish	0	1	3	6	6	8	24
Nearshore Species	1	1	5	7	6	6	26
Shelf Species	1	1	4	9	8	7	30
Slope Species	2	1	4	7	7	9	30
Limited Entry Fixed Gear							
Sablefish	1	0	2	6	2	5	16
Nearshore Species	3	4	12	7	6	0	32
Shelf Species	4	4	9	7	8	6	38
Slope Species	4	1	5	7	5	5	27
Open Access >5% Revenue from Groundfish							
Sablefish	3	2	3	8	5	6	27
Nearshore Species	45	23	19	9	9	6	111
Shelf Species	43	20	21	10	7	7	108
Slope Species	12	6	12	9	6	4	49
Open Access <5% Revenue from Groundfish							
Sablefish	3	2	0	2	1	1	9
Nearshore Species	6	6	7	5	7	1	32
Shelf Species	3	7	5	7	7	5	34
Slope Species	2	2	1	3	2	1	11
Nongroundfish Fisheries							
Halibut	17	14	16	9	8	6	70
Shrimps and Prawns	2	0	4	5	8	6	25
Crabs	26	23	18	12	14	5	98
Salmon	74	35	27	11	13	9	169
HMS	27	23	16	5	11	13	95
CPS	2	2	6	4	4	5	23

TABLE 3.4-45. Number of buyers buying fish caught by the indicated fleet segment from the indicated INPFC area, by species groups and processor's total purchases. (Page 3 of 3)

Gear and Species	<$5,000	$5,000-$20,000	$20,000-$100,000	$100,000-$300,000	$300,000-$1,000,000	$>1,000,000	Total
	Level of Puchases in Exvessel Value (All Fish Product Landed on West Coast Fishtickets)						
Other	33	26	25	21	21	12	138
			Conception INPFC Area				
Limited Entry Trawl							
Whiting	0	0	0	0	0	1	1
Sablefish	0	0	1	3	1	2	7
Nearshore Species	0	0	1	3	0	2	6
Shelf Species	0	1	2	3	1	2	9
Slope Species	0	0	2	1	1	2	6
Limited Entry Fixed Gear							
Sablefish	1	1	5	7	4	2	20
Nearshore Species	2	2	11	7	3	2	27
Shelf Species	3	1	13	6	2	2	27
Slope Species	1	1	5	8	4	2	21
Open Access >5% Revenue from Groundfish							
Sablefish	0	0	4	6	0	2	12
Nearshore Species	16	16	23	21	8	7	91
Shelf Species	12	10	18	17	7	6	70
Slope Species	2	6	15	16	5	5	49
Open Access <5% Revenue from Groundfish							
Sablefish	2	1	2	4	2	0	11
Nearshore Species	7	10	24	23	9	6	79
Shelf Species	6	9	20	12	9	9	65
Slope Species	4	6	14	10	6	3	43
Nongroundfish Fisheries							
Halibut	15	12	30	25	5	4	91
Shrimps and Prawns	8	6	21	17	8	4	64
Crabs	40	31	40	31	14	5	161
HMS	27	22	31	24	11	15	130
CPS	8	13	18	16	9	13	77
Other	41	30	53	35	22	20	201
			All Ocean Areas (Council Managed 0-200 Miles)				
Limited Entry Trawl							
Whiting	0	0	0	4	10	16	30
Sablefish	0	1	9	15	21	28	74
Nearshore Species	2	2	10	12	10	23	59
Shelf Species	2	3	15	18	23	31	92
Slope Species	2	2	12	16	22	28	82
Limited Entry Fixed Gear							
Sablefish	3	2	12	14	12	26	69
Nearshore Species	6	7	20	15	12	11	71
Shelf Species	8	7	19	19	13	24	90
Slope Species	6	2	10	14	11	25	68
Open Access >5% Revenue from Groundfish							
Sablefish	3	2	8	16	7	21	57
Nearshore Species	70	42	54	34	19	19	238
Shelf Species	64	37	53	31	20	25	230
Slope Species	15	12	31	27	13	20	118
Open Access <5% Revenue from Groundfish							
Sablefish	5	5	2	8	9	14	43
Nearshore Species	14	17	38	32	22	16	139
Shelf Species	16	22	40	26	24	34	162
Slope Species	6	9	17	14	12	20	78
Nongroundfish Fisheries							
Halibut	44	46	66	40	29	35	260
Shrimps and Prawns	10	8	24	23	20	22	107
Crabs	114	94	101	54	48	37	448
Salmon	130	70	61	24	34	35	354
HMS	100	100	79	39	30	40	388
CPS	11	16	25	25	28	29	134
Other	91	62	99	67	57	48	424

TABLE 3.4-46. For buyers of the indicated size (based on purchases) buying the indicated species from the indicated fleet, the percent of those buyers total revenue from the indicated INPFC area, during November 2000 through October 2001. (Page 1 of 3)

	Level of Puchases in Exvessel Value (All Fish Product Landed on West Coast Fishtickets)						
Gear and Species	<$5,000	$5,000-$20,000	$20,000-$100,000	$100,000-$300,000	$300,000-$1,000,000	$>1,000,000	Total
			Vancouver INPFC Area				
Limited Entry Trawl							
Whiting	-	-	-	-	0.81	0.23	0.24
Sablefish	-	-	0.25	0.07	0.19	0.22	0.21
Nearshore Species	-	-	0.00	0.01	0.00	0.00	0.00
Shelf Species	1.00	0.83	0.61	0.63	0.30	0.17	0.20
Slope Species	-	0.18	0.08	0.28	0.05	0.16	0.15
Limited Entry Fixed Gear							
Sablefish	-	-	-	0.71	0.07	0.19	0.19
Nearshore Species	-	-	-	-	-	0.00	0.00
Shelf Species	-	-	-	0.01	-	0.02	0.02
Slope Species	-	-	-	0.01	0.00	0.00	0.00
Open Access >5% Revenue from Groundfish							
Sablefish	-	-	-	0.00	-	0.02	0.02
Nearshore Species	-	-	-	-	-	0.00	0.00
Shelf Species	-	-	-	-	0.00	0.00	0.00
Slope Species	-	-	-	-	-	0.00	0.00
Open Access <5% Revenue from Groundfish							
Sablefish	-	-	-	-	-	0.00	0.00
Shelf Species	-	-	-	-	0.01	0.00	0.00
Slope Species	-	-	-	-	-	0.00	0.00
Nongroundfish Fisheries							
Halibut	1.00	0.17	0.00	0.05	0.19	0.06	0.08
Shrimps and Prawns	-	-	-	-	-	0.08	0.08
Crabs	1.00	1.00	1.00	1.00	0.76	0.29	0.32
Salmon	1.00	0.98	0.11	0.25	0.20	0.06	0.09
HMS	1.00	0.72	0.87	1.00	0.29	0.01	0.14
CPS	-	-	-	1.00	0.06	0.00	0.01
Other	-	-	0.01	0.02	0.02	0.01	0.01
			Columbia INPFC Area				
Limited Entry Trawl							
Whiting	-	-	-	0.99	0.90	0.16	0.23
Sablefish	-	-	0.08	0.00	0.01	0.07	0.06
Nearshore Species	0.00	0.04	0.00	0.00	0.05	0.00	0.00
Shelf Species	-	-	0.28	0.00	0.04	0.06	0.06
Slope Species	-	-	0.08	0.00	0.03	0.07	0.07
Limited Entry Fixed Gear							
Sablefish	1.00	0.01	0.04	0.46	0.02	0.06	0.06
Nearshore Species	0.03	0.02	0.18	-	0.00	0.00	0.00
Shelf Species	0.01	0.02	0.02	0.00	0.00	0.00	0.00
Slope Species	0.01	-	-	-	-	0.00	0.00
Open Access >5% Revenue from Groundfish							
Sablefish	-	-	0.01	0.00	0.00	0.00	0.00
Nearshore Species	0.43	0.38	0.06	0.04	0.00	0.00	0.00
Shelf Species	0.08	0.05	0.01	0.02	0.00	0.00	0.00
Slope Species	-	-	-	0.00	-	0.00	0.00
Open Access <5% Revenue from Groundfish							
Sablefish	-	0.00	-	0.00	0.00	0.00	0.00
Nearshore Species	0.01	-	0.00	0.00	0.00	0.00	0.00
Shelf Species	0.02	0.00	0.00	0.00	0.00	0.00	0.00
Slope Species	-	0.00	0.00	0.00	0.00	0.00	0.00
Nongroundfish Fisheries							
Halibut	0.75	0.33	0.13	0.04	0.01	0.01	0.01
Shrimps and Prawns	-	-	-	0.59	0.18	0.14	0.14
Crabs	0.79	0.75	0.61	0.58	0.69	0.34	0.38
Salmon	0.70	0.33	0.35	0.25	0.06	0.05	0.06
HMS	0.68	0.79	0.28	0.16	0.04	0.19	0.19
CPS	0.52	-	1.00	0.58	0.23	0.02	0.04
Other	0.92	0.17	0.08	0.04	0.04	0.01	0.01

TABLE 3.4-46. For buyers of the indicated size (based on purchases) buying the indicated species from the indicated fleet, the percent of those buyers total revenue from the indicated INPFC area, during November 2000 through October 2001. (Page 2 of 3)

	Level of Puchases in Exvessel Value (All Fish Product Landed on West Coast Fishtickets)						
Gear and Species	<$5,000	$5,000-$20,000	$20,000-$100,000	$100,000-$300,000	$300,000-$1,000,000	$>1,000,000	Total
			Eureka INPFC Area				
Limited Entry Trawl							
Whiting	-	-	-	-	0.99	0.02	0.02
Sablefish	-	-	-	0.00	0.07	0.12	0.11
Nearshore Species	-	-	-	-	0.00	0.01	0.01
Shelf Species	-	-	0.00	0.01	0.07	0.09	0.08
Slope Species	-	-	0.17	0.00	0.13	0.21	0.20
Limited Entry Fixed Gear							
Sablefish	-	-	0.01	0.01	0.00	0.05	0.05
Nearshore Species	-	-	0.22	0.10	0.06	0.02	0.03
Shelf Species	-	-	0.02	0.00	0.01	0.00	0.00
Slope Species	-	-	-	0.00	0.00	0.00	0.00
Open Access >5% Revenue from Groundfish							
Sablefish	-	-	-	0.01	0.00	0.01	0.01
Nearshore Species	0.31	0.48	0.20	0.30	0.24	0.02	0.07
Shelf Species	0.11	0.15	0.03	0.03	0.04	0.00	0.01
Slope Species	0.02	-	0.04	0.00	0.00	0.00	0.00
Open Access <5% Revenue from Groundfish							
Sablefish	-	0	-	-	0.00	0.00	0.00
Nearshore Species	-	0.00	0.00	0.00	0.00	0.00	0.00
Shelf Species	-	0.05	0.01	0.00	0.00	0.00	0.00
Slope Species	-	-	0.00	-	0.00	0.00	0.00
Nongroundfish Fisheries							
Halibut	1.00	0.41	0.21	1.00	0.00	0.00	0.00
Shrimps and Prawns	-	0.57	0.00	0.11	0.06	0.09	0.08
Crabs	0.82	0.57	0.66	0.59	0.63	0.38	0.44
Salmon	0.64	0.41	0.18	0.13	0.03	0.01	0.02
HMS	0.82	0.87	0.25	0.04	1.00	0.09	0.10
CPS	-	1.00	-	-	0.00	0.00	0.00
Other	0.05	0.00	0.15	0.01	0.06	0.05	0.05
			Monterey INPFC Area				
Limited Entry Trawl							
Whiting	-	-	-	0.00	-	-	0.00
Sablefish	-	0.05	0.02	0.02	0.01	0.08	0.06
Nearshore Species	0.00	0.10	0.07	0.19	0.06	0.01	0.04
Shelf Species	0.20	0.24	0.14	0.10	0.06	0.11	0.10
Slope Species	0.14	0.05	0.11	0.09	0.03	0.18	0.13
Limited Entry Fixed Gear							
Sablefish	0.97	-	0.01	0.10	0.05	0.08	0.07
Nearshore Species	0.64	0.54	0.12	0.07	0.01	-	0.04
Shelf Species	0.21	0.12	0.05	0.03	0.00	0.00	0.00
Slope Species	0.11	0.03	0.06	0.01	0.06	0.01	0.02
Open Access >5% Revenue from Groundfish							
Sablefish	0.12	0.12	0.03	0.07	0.01	0.06	0.05
Nearshore Species	0.33	0.42	0.25	0.20	0.14	0.01	0.08
Shelf Species	0.34	0.11	0.08	0.03	0.02	0.01	0.02
Slope Species	0.19	0.00	0.01	0.00	0.00	0.00	0.00
Open Access <5% Revenue from Groundfish							
Sablefish	0.02	0.01	-	0.02	0.00	0.00	0.00
Nearshore Species	0.01	0.01	0.00	0.01	0.00	0.00	0.00
Shelf Species	0.01	0.01	0.00	0.00	0.00	0.00	0.00
Slope Species	0.04	0.00	0.00	0.00	0.00	0.00	0.00
Nongroundfish Fisheries							
Halibut	0.19	0.32	0.18	0.09	0.07	0.01	0.04
Shrimps and Prawns	0.75	-	0.28	0.58	0.05	0.04	0.08
Crabs	0.77	0.66	0.59	0.38	0.48	0.23	0.37
Salmon	0.70	0.49	0.42	0.25	0.28	0.11	0.18
HMS	0.46	0.41	0.21	0.07	0.02	0.10	0.09
CPS	0.75	0.00	0.02	0.00	0.07	0.33	0.26
Other	0.41	0.10	0.15	0.28	0.34	0.21	0.25

TABLE 3.4-46. For buyers of the indicated size (based on purchases) buying the indicated species from the indicated fleet, the percent of those buyers total revenue from the indicated INPFC area, during November 2000 through October 2001. (Page 3 of 3)

	Level of Puchases in Exvessel Value (All Fish Product Landed on West Coast Fishtickets)						
Gear and Species	<$5,000	$5,000-$20,000	$20,000-$100,000	$100,000-$300,000	$300,000-$1,000,000	$>1,000,000	Total
			Conception INPFC Area				
Limited Entry Trawl							
Whiting	-	-	-	-	-	0.00	0.00
Sablefish	-	-	0.00	0.00	0.00	0.02	0.02
Nearshore Species	-	-	0.00	0.02	-	0.00	0.00
Shelf Species	-	0.00	0.06	0.28	0.01	0.03	0.05
Slope Species	-	-	0.03	0.03	0.00	0.06	0.05
Limited Entry Fixed Gear							
Sablefish	0.03	0.00	0.13	0.13	0.00	0.04	0.04
Nearshore Species	0.21	0.19	0.06	0.01	0.00	0.00	0.01
Shelf Species	0.35	0.01	0.06	0.03	0.00	0.00	0.01
Slope Species	1.00	0.01	0.15	0.19	0.03	0.06	0.07
Open Access >5% Revenue from Groundfish							
Sablefish	-	-	0.09	0.05	-	0.00	0.02
Nearshore Species	0.24	0.27	0.07	0.13	0.19	0.05	0.08
Shelf Species	0.29	0.12	0.01	0.01	0.02	0.00	0.01
Slope Species	0.09	0.01	0.03	0.01	0.00	0.00	0.00
Open Access <5% Revenue from Groundfish							
Sablefish	0.06	0	0.00	0.00	0.00	-	0.00
Nearshore Species	0.03	0.02	0.01	0.00	0.00	0.00	0.00
Shelf Species	0.08	0.03	0.01	0.00	0.00	0.00	0.00
Slope Species	0.04	0.01	0.00	0.00	0.00	0.00	0.00
Nongroundfish Fisheries							
Halibut	0.24	0.11	0.06	0.12	0.00	0.00	0.04
Shrimps and Prawns	0.63	0.53	0.39	0.24	0.25	0.24	0.25
Crabs	0.85	0.62	0.47	0.31	0.37	0.11	0.28
HMS	0.62	0.56	0.35	0.16	0.50	0.31	0.32
CPS	0.06	0.33	0.14	0.27	0.36	0.67	0.60
Other	0.34	0.22	0.25	0.34	0.40	0.13	0.20
			All Ocean Areas (Council Managed 0-200 Miles)				
Limited Entry Trawl							
Whiting	-	-	-	0.36	0.90	0.12	0.17
Sablefish	-	0.05	0.11	0.02	0.04	0.09	0.08
Nearshore Species	0.00	0.06	0.04	0.11	0.05	0.00	0.01
Shelf Species	0.75	0.10	0.24	0.13	0.07	0.08	0.08
Slope Species	0.14	0.06	0.08	0.07	0.04	0.10	0.10
Limited Entry Fixed Gear							
Sablefish	0.53	0.01	0.07	0.13	0.02	0.06	0.06
Nearshore Species	0.33	0.16	0.11	0.05	0.02	0.00	0.01
Shelf Species	0.21	0.03	0.05	0.02	0.00	0.00	0.00
Slope Species	0.15	0.02	0.11	0.09	0.03	0.00	0.01
Open Access >5% Revenue from Groundfish							
Sablefish	0.11	0.12	0.05	0.04	0.00	0.01	0.01
Nearshore Species	0.30	0.36	0.14	0.15	0.15	0.01	0.04
Shelf Species	0.29	0.10	0.04	0.01	0.01	0.00	0.00
Slope Species	0.18	0.01	0.02	0.00	0.00	0.00	0.00
Open Access <5% Revenue from Groundfish							
Sablefish	0.04	0.01	0.00	0.01	0.00	0.00	0.00
Nearshore Species	0.02	0.01	0.01	0.00	0.00	0.00	0.00
Shelf Species	0.04	0.02	0.01	0.00	0.00	0.00	0.00
Slope Species	0.04	0.01	0.00	0.00	0.00	0.00	0.00
Nongroundfish Fisheries							
Halibut	0.37	0.26	0.10	0.10	0.04	0.01	0.02
Shrimps and Prawns	0.64	0.54	0.34	0.31	0.11	0.11	0.12
Crabs	0.80	0.67	0.53	0.39	0.53	0.29	0.34
Salmon	0.69	0.42	0.30	0.22	0.15	0.05	0.07
HMS	0.61	0.63	0.31	0.18	0.19	0.19	0.19
CPS	0.26	0.30	0.16	0.26	0.24	0.23	0.23
Other	0.45	0.16	0.19	0.25	0.24	0.07	0.11

TABLE 3.4-47 Estimated Recreational catch in ocean waters by subregion and type of boat (mt). (Page 1 of 1)

		S. California			N. California			Oregon			Washington			Coast Wide		
Year	Species	Charter	Private	Total	Charter	Private	Total	Charter	Private	Total	Charter	Private	Total	Charter	Private	Total
1998	Bocaccio	12.9	15.3	28.2	20.0	2.7	22.7	0.2	0.1	0.3	0.1	0.1	0.2	33.2	18.1	51.4
	Canary Rockfish	1.1	0.3	1.5	12.7	11.4	24.1	25.3	17.9	43.3	9.6	1.5	11.1	48.7	31.2	80.0
	Cowcod	0.7	2.1	2.8	-	-	-	-	-	-	-	-	-	0.7	2.1	2.8
	Widow Rockfish	0.3	0.0	0.3	32.4	3.2	35.5	15.3	0.7	16.0	-	-	-	47.9	3.9	51.8
	Yelloweye Rockfish	-	-	-	3.2	2.3	5.5	8.3	10.5	18.8	9.9	4.5	14.4	21.4	17.3	38.7
	Lingcod	7.2	9.6	16.9	32.6	165.1	197.7	17.7	51.3	69.0	20.0	7.0	27.0	77.5	233.0	310.6
1999	Bocaccio	38.7	27.9	66.6	45.8	6.4	52.2	0.2	0.2	0.4	0.2	0.2	0.4	84.9	34.7	119.6
	Canary Rockfish	1.7	0.1	1.8	47.2	15.1	62.3	15.3	13.4	28.7	4.2	0.7	4.9	68.3	29.4	97.7
	Cowcod	2.2	1.5	3.8	1.8	-	1.8	-	-	-	-	-	-	4.0	1.5	5.6
	Widow Rockfish	0.1	-	0.1	27.6	2.6	30.3	0.9	1.1	2.0	-	-	-	28.7	3.7	32.4
	Yelloweye Rockfish	1.6	-	1.6	7.3	3.7	11.0	8.9	8.4	17.3	8.0	10.4	18.5	25.8	22.5	48.4
	Lingcod	19.6	10.6	30.2	93.2	195.3	288.6	30.5	49.5	80.0	21.6	12.4	34.0	164.9	267.8	432.7
2000	Bocaccio	32.1	11.1	43.2	53.6	5.3	58.9	0.7	-	0.7	0.3	0.1	0.3	86.7	16.5	103.2
	Canary Rockfish	0.4	-	0.4	62.1	14.2	76.3	10.3	4.2	14.5	1.8	0.9	2.8	74.7	19.3	94.0
	Cowcod	0.5	3.7	4.2	-	1.7	1.7	-	-	-	-	-	-	0.5	5.4	5.9
	Widow Rockfish	0.1	-	0.1	11.5	0.2	11.6	3.0	-	3.0	-	-	-	14.5	0.2	14.7
	Yelloweye Rockfish	-	-	-	3.8	3.7	7.5	9.0	0.5	9.5	4.4	6.3	10.7	17.2	10.5	27.7
	Lingcod	3.1	2.0	5.1	56.0	107.1	163.1	22.6	27.4	50.0	17.8	10.4	28.2	99.5	146.9	246.4
2001	Bocaccio	25.9	28.4	54.3	45.9	3.0	48.8	0.5	0.2	0.7	0.7	0.2	0.9	73.0	31.8	104.8
	Canary Rockfish	-	-	-	20.5	11.8	32.3	6.1	4.7	10.9	1.2	1.2	2.4	27.9	17.7	45.6
	Cowcod	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Pacific Ocean Perch	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Widow Rockfish	-	0.3	0.3	9.1	0.1	9.2	4.1	-	4.1	-	-	-	13.2	0.4	13.6
	Yelloweye Rockfish	-	-	-	3.0	1.7	4.6	4.5	0.2	4.7	6.3	8.3	14.7	13.8	10.2	24.0
	Lingcod	3.1	19.2	22.3	39.7	76.6	116.3	28.6	31.4	60.0	17.5	14.7	32.2	88.9	141.9	230.8
2002[a/]	Bocaccio	53.4	20.0	73.3	7.7	0.5	8.2	0.4	0.4	0.8	-	-	-	61.5	20.9	82.3
	Canary Rockfish	0.0	0.2	0.2	2.5	3.2	5.7	3.8	4.6	8.4	0.1	3.5	3.6	6.4	11.5	17.9
	Cowcod	-	0.5	0.5	0.1	-	0.1	-	-	-	-	-	-	0.1	0.5	0.6
	Pacific Ocean Perch	0.0	-	0.0	0.2	0.2	0.4	-	-	-	-	-	-	0.2	0.2	0.4
	Widow Rockfish	0.7	-	0.7	0.9	0.0	0.9	1.0	-	1.0	-	-	-	2.5	0.0	2.6
	Yelloweye Rockfish	0.6	-	0.6	0.4	1.1	1.5	0.7	2.4	3.1	-	-	-	1.7	3.5	5.2
	Lingcod	28.7	35.0	63.7	187.6	216.7	404.3	10.7	64.3	75.0	4.0	23.0	27.1	231.0	339.1	570.1

a/ 2002 estimates are preliminary. Source: RecFin and ODFW, May 2003.

TABLE 3.4-48 Effort, personal income, and jobs related to the recreational ocean fisheries off Washington, Oregon, and California in 2001. (Page 1of 1)

Area		Angler Trips (1,000s)			Coastal Community Income Impacts for the Recreational Fishery ($1,000s)			Jobs
		Charter	Private	Total	Charter	Private	Total	Total
Washington Coast	Total	59	88	147	$5,335	$3,285	$8,620	392
	Groundfish	12	10	23	$1,134	$385	$1,519	69
Oregon	Total	70	140	211	$6,382	$4,911	$11,293	514
	Groundfish	47	22	69	$4,227	$783	$5,011	228
North/Central California[a/]	Total	221	901	1,122	$27,294	$54,172	$81,466	3,363
	Groundfish	141	164	305	$17,414	$9,860	$27,274	1,126
Southern California[b/]	Total	577	1,757	2,334	$72,321	$81,023	$153,345	5,536
	Groundfish	204	252	456	$25,569	$11,621	$37,190	1,343
California Total	Total	798	2,658	3,456	$99,616	$135,195	$234,811	8,899
	Groundfish	345	416	761	$43,983	$21,481	$64,465	2,468
Grand Total	Total	927	2,886	3,813	$111,332	$143,392	$254,724	9,823
	Groundfish	404	449	853	$48,345	$22,649	$70,994	2,765

a/ Includes counties from Monterey north.
b/ Includes counties from San Luis Obispo south.

TABLE 3.4-49. Historical West Coast groundfish catch in ocean areas by Tribal fleet for years 1995 through 2001. (round weight-lbs.) (Page 1 of 1)

Species	1995	1996	1997	1998	1999	2000	2001	2002
Arrowtooth Flounder	240	3		255	13,195	331	961	7,137
Dover Sole	1,764	2,441	1,268	4,509	11,594	2,030	4,619	35,417
English Sole		4	118	1,847	593	996	7,103	88,684
Petrale Sole		5	12	3,249	545	80	1,954	45,479
Rex Sole					26	151	1,358	6,632
Rock Sole				2,396	16		22	5,833
Unsp. Flatfish				38	775		437	8,406
Unspecified Sanddab							1,599	19,655
Sand Sole		12	40				269	2,748
Starry Flounder		22	54				3	301
Butter Sole								605
Flatfish Total	2,004	2,487	1,492	12,294	26,744	3,588	18,325	220,897
Bocaccio				**2**	**38**	**145**	**449**	**0**
Nom. Canary Rockfish	59	171	26	609	1,033	539	4,064	7,071
Canary Rockfish				**277**	**252**	**330**	**1,380**	**0**
Darkblotched Rockfish				**0**	**36**	**76**	**226**	**3,273**
Greenstriped Rockfish				1	51	16	0	
Pacific Ocean Perch				**0**	**110**	**20**	**16**	**0**
Redbanded Rockfish				1	128	492	0	
Redstripe Rockfish				1	63	131	1,510	
Rougheye Rockfish				1	80	76	1,529	
Rosethorn Rockfish				0	0		0	
Sharpchin Rockfish				1	9	10	85	
Silvergrey Rockfish				0	36	4	12	
Unsp. Pop Group		3			104			472
Unsp. Rockfish	114,684	79,545	65,121	65,245	59,875	45,953		
Widow Rockfish				**54**	**411**	**2,010**	**16,265**	**0**
Nom. Widow Rockfish					53	3	51	27,969
Yelloweye Rockfish					**68**	**3**	**2**	**0**
Nom. Yellowtail Rockfish	519	1,297	2,471	10,448	28,671	9,585	7,598	572,996
Yellowtail Rockfish				3,263	6,498	68,463	210,006	0
Unsp. Shelf Rockfish						3,099	20,503	23,629
Unsp. Near-shore Rockfish						10	58	116
Unsp. Slope Rockfish						19,891	54,920	32,941
Blackgill Rockfish							19	
Shortraker Rockfish							289	
Rockfish Total	115,262	81,016	67,618	79,903	97,516	150,856	318,982	668,467
Spiny Dogfish		5,521			881	6,251		2,607
Lingcod	**2,873**	**2,732**	**1,648**	**5,247**	**7,051**	**6,817**	**9,429**	**24,854**
Pacific Cod	2,814	1,540	2,166	4,873	2,677	4,573	8,712	128,530
Sablefish	1,696,098	1,881,702	1,775,108	980,719	1,566,260	1,555,808	1,451,522	959,982
Unspecified Skate	2,517	1,689	1,017	2,031	2,169	1,920	1,407	18,635
Nominal Shortspine Thornyhead	15,697	16,010	16,892	7,606	13,251	8,987	10,945	10,499
Shortspine Thornyhead				471	240		27	
Nominal Longspine Thornyhead	1,305	538	139	28				
Other Groundfish Total	1,721,304	1,909,732	1,796,970	1,000,975	1,592,529	1,584,356	1,482,042	1,145,107
Pacific Whiting		**33,039,648**	**54,713,657**	**53,984,582**	**56,768,061**	**13,781,257**	**13,404,001**	**45,867,384**
All Groundfish Species Total	1,838,570	35,032,883	56,579,737	55,077,754	58,484,850	15,520,057	15,223,350	47,901,855

TABLE 3.4-50 Historical West Coast groundfish catch in ocean areas by tribal fleet for years 1995 through 2001 (exvessel revenue $). (Page 1 of 1)

Species	1995	1996	1997	1998	1999	2000	2001	2002
Arrowtooth Flounder	24	1		26	1,319	33	111	715
Dover Sole	570	768	393	1,478	3,817	663	1,498	11,335
English Sole		1	106	613	220	309	2,726	29,289
Petrale Sole		8	8	3,249	545	84	1,692	46,509
Rex Sole					8	51	471	2,316
Rock Sole				791	5		7	2,033
Unsp. Flatfish				13	271		145	2,773
Unspecified Sanddab							372	5,110
Sand Sole		9	30				204	2,084
Starry Flounder		7	16				1	98
Butter Sole								206
Flatfish Total	594	794	553	6,170	6,185	1,140	7,227	102,468
Bocaccio				**1**	**13**	**64**	**207**	**0**
Nom. Canary Rockfish	20	60	12	230	372	196	1,901	3,329
Canary Rockfish				**97**	**89**	**145**	**655**	**0**
Darkblotched Rockfish				**0**	**12**	**33**	**104**	**1,477**
Greenstriped Rockfish				0	18	7	0	
Pacific Ocean Perch				**0**	**38**	**9**	**7**	**0**
Redbanded Rockfish				0	44	216	0	
Redstripe Rockfish				0	22	58	689	
Rougheye Rockfish				0	27	33	705	
Rosethorn Rockfish				0	0		0	
Sharpchin Rockfish				0	3	4	39	
Silvergrey Rockfish				0	12	2	5	
Unsp. Pop Group		1			36			212
Unsp. Rockfish	48,130	32,345	26,723	26,575	25,334	20,737		
Widow Rockfish				**19**	**143**	**883**	**7,801**	**0**
Nom. Widow Rockfish					19	1	16	13,425
Yelloweye Rockfish					**24**	**2**	**0**	**0**
Nom. Yellowtail Rockfish	189	438	864	3,542	10,256	3,429	3,379	274,509
Yellowtail Rockfish				1,142	2,275	30,124	99,901	
Unsp. Shelf Rockfish						1,758	13,068	9,794
Unsp. Near-shore Rockfish						4	25	14,434
Unsp. Slope Rockfish						8,238	22,558	55
Blackgill Rockfish							9	
Shortraker Rockfish							134	
Rockfish Total	61,977	48,699	42,552	39,366	49,703	73,143	159,637	317,235
Spiny Dogfish		544			177	830		405
Lingcod	**1,404**	**1,255**	**731**	**3,007**	**4,169**	**4,065**	**6,075**	**18,176**
Pacific Cod	1,086	587	818	1,924	1,096	1,987	3,792	63,961
Sablefish	3,046,910	3,003,716	3,162,376	1,280,233	2,045,434	2,544,542	2,411,517	1,512,595
Unspecified Skate	588	120	68	136	145	129	143	2,563
Nominal Shortspine Thornyhead	12,581	15,340	14,828	7,310	10,751	7,199	8,414	8,232
Shortspine Thornyhead				425	215		20	
Nominal Longspine Thornyhead	1,057	515	125	25				
Other Groundfish Total	3,049,988	3,006,222	3,163,993	1,285,300	2,051,021	2,551,553	2,421,527	1,605,932
Pacific Whiting		**1,651,982**	**2,735,683**	**2,699,229**	**2,838,403**	**551,250**	**536,160**	**2,065,122**
All Groundfish Species Total	3,112,559	4,707,697	5,942,781	4,030,065	4,945,312	3,177,086	3,124,551	4,090,757

TABLE 3.4-51. Bycatch of groundfish species in Makah trawl and troll fisheries in 2000, 2001, and 2002.
Note: No data available for bycatch by target species in bottom trawl. Primary target species are Pacific cod and flatfish. (Page 1 of 1)

2000 MIDWATER	Pounds	2001 MIDWATER	Pounds	2002 MIDWATER	Pounds
black	0	black	0	black	0
lingcod	0	lingcod	6	lingcod	365
canary	306	canary	1,366	canary	3,989
yelloweye	0	yelloweye	0	yelloweye	53
widow	2,036	widow	11,549	widow	27,757
yellowtail	67,872	yellowtail	190,494	yellowtail	540,000
POP	0	POP	0	POP	0
darkblotched	0	darkblotched	102	darkblotched	2,984
SST	0	SST	0	SST	0
2000 BOTTOM	**Pounds**	**2001 BOTTOM**	**Pounds**	**2002 BOTTOM**	**Pounds**
black	0	black	53	black	0
lingcod	7	lingcod	508	lingcod	9,003
canary	24	canary	0	canary	644
yelloweye	0	yelloweye	0	yelloweye	0
widow	0	widow	0	widow	0
yellowtail	563	yellowtail	505	yellowtail	6,724
POP	0	POP	0	POP	0
darkblotched	0	darkblotched	0	darkblotched	0
SST	0	SST	0	SST	182
2000 Troll	**Pounds**	**2001 Troll**	**Pouds**	**2002 Troll**	**Pounds**
black	0	black	0	black	0
lingcod	1,958	lingcod	773	lingcod	2,006
canary	381	canary	607	canary	1189
yelloweye	988	yelloweye	43	yelloweye	83
widow	0	widow	32	widow	0
yellowtail	8,948	yellowtail	7,060	yellowtail	7,071
POP	0	POP	0	POP	0
darkblotched	0	darkblotched	0	darkblotched	0
SST	0	SST	0	SST	0

TABLE 3.4-52. Bycatch of groundfish species in tribal longline fisheries in 2000, 2001, and 2002. (Page 1 of 2)

Target Fishery		Bycatch		Target Fishery		Bycatch		Target Fishery		Bycatch	
2000	Pounds	Bycatch Species	Pounds	2001	Pounds	Bycatch Species	Pounds	2002	Pounds	Bycatch Species	Pounds
Quinault[a]											
Halibut	85,252		b/	Halibut	85,644	rock	49	Halibut	104,191	canary	4
Sablefish	309,762		b/	Sablefish	288,511	rougheye	7,964			yelloweye	10
						blackgill	2,444			yellowtail	4
						shortraker	3,710			shelf	19
						SST	542	Sablefish	114,269	slope	4,121
										SST	570
Quileute											
Halibut	42,666	black	30	Halibut	45,034	black	0	Halibut	67,290	black	0
		lingcod	144			lingcod	1,599			lingcod	1,005
		canary	74			canary	25			canary	107
		yelloweye	2,365			yelloweye	4,224			yelloweye	3,278
		yellowtail	63			yellowtail	19			yellowtail	42
		widow	0			widow	0			widow	0
		POP	0			POP	0			POP	0
		darkblotched	0			darkblotched	0			darkblotched	0
		SST	0			SST	0			SST	0
Sablefish	164,016	black	0	Sablefish	143,591	black	0	Sablefish	92,438	black	0
		lingcod	0			lingcod	0			lingcod	0
		canary	0			canary	0			canary	0
		yelloweye	0			yelloweye	0			yelloweye	0
		yellowtail	0			yellowtail	0			yellowtail	0
		widow	0			widow	0			widow	0
		POP	0			POP	0			POP	0
		darkblotched	0			darkblotched	0			darkblotched	0
		SST	624			SST	482			SST	80
Makah											
Halibut	151,268	black	0	Halibut	270,365	black	0	Halibut	294,618	black	0
		lingcod	2,289			lingcod	4,092			lingcod	10,793
		canary	19,547			canary	2,330			canary	597
		yelloweye	523			yelloweye	2,075			yelloweye	1,819
		yellowtail	0			yellowtail	382			yellowtail	235
		widow	3			widow	19			widow	0
		POP	0			POP	0			POP	0
		darkblotched	0			darkblotched	0			darkblotched	0

TABLE 3.4-52. Bycatch of groundfish species in tribal longline fisheries in 2000, 2001, and 2002. (Page 2 of 2)

Target Fishery		Bycatch		Target Fishery		Bycatch		Target Fishery		Bycatch	
		SST	0			SST	0			SST	0
Sablefish	490,229	black	0	Sablefish	464,723	black	0	Sablefish	227,740	black	0
		lingcod	0			lingcod	0			lingcod	0
		canary	0			canary	0			canary	0
		yelloweye	0			yelloweye	0			yelloweye	0
		yellowtail	0			yellowtail	0			yellowtail	0
		widow	0			widow	0			widow	0
		POP	0			POP	0			POP	0
		darkblotched	0			darkblotched	0			darkblotched	0
		SST	7,662			SST	10,081			SST	9,229

a/ No black rockfish, lingcod, Pacific ocean perch, widow, or darkblotched caught for these fisheries/years for Quinault.
b/ Data unavailable.

TABLE 3.4-53. Local income impacts associated with commercial fishery landings by major port area for 1998 ($1,000). (Page 1 of 2)

Species Group	WASHINGTON						OREGON				
	Puget Sound	NW Olympic Peninsula	Central WA Coast	South WA Coast	Unsp. WA	WA TOTAL	Astoria-Tillamook	Newport	Coos Bay	Brookings	OR TOTAL
Whiting	126	0	3,562	676	0	4,364	14,252	21,062	24	0	35,338
Sablefish	1,766	1,930	984	143	802	5,625	2,517	2,302	1,941	887	7,647
Shortspine Thornyhead	135	68	88	32	5	327	504	363	545	170	1,581
Longspine Thornyhead	55	0	114	31	0	200	1,020	253	1,141	233	2,647
Slope Rockfish	1,319	219	523	47	8	2,116	1,125	617	431	162	2,335
Dover Sole	0	126	1	115	0	243	2,118	355	2,048	525	5,046
Rex Sole	18	40	18	15	0	90	142	45	199	30	416
Petrale Sole	486	251	253	34	0	1,024	728	411	827	87	2,053
Arrowtooth Flounder	0	62	0	22	0	84	1,101	38	127	0	1,266
Other Slope Groundfish	0	0	0	0	0	0	23	11	207	23	264
Widow Rockfish	973	89	246	194	0	1,501	1,616	1,172	665	345	3,799
Chilipepper Rockfish	0	0	0	0	0	0	0	0	26	6	32
Yellowtail Rockfish	1,219	207	389	100	0	1,916	1,716	552	319	258	2,845
Shelf Rockfish	1,428	122	179	73	0	1,803	896	598	529	499	2,521
English Sole, Flathead Sole	127	182	69	24	0	402	248	88	262	91	689
Sandabs	0	0	0	0	0	0	3	3	127	4	138
Other ShelfGroundfish	1,001	381	107	18	0	1,507	441	106	89	122	759
Nearshore Rockfish	0	0	0	29	0	29	183	5	3	337	528
Other Flatfish	35	31	2	2	0	70	92	31	96	0	219
Other Groundfish	0	0	0	0	0	0	1	4	0	86	91
Groundfish Total	8,688	3,708	6,535	1,555	815	21,301	28,726	28,018	9,605	3,866	70,214
Pink Shrimp Trawl	0	8	1,178	297	0	1,483	1,774	2,018	1,033	620	5,445
Spot Prawn Trawl	0	0	0	0	0	0	0	0	0	0	0
Spot Prawn Pot	0	0	0	0	0	0	0	0	0	0	0
Ridgeback Prawn Trawl	0	0	0	0	0	0	0	0	0	0	0
Pacific Halibut	1	659	18	34	80	793	128	188	113	8	438
CA Halibut (except Gillnet)	0	0	0	0	0	0	0	0	0	0	0
Salmon	2	241	373	0	14	630	2,939	37	39	1	3,016
Sea Cucumber	0	0	0	0	0	0	0	0	0	0	0
CA Sheephead	0	0	0	0	0	0	0	0	0	0	0
Gillnet Complex	0	0	0	0	0	0	0	0	0	0	0
Squid	0	0	0	0	0	0	0	0	0	0	0
Other CPS	0	0	68	6	0	75	0	0	0	0	0
HMS	1,112	2	7,357	10,721	58	19,249	9,603	2,754	1,788	203	14,348
Dungeness Crab	2,149	1,698	12,571	3,743	852	21,014	5,706	5,421	3,427	4,665	19,220
Other Crustaceans	2	9	460	39	127	637	78	106	52	11	248
Other Species	0	0	0	10	0	10	78	26	36	190	331
Total	11,954	6,325	28,562	16,406	1,945	65,192	49,034	38,568	16,094	9,565	113,260

TABLE 3.4-53. Local income impacts associated with commercial fishery landings by major port area for 1998 ($1,000). (Page 2 of 2)

Species Group	CALIFORNIA											At Sea Sector	W - O - C TOTAL
	Crescent City	Eureka	Fort Bragg	San Francisco	Monterey	San Luis Obispo	Santa Barbara	Los Angeles	San Diego	Unsp. CA	CA TOTAL		
Whiting	3,150	341	0	0	0	0	0	0	0	0	3,492	0	43,194
Sablefish	1,113	1,906	1,119	819	1,122	474	168	345	257	0	7,324	0	20,596
Shortspine Thornyhead	396	769	436	283	485	462	43	218	247	0	3,339	0	5,247
Longspine Thornyhead	800	1,341	659	357	715	648	57	261	155	0	4,993	0	7,841
Slope Rockfish	214	487	545	683	866	312	305	43	21	0	3,474	0	7,925
Dover Sole	0	1,969	905	650	689	1,163	a/	a/	0	0	5,377	0	10,666
Rex Sole	94	137	95	56	97	95	a/	a/	0	0	577	0	1,082
Petrale Sole	331	383	307	391	349	116	a/	a/	0	0	1,887	0	4,965
Arrowtooth Flounder	25	5	0	2	0	0	0	0	0	0	32	0	1,382
Other Slope Groundfish	17	69	152	32	235	9	0	0	0	0	514	0	778
Widow Rockfish	281	338	268	408	107	95	1	10	0	0	1,508	0	6,808
Chilipepper Rockfish	33	50	349	1,196	425	338	4	13	4	0	2,413	0	2,445
Yellowtail Rockfish	94	117	154	422	23	16	8	1	0	0	835	0	5,595
Shelf Rockfish	158	184	466	805	339	639	490	394	72	0	3,548	0	7,871
English Sole, Flathead Sole	258	113	123	209	131	12	0	0	0	0	847	0	1,938
Sandabs	44	34	6	660	456	20	a/	23	a/	0	1,252	0	1,390
Other ShelfGroundfish	97	74	89	189	66	67	63	53	50	0	748	0	3,014
Nearshore Rockfish	147	57	159	767	435	967	145	241	10	0	2,929	0	3,485
Other Flatfish	60	27	2	201	16	13	21	62	0	0	404	0	692
Other Groundfish	42	3	206	203	222	1,237	195	18	5	0	2,132	0	2,223
Groundfish Total	7,356	8,404	6,041	8,336	6,780	6,684	1,516	1,683	823	0	47,623	0	139,138
Pink Shrimp Trawl	2,098	0	0	0	0	0	0	0	0	0	2,098	0	9,026
Spot Prawn Trawl	0	2	17	1,254	544	2,496	2,457	29	0	0	6,800	0	6,800
Spot Prawn Pot	0	5	0	5	972	23	756	1,592	367	0	3,720	0	3,720
Ridgeback Prawn Trawl	0	0	0	0	0	7	1,813	31	0	0	1,850	0	1,850
Pacific Halibut	1	0	19	0	0	0	0	0	0	0	20	0	1,251
CA Halibut (except Gillnet)	61	49	0	2,846	122	496	504	609	25	0	4,713	0	4,713
Salmon	0	110	116	5,284	0	2,297	0	0	0	0	7,806	0	11,452
Sea Cucumber	0	0	0	0	0	0	1,067	493	25	0	1,585	0	1,585
CA Sheephead	0	0	0	0	1	7	415	289	147	0	858	0	858
Gillnet Complex	1	0	0	15	262	37	860	773	178	0	2,126	0	2,127
Squid	0	0	0	40	0	0	4,741	464	8	0	5,252	0	5,252
Other CPS	0	15	0	7	7,611	0	1,821	39,636	385	0	49,475	0	49,550
HMS	1,088	559	114	2,741	2,743	1,011	1,597	56,041	9,050	1	74,945	0	108,541
Dungeness Crab	11,655	9,762	1,881	12,711	228	98	1	3	0	5	36,344	0	76,578
Other Crustaceans	472	32	0	3,139	63	640	5,798	4,900	2,623	330	17,996	0	18,881
Other Species	2	0	3,415	810	0	0	9,568	1,908	908	0	16,611	0	16,953
Total	22,732	18,939	11,604	37,188	19,326	13,795	32,914	108,450	14,539	336	279,823	0	458,275

a/ Values omitted to preserve confidentiality. Totals include the value.

TABLE 3.4-54. Estimated exvessel revenue and income* from commercial fishing by major port area in 2000 through 2001 and 2003. (Page 1 of 2)

	WASHINGTON					OREGON				
2001 Revenue Estimate ($,000)	Puget Sound	NW Olympic Peninsula	Central WA Coast	South WA Coast	WA TOTAL	Astoria-Tillamook	Newport	Coos Bay	Brookings	OR TOTAL
Total West Coast (All Ocean Fisheries, 0-200 miles)	7,402	5,282	16,662	12,784	44,621	24,531	21,294	12,629	5,800	64,255
Groundfish (including at-sea, excluding tribes)	4,116	3,200	2,432	583	10,338	9,921	7,659	5,076	2,448	25,104
Limited Entry Trawl Groundfish	2,980	803	1,841	468	6,093	8,765	6,234	4,081	1,162	20,242
All Other Groundfish Gear	1,136	2,397	591	115	4,245	1,156	1,425	995	1,286	4,861
2003 Revenue Estimate ($,000)										
Total West Coast (All Ocean Fisheries, 0-200 miles)	6,044	4,817	15,928	12,595	41,812	22,341	19,492	12,123	5,420	59,376
Groundfish (including at-sea, excluding tribes)	2,758	2,734	1,698	394	7,589	7,730	5,857	4,570	2,068	20,225
Limited Entry Trawl Groundfish	1,892	613	1,211	305	4,022	6,793	4,687	3,759	1,135	16,375
All Other Groundfish Gear	865	2,121	487	89	3,568	937	1,170	810	933	3,850
% Change in Revenue: 2003-2001										
Total West Coast (All Ocean Fisheries, 0-200 miles)	-18%	-9%	-4%	-1%	-6%	-9%	-8%	-4%	-7%	-8%
Groundfish (including at-sea, excluding tribes)	-33%	-15%	-30%	-32%	-27%	-22%	-24%	-10%	-16%	-19%
Limited Entry Trawl Groundfish	-36%	-24%	-34%	-35%	-34%	-22%	-25%	-8%	-2%	-19%
All Other Groundfish Gear	-24%	-12%	-18%	-22%	-16%	-19%	-18%	-19%	-27%	-21%
2001 Income Estimate ($,000)										
Total West Coast (All Ocean Fisheries, 0-200 miles)	14,344	8,262	29,858	21,053	77,099	46,402	45,709	23,476	8,792	124,378
Groundfish (including at-sea, excluding tribes)	8,694	4,865	7,442	1,557	22,569	24,122	22,122	9,266	3,754	59,264
Limited Entry Trawl Groundfish	6,558	1,318	6,558	1,377	15,811	22,338	19,991	7,718	1,985	52,032
All Other Groundfish Gear	2,136	3,547	885	180	6,758	1,784	2,132	1,548	1,769	7,233
2003 Income Estimate ($,000)										
Total West Coast (All Ocean Fisheries, 0-200 miles)	11,228	7,540	27,361	20,562	70,183	40,762	39,415	22,237	8,276	110,689
Groundfish (including at-sea, excluding tribes)	5,578	4,142	4,946	1,066	15,741	18,482	15,828	8,027	3,238	45,575
Limited Entry Trawl Groundfish	4,025	1,002	4,217	928	10,172	17,033	14,077	6,764	1,947	39,822
All Other Groundfish Gear	1,553	3,140	729	139	5,569	1,449	1,751	1,263	1,291	5,753
% Change in Income: 2003-2001										
Total West Coast (All Ocean Fisheries, 0-200 miles)	-22%	-9%	-8%	-2%	-9%	-12%	-14%	-5%	-6%	-11%
Groundfish (including at-sea, excluding tribes)	-36%	-15%	-34%	-31%	-30%	-23%	-28%	-13%	-14%	-23%
Limited Entry Trawl Groundfish	-39%	-24%	-36%	-33%	-36%	-24%	-30%	-12%	-2%	-23%
All Other Groundfish Gear	-27%	-11%	-18%	-23%	-18%	-19%	-18%	-18%	-27%	-20%

* Includes total income impacts (wages and salaries paid to primary producers, processors and suppliers, and the additional income generated when wages and salaries are spent).
Note: Includes impacts of all commercial ocean fisheries based on Council FEAM (9/02).

TABLE 3.4-54. Estimated exvessel revenue and income* from commercial fishing by major port area in 2000 through 2001 and 2003. (Page 2 of 2)

	CALIFORNIA											
2001 Revenue Estimate ($,000)	Crescent City	Eureka	Fort Bragg	San Fran-cisco	Montere y	San Luis Obispo	Santa Barbara	Los Angeles	San Diego	CA TOTAL	At Sea Sector	Grand Total
Total West Coast (All Ocean Fisheries, 0-200 miles)	9,204	7,302	8,372	17,436	7,736	5,598	22,421	35,733	5,917	119,872	7,850	236,59
Groundfish (including at-sea, excluding tribes)	2,518	3,714	3,147	2,641	2,720	1,832	927	570	303	18,373	7,839	61,653
Limited Entry Trawl Groundfish	1,627	3,039	2,111	1,712	1,167	518	4	0	2	10,181	7,839	44,355
All Other Groundfish Gear	892	674	1,035	929	1,553	1,314	922	569	301	8,191	0	17,298
2003 Revenue Estimate ($,000)												
Total West Coast (All Ocean Fisheries, 0-200 miles)	8,625	7,012	7,877	16,469	7,285	5,099	22,276	35,902	6,090	116,788	5,806	223,78
Groundfish (including at-sea, excluding tribes)	1,940	3,423	2,651	1,674	2,269	1,334	782	739	476	15,289	5,798	48,901
Limited Entry Trawl Groundfish	1,583	3,039	1,861	1,231	1,172	537	4	1	2	9,430	5,798	35,624
All Other Groundfish Gear	357	384	790	443	1,097	797	778	738	474	5,858	0	13,277
% Change in Revenue: 2003-2001												
Total West Coast (All Ocean Fisheries, 0-200 miles)	-6%	-4%	-6%	-6%	-6%	-9%	-1%	0%	3%	-3%	-26%	-5%
Groundfish (including at-sea, excluding tribes)	-23%	-8%	-16%	-37%	-17%	-27%	-16%	30%	57%	-17%	-26%	-21%
Limited Entry Trawl Groundfish	-3%	0%	-12%	-28%	0%	3%	-8%	146%	0%	-7%	-26%	-20%
All Other Groundfish Gear	-60%	-43%	-24%	-52%	-29%	-39%	-16%	30%	57%	-28%		-23%
2001 Income Estimate ($,000)												
Total West Coast (All Ocean Fisheries, 0-200 miles)	19,111	14,729	15,740	39,330	34,174	10,348	98,377	149,075	13,431	394,726	39,126	635,32
Groundfish (including at-sea, excluding tribes)	6,246	7,501	6,183	5,744	5,091	2,482	1,396	1,148	625	36,418	39,126	157,37
Limited Entry Trawl Groundfish	5,019	6,437	4,503	4,176	2,579	1,095	9	1	4	23,821	39,126	130,79
All Other Groundfish Gear	1,227	1,064	1,680	1,569	2,512	1,388	1,387	1,147	621	12,597	0	26,587
2003 Income Estimate ($,000)												
Total West Coast (All Ocean Fisheries, 0-200 miles)	17,598	14,393	15,030	37,694	33,663	9,868	98,290	149,507	13,821	390,274	28,939	600,08
Groundfish (including at-sea, excluding tribes)	4,733	7,166	5,473	4,109	4,579	2,002	1,309	1,581	1,015	31,967	28,939	122,22
Limited Entry Trawl Groundfish	4,162	6,485	4,156	3,261	2,690	1,178	9	3	4	21,948	28,939	100,88
All Other Groundfish Gear	571	681	1,316	848	1,890	824	1,300	1,579	1,010	10,019	0	21,341
% Change in Income: 2003-2001												
Total West Coast (All Ocean Fisheries, 0-200 miles)	-8%	-2%	-5%	-4%	-1%	-5%	0%	0%	3%	-1%	-26%	-6%
Groundfish (including at-sea, excluding tribes)	-24%	-4%	-11%	-28%	-10%	-19%	-6%	38%	62%	-12%	-26%	-22%
Limited Entry Trawl Groundfish	-17%	1%	-8%	-22%	4%	8%	4%	146%	0%	-8%	-26%	-23%
All Other Groundfish Gear	-53%	-36%	-22%	-46%	-25%	-41%	-6%	38%	63%	-20%		-20%

* Includes total income impacts (wages and salaries paid to primary producers, processors and suppliers, and the additional income generated when wages and salaries are spent).
Note: Includes impacts of all commercial ocean fisheries based on Council FEAM (9/02).

TABLE 3.4-55. Income and Employment from Commercial Fishing Activities by Port Area: 2000 through 2001. (Page 1 of 1)

Port Group Area	Groundfish Limited Entry Trawl				Other Groundfish Gear			
	Income ($,000)	Employment	Limited Entry Groundfish Trawl-Related Income as a share of Fishery Income		Income ($,000)	Employment	Other Groundfish-Related Income as a share of Fishery Income	
			(Percent)	(Rank)			(Percent)	(Rank)
Puget Sound	6,558	243	45.72%	2	2,136	79	14.89%	3
NW Olympic Peninsula	1,318	57	15.96%	10	3,547	153	42.93%	1
Central WA Coast	6,558	240	21.96%	9	885	32	2.96%	14
South WA Coast	1,377	63	6.54%	14	180	8	0.85%	16
Astoria-Tillamook	22,338	943	48.14%	1	1,784	75	3.85%	13
Newport	19,991	861	43.74%	3	2,132	92	4.66%	10
Coos Bay	7,718	312	32.88%	5	1,548	63	6.59%	8
Brookings	1,985	90	22.58%	8	1,769	80	20.12%	2
Crescent City	5,019	203	26.26%	7	1,227	50	6.42%	9
Eureka	6,437	258	43.70%	4	1,064	43	7.23%	7
Fort Bragg	4,503	186	28.61%	6	1,680	69	10.68%	5
San Francisco	4,176	128	10.62%	11	1,569	48	3.99%	12
Monterey	2,579	86	7.55%	13	2,512	84	7.35%	6
San Luis Obispo	1,095	40	10.58%	12	1,388	50	13.41%	4
Santa Barbara	9	0	0.01%	16	1,387	43	1.41%	15
Los Angeles	1	0	0.00%	17	1,147	30	0.77%	17
San Diego	4	0	0.03%	15	621	17	4.62%	11
TOTAL	91,664	3,709	15.48%		26,575	1,017	4.49%	

Note: Results based on Council FEAM (9/02).

TABLE 3.4-56. Coastal counties social profile. (Page 1 of 1)

										Race of Census Households					
		County	Unemploy-ment Rate (2001)	Rank	Poverty Rate (1998)	Rank	Median Income (1998)	Rank	White	Black or African American	American Indian and Alaska Native	Asian	Other	Hispanic or Latino (of any race)
WA	1	Whatcom	6.8%	27	11.1%	19	$39,261	25	88.4%	0.7%	2.8%	2.8%	8.1%	5.2%
	2	Skagit	7.4%	32	10.9%	18	$39,992	24	86.5%	0.4%	1.9%	1.5%	11.2%	11.2%
	3	Snohomish	5.4%	16	6.6%	2	$51,560	6	85.6%	1.7%	1.4%	5.8%	11.3%	4.7%
	4	King	5.1%	13	7.6%	4	$52,435	4	75.7%	5.4%	0.9%	10.8%	17.9%	5.5%
	5	Pierce	6.4%	25	10.3%	14	$44,389	17	78.4%	7.0%	1.4%	5.1%	13.2%	5.5%
	6	Thurston	5.7%	18	8.8%	8	$44,474	16	85.7%	2.4%	1.5%	4.4%	10.5%	4.5%
	7	Clallam	7.8%	33	12.3%	24	$35,816	31	89.1%	0.8%	5.1%	1.1%	4.9%	3.4%
	8	Jefferson	5.8%	20	11.5%	20	$37,745	27	92.2%	0.4%	2.3%	1.2%	5.1%	2.1%
	9	Grays Harbor	10.6%	42	16.1%	40	$31,831	38	88.3%	0.3%	4.7%	1.2%	6.7%	4.8%
	10	Pacific	9.0%	37	15.6%	38	$28,946	45	90.5%	0.2%	2.4%	2.1%	6.8%	5.0%
	11	Wahkiakum	7.3%	31	10.7%	16	$37,465	29	93.5%	0.3%	1.6%	0.5%	4.7%	2.6%
	12	Cowlitz	11.0%	43	12.8%	26	$38,819	26	91.8%	0.5%	1.5%	1.3%	6.2%	4.6%
	13	Clark	7.1%	30	8.8%	8	$47,916	10	88.8%	1.7%	0.8%	3.2%	8.7%	4.7%
	14	Skaminia	11.1%	44	9.7%	11	$40,735	20	92.1%	0.3%	2.2%	0.5%	5.4%	4.0%
	15	Klickitat	15.1%	45	14.9%	34	$34,575	35	87.6%	0.3%	3.5%	0.7%	8.7%	7.8%
OR	16	Clatsop	5.2%	14	13.4%	28	$34,716	34	93.1%	0.5%	1.0%	1.2%	5.3%	4.5%
	17	Tillamook	5.5%	17	14.3%	33	$30,975	41	93.9%	0.2%	1.2%	0.6%	4.7%	5.1%
	18	Lincoln	6.9%	29	15.8%	39	$31,466	40	90.6%	0.3%	3.1%	0.9%	6.0%	4.8%
	19	Lane	6.8%	27	13.7%	30	$35,935	30	90.6%	0.8%	1.1%	2.0%	7.5%	4.6%
	20	Douglas	9.0%	37	15.3%	36	$33,178	36	93.9%	0.2%	1.5%	0.6%	4.4%	3.3%
	21	Coos	8.2%	35	17.5%	41	$30,766	42	92.0%	0.3%	2.4%	0.9%	5.3%	3.4%
	22	Curry	6.0%	21	15.0%	35	$29,180	44	92.9%	0.2%	2.1%	0.7%	4.8%	3.6%
	23	Columbia	7.8%	33	9.0%	10	$45,597	14	94.4%	0.2%	1.3%	0.6%	4.0%	2.5%
	24	Multnomah	6.3%	24	12.3%	24	$40,038	22	79.2%	5.7%	1.0%	5.7%	14.1%	7.5%
	25	Hood River	9.2%	39	13.9%	31	$35,227	33	78.9%	0.6%	1.1%	1.5%	19.4%	25.0%
	26	Wasco	10.1%	41	13.4%	28	$35,532	32	86.6%	0.3%	3.8%	0.8%	9.3%	9.3%
CA	27	Del Norte	8.7%	36	20.7%	45	$30,420	43	78.9%	4.3%	6.4%	2.3%	10.4%	13.9%
	28	Humboldt	6.1%	22	17.8%	43	$31,630	39	84.7%	0.9%	5.7%	1.7%	8.7%	6.5%
	29	Mendocino	6.6%	26	17.5%	41	$32,994	37	80.8%	0.6%	4.8%	1.2%	13.9%	16.5%
	30	Sonoma	2.9%	4	8.4%	6	$46,149	13	81.6%	1.4%	1.2%	3.1%	15.8%	17.3%
	31	Marin	2.5%	1	6.6%	2	$62,126	1	84.0%	2.9%	0.4%	4.5%	12.7%	11.1%
	32	Napa	3.3%	7	8.7%	7	$46,246	12	80.0%	1.3%	0.8%	3.0%	17.9%	23.7%
	33	Solano	4.1%	10	10.6%	15	$47,953	9	56.4%	14.9%	0.8%	12.7%	27.9%	17.6%
	34	Contra Costa	3.3%	7	8.1%	5	$57,611	3	65.5%	9.4%	0.6%	11.0%	24.5%	17.7%
	35	Alameda	4.5%	11	10.8%	17	$48,445	8	48.8%	14.9%	0.6%	20.4%	35.6%	19.0%
	36	San Francisco	5.2%	14	11.7%	21	$47,239	11	49.7%	7.8%	0.4%	30.8%	42.1%	14.1%
	37	San Mateo	2.8%	2	5.9%	1	$59,771	2	59.5%	3.5%	0.4%	20.0%	36.6%	21.9%
	38	Santa Cruz	6.1%	22	12.0%	22	$45,267	15	75.1%	1.0%	1.0%	3.4%	23.0%	26.8%
	39	Monterey	9.3%	40	15.4%	37	$40,480	21	55.9%	3.7%	1.0%	6.0%	39.3%	46.8%
	40	San Luis Obispo	2.8%	2	12.2%	23	$40,032	23	84.6%	2.0%	0.9%	2.7%	12.4%	16.3%
	41	Santa Barbara	3.5%	9	14.1%	32	$42,806	18	72.7%	2.3%	1.2%	4.1%	23.8%	34.2%
	42	Ventura	4.5%	11	10.0%	12	$51,710	5	69.9%	1.9%	0.9%	5.3%	27.2%	33.4%
	43	Los Angeles	5.7%	18	18.9%	44	$37,655	28	48.7%	9.8%	0.8%	11.9%	40.7%	44.6%
	44	Orange	3.0%	5	10.1%	13	$50,986	7	64.8%	1.7%	0.7%	13.6%	32.8%	30.8%
	45	San Diego	3.2%	6	13.1%	27	$41,909	19	66.5%	5.7%	0.9%	8.9%	26.9%	26.7%

Source: U.S. Department of Labor / Bureau of Labor Statistics; U.S. Department of Commerce/Bureau of the Census/1999 Current Population Survey; U.S. Department of Commerce/Bureau of the Census/Census 2000 Redistricting Data.

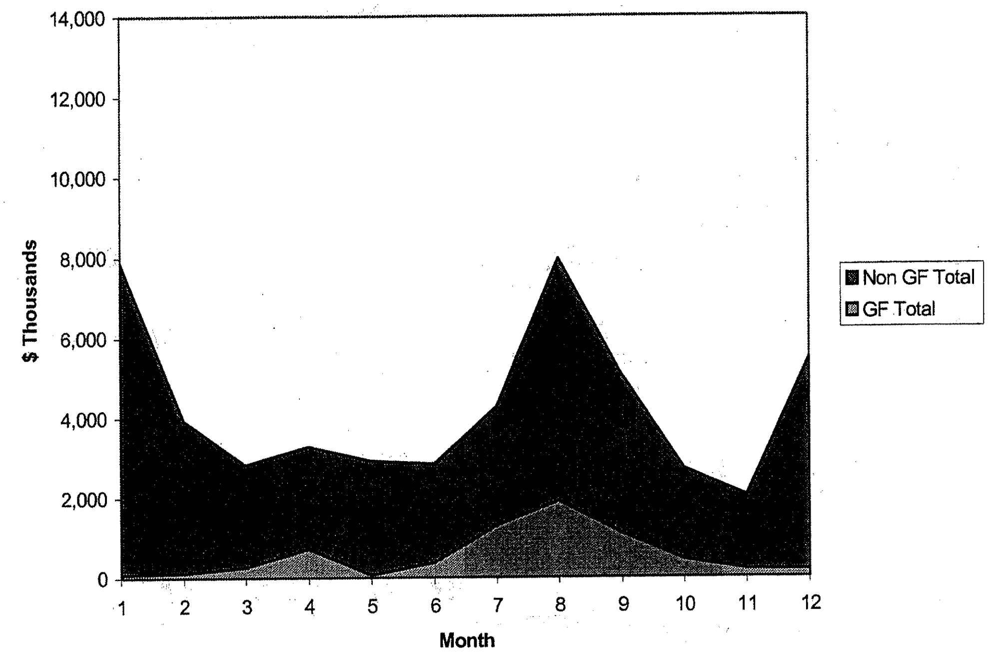

FIGURE 3.4-1. Value of landings by **all vessels** by month -- Coastal Washington (and Columbia River), **2000**

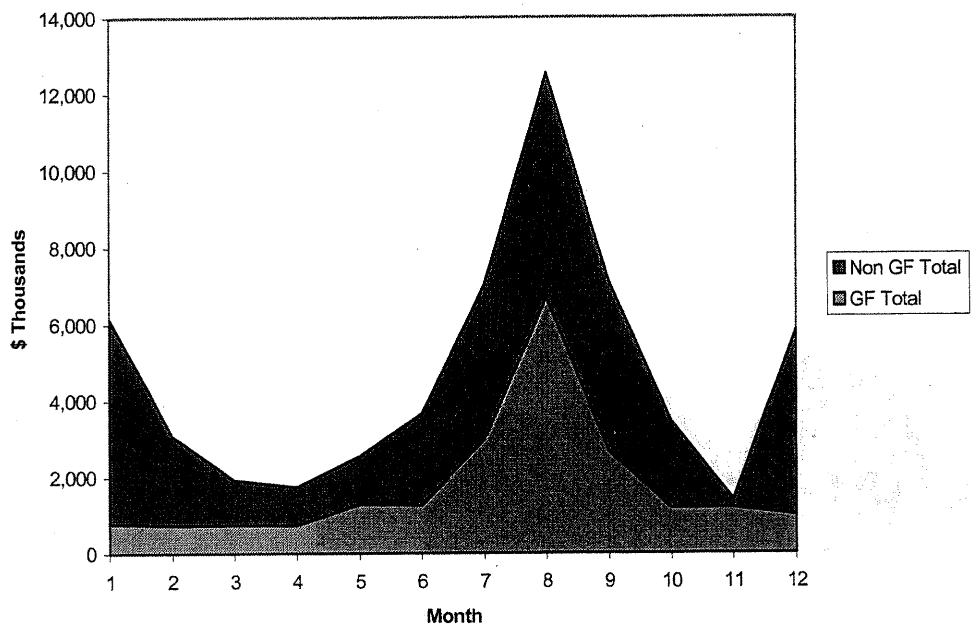

FIGURE 3.4-2. Value of landings by **all vessels** by month -- Oregon (north of Yachats), **2000**.

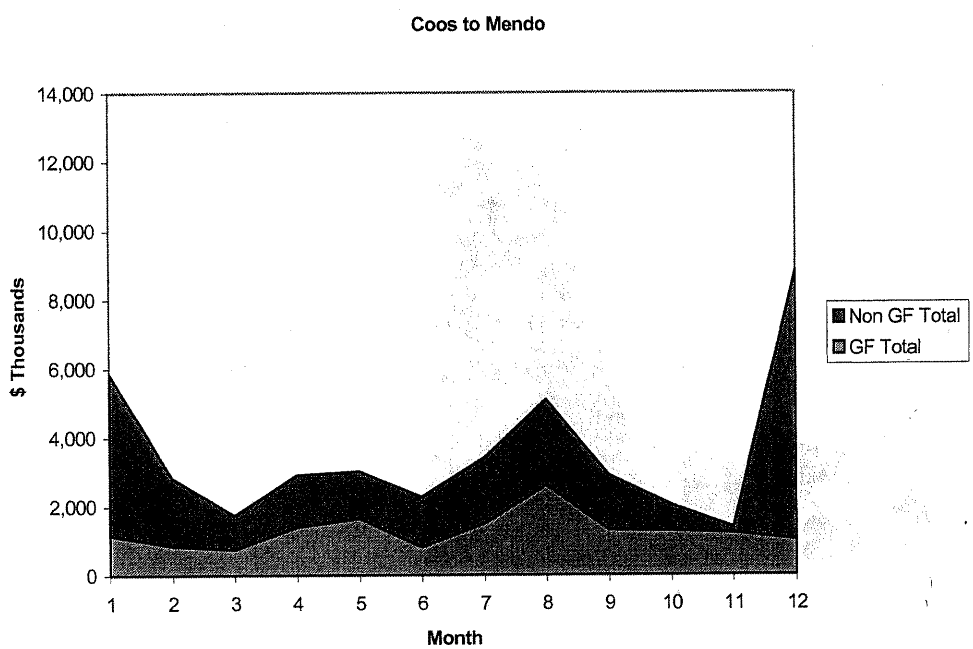

FIGURE 3.4-3. Value of landings by **all vessels** by month -- Coos Bay to Cape Mendocino, **2000**.

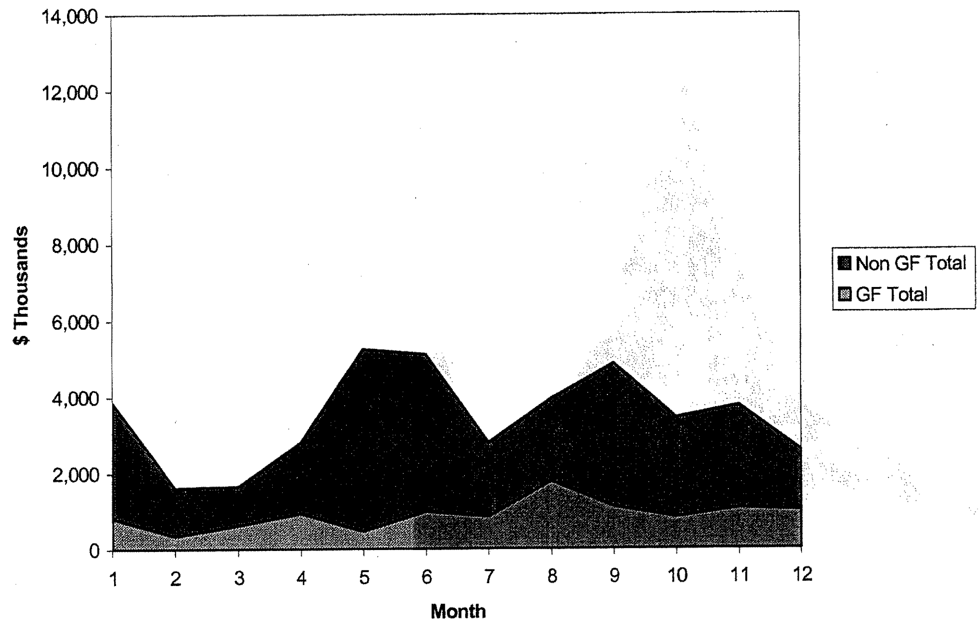

FIGURE 3.4-4. Value of landings by **all vessels** by month -- Cape Mendocino to Point Conception, **2000**.

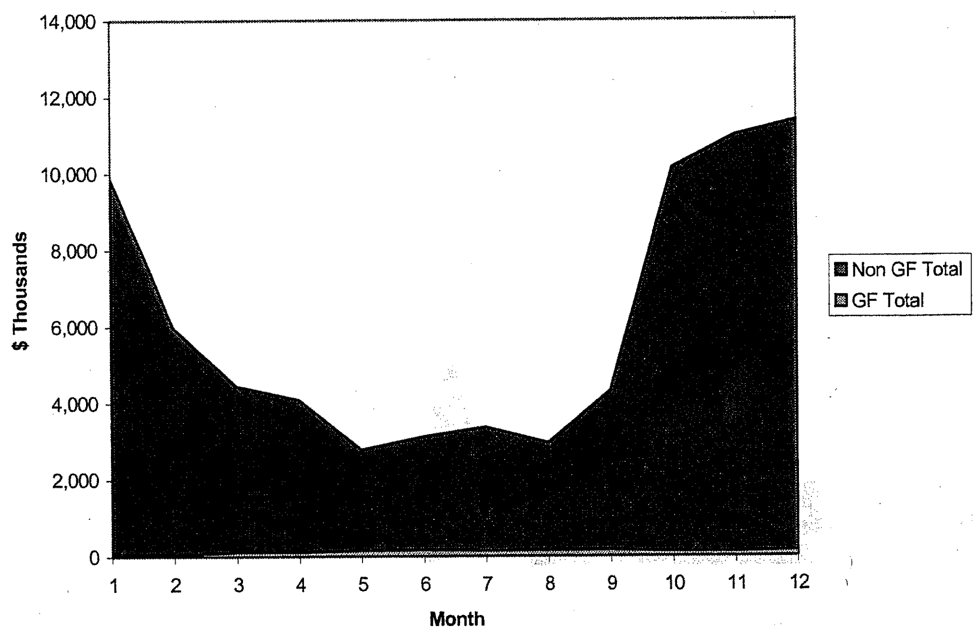

FIGURE 3.4-5. Value of landings by **all vessels** by month -- South of Point Conception, **2000**.

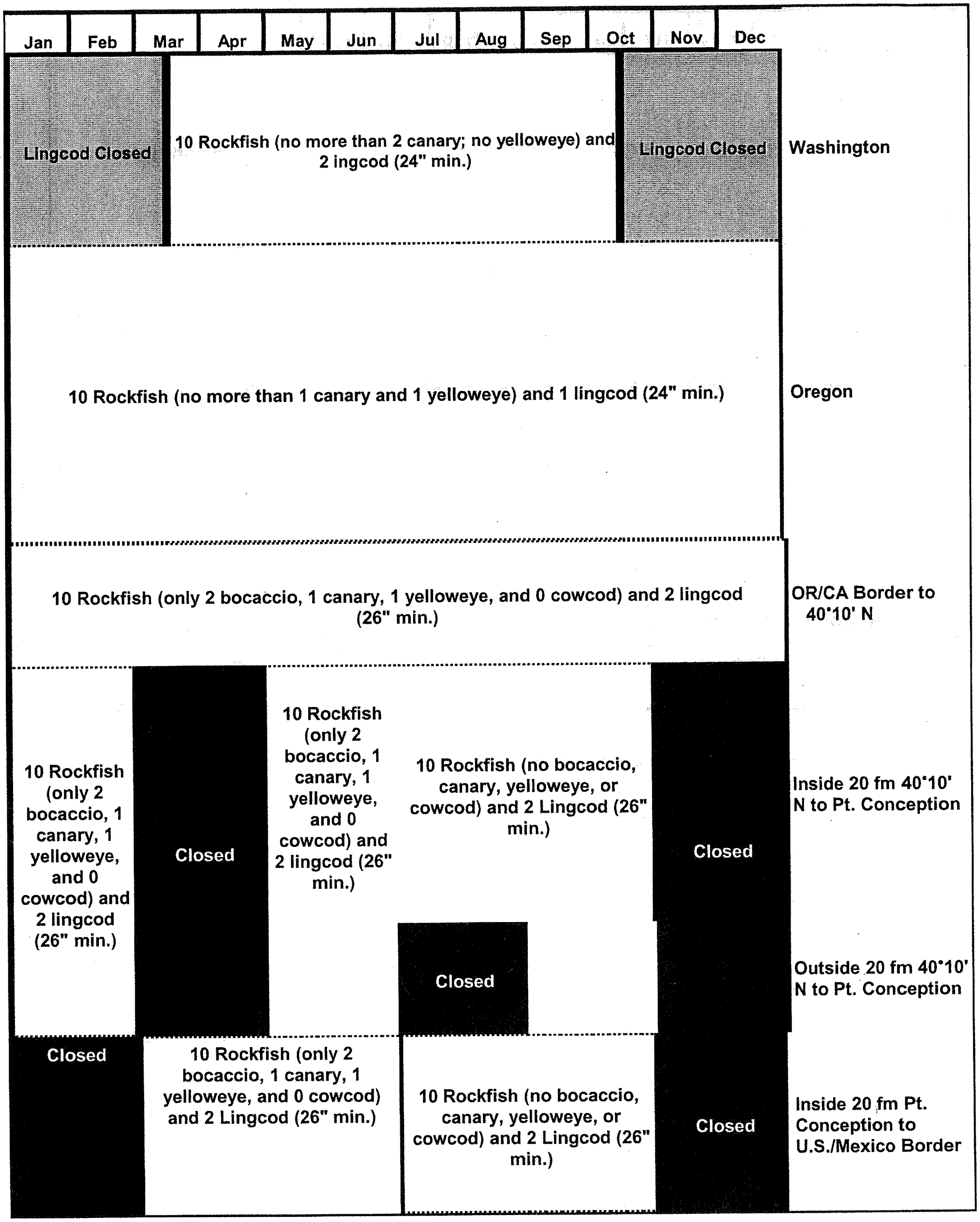

FIGURE 3.4-6. Recreational rockfish and lingcod seasons, 2002.

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
10 Rockfish and 3 lingcod (24" min.)												Washington
13 Rockfish (of which no more than 10 may be black rockfish) and 3 lingcod (24" min.)												Oregon
15 Rockfish (of which no more than 3 may be bocaccio) and 3 lingcod (24" min.)												California

FIGURE 3.4-7. Recreational rockfish and lingcod seasons, 1998.

4.0 IMPACTS OF THE REBUILDING PLAN ALTERNATIVES

This rebuilding plan EIS analyzes the impacts of alternative strategies for rebuilding darkblotched rockfish, Pacific ocean perch, canary rockfish, and lingcod on the habitat and ecosystem (including protected species), the biological environment (e.g., probability of successful stock rebuilding and impacts to co-occurring species), the management regime, and the socioeconomic environment (Table 4.0-1).

NOTE: Some of the biological and economic analyses anticipated for this rebuilding plan are not currently available. The cumulative effects analyses are not included in this draft, but will be incorporated in the final draft. There may be some additional rebuilding plan analysis and relevant data available as supplemental information at the June Council meeting.

TABLE 4.0-1. Ranked relative effects of rebuilding alternatives on potential negative habitat impacts, the probability of rebuilding by T_{MAX} (P_{MAX}), and short term economic costs (1 is highest rank, 5 is lowest rank).

Alternative	Potential Negative Habitat Effects	Probability of Rebuilding by T_{MAX}	Short Term Economic Costs
No Action	2	4	4
Maximum Conservation	5	1	1
Maximum Harvest	3	3	3
Council Interim [a/]	4	2	2
Mixed Stock Exception	1	5	5

a/ Other intermediate alternatives considered have P_{MAX} values ranging between 60% and 80% which are higher or lower than those for the *Council Interim* alternative depending on species. Those P_{MAX} values higher than the *Council Interim* P_{MAX} have lower potential negative habitat effects, higher short term economic costs and vice versa.

4.1 Impacts on Habitat and Ecosystem, Including Protected Species

Potential fishing-related impacts to rockfish habitat are incurred from direct disturbance of the seafloor from contact by actively-fished, lost, or discarded fishing gear. The most common bottom fishing gears associated with seafloor disturbance on the West Coast are trawl nets, longlines, and fish traps. Auster and Langton (1999) reviewed a variety of studies reporting habitat effects due to fishing for a wide range of habitats and gear types. Commonalities of all studies included immediate effects on species composition and diversity and a reduction of habitat complexity.

Bottom trawling gear is known to modify seafloor habitats by altering benthic habitat complexity and by removing or damaging infauna and sessile organisms (Freese *et al.* 1999; Friedlander *et al.* 1999; National Research Council 2002). High resolution sidescan sonar images on the shelf and slope off Eureka, California revealed deep gouges on the seafloor believed to be caused by trawl doors (Friedlander *et al.* 1999). The effects of bottom trawling on a "hard bottom" (pebble, cobble, and boulder) seafloor were also investigated in the Gulf of Alaska where a significant number of boulders were displaced and emergent epifauna were removed or damaged after a single pass with trawl gear. Casual observations during the Freese *et al.* (1999) study revealed that *Sebastes* species use cobble-boulder and epifaunal invertebrates for cover. When boulders are displaced they can still provide cover, but the number and complexity of crevices is reduced (Freese *et al.* 1999).

Limited qualitative observations of fish traps, longlines, and gillnets dragged across the seafloor during set and retrieval were similar to observations of bottom trawling gear, in that some types of organisms living on the seabed were dislodged. Quantitative studies of acute and chronic effects of fixed gear on habitat have not been conducted (Auster and Langton 1999).

In addition to fishing activities, humans have many other direct and indirect effects on fish habitat. While non-fishing human impacts have not been directly assessed on darkblotched rockfish habitat, a study of flatfish in Puget Sound, Washington indicted anthropogenic stressors included chemical contaminant exposure and alteration of nearshore nursery habitats (Johnson *et al.* 1998). The New England Fishery Management

Council compiled a list of human-induced threats to fish habitat that may be used as a guide to factors affecting groundfish species off the West Coast. Oil, heavy metals, acid, chlorine, radioactive waste, herbicides and pesticides, sediments, greenhouse gases, and ozone loss are thought to be chemical factors that affect fish habitat. Biological threats can include the introduction of non-indigenous species, stimulation of nuisance and toxic algae, and the spread of disease. Human activities that may physically threaten fish habitat are dredging and disposal, mineral harvesting, vessel activity, shoreline alteration, and debris disposal (Wilbur and Pentony 1999).

Marine debris has also been recognized as posing a risk to marine organisms via entanglement and ingestion. Seafloor debris was surveyed from Point Conception, California to the U.S./Mexico border at depths of 10 m to 200 m, and anthropogenic debris occurred on approximately 14% of the mainland shelf. Of the debris sampled, discarded fishing gear had the largest spatial coverage, followed by plastic, metal, and other debris (e.g., shoe soles and automobile parts) (Moore and Allen 1999). Less is known about the quantity of marine debris off Washington and Oregon, but it may be at levels that could negatively affect marine organisms.

As more information is gathered about the effects of fishing and non-fishing human activities on darkblotched rockfish habitat, additional management measures may be taken.

Alternative rebuilding strategies have varying effects on the rocky bottom habitats of the continental slope where darkblotched rockfish reside, primarily due to the temporal and spatial extent fishing activities are affected (i.e., seasonal and depth-based restrictions). Since bottom trawl operations account for over 96% of recent (1981 through 2002) darkblotched landings, it is assumed that differential bottom trawl fishing opportunities within darkblotched habitats will determine the relative potential adverse habitat effects among alternatives. To the extent that fixed gear and other potential fishery impacts to darkblotched rockfish habitat can be avoided or mitigated, a modest benefit could also be anticipated. The relative fishing intensity of darkblotched rockfish rebuilding alternatives is assumed to be correlated with potential negative habitat effects. The ranking of darkblotched rockfish rebuilding alternatives by their assumed relative effect on these habitats (Table 4.0-1) is on this basis.

Small footrope and chafing gear restrictions are believed to reduce potentially harmful effects of bottom trawls in rocky habitat since trawl nets so equipped are destroyed if they make significant bottom contact in high relief areas (National Research Council 2002). The *No Action* alternative does not mandate these precautionary bottom trawl gear restrictions; such management measures were first imposed on portions of the directed groundfish trawl fishery in 2000. Trawl fisheries operated in primary darkblotched habitats prior to September 2002 using large footrope trawls. This resulted in significantly more trawl gear bottom contact in slope rockfish habitats. The displacement of trawl fisheries since September 2002 in the depth zones where darkblotched primarily occur will certainly reduce the amount of potential habitat disruption where darkblotched reside. This may be considered the relative impact of the *Council Interim* alternative in this plan which would be expected to have intermediate effects relative to the maximum alternatives. The higher darkblotched OYs and the lack of small footrope restrictions under the *Maximum Harvest* alternative relative to the other rebuilding alternatives and *No Action* allows the highest trip limits and bottom trawl fishing effort. Conversely, the *Maximum Conservation* alternative would have no habitat impact since it eliminates fisheries that target or incidentally catch darkblotched and therefore eliminates potential fishing-related habitat impacts.

Population productivity could be enhanced by protecting these habitats through the use of Marine Protected Areas (MPAs). This may be true globally for rockfish and other West Coast groundfish species. Programmatic measures designed to identify, protect, and minimize potential fishing impacts on West Coast rockfish EFH will be analyzed in the Supplemental EIS (EFH SEIS) in preparation by NMFS. Any habitat protection measures identified in the EFH SEIS that can be applied to encourage rebuilding darkblotched rockfish either through reducing total mortality or enhancing population productivity should be seriously considered as an adjunct to other harvest control measures analyzed in this plan. One consideration in whether MPAs should be incorporated in darkblotched rebuilding, is the relative productivity and extinction/depletion risk. If risks are high due to extremely low potential productivity, then MPAs should be considered more seriously as a mitigation of those risks.

4.2 Impacts to the Biological Environment

The analysis of impacts of rebuilding alternatives on overfished groundfish stocks is sensitive to the ability of the management regime to accurately account for all sources of fishing-related mortality. While the coastwide commercial landed catch and state recreational landed catch accounting (at least in Oregon and Washington) systems are generally considered accurate, bycatch/discarded catch accounting is still very much uncertain. This EIS uses the revised Hastie trawl bycatch model with logbook-based bycatch rates in its analysis of impacts of the alternatives. The Council decided to use data from the first year of the NMFS Groundfish Observer Program for 2003 inseason management of the trawl fishery at its April 2003 meeting. While these data were provided too late for use in the analyses herein, the implications of using observer data are discussed qualitatively. The important distinctions to make are that rebuilding measures now and in the future will always rely on the best available science and the analyses of trawl effects on rebuilding the overfished stocks evaluated in this EIS will still provide the relative impact of rebuilding alternatives. Neither data system (observers nor logbooks) provides information relevant to management of the West Coast nontrawl sectors as of yet. A more detailed description of the evolution of data systems and the effect on the management and rebuilding of overfished groundfish species is provided in sections 3.3 and 4.3 of this EIS.

A summary of predicted values of the strategic rebuilding parameters (the probability of achieving B_{MSY} within the maximum allowable time (P_{MAX}), the most likely year of attaining B_{MSY} (T_{TARGET}), and the fishing mortality rate (F) under all the analyzed alternatives is shown in Table 2.0-1.

4.2.1 Impacts to the Darkblotched Rockfish Stock

4.2.1.1 Impacts of the *No Action* Alternative

The *No Action* alternative complies with rebuilding mandates under National Standard 1. The probability of achieving $B_{40\%}$ within T_{MAX} is 74%. Darkblotched harvest in the next ten years under *No Action* is considerably lower than for the other alternatives analyzed except *Maximum Conservation*, but exceeds the harvest predicted under *Council Interim* ten years from now (Table 4.4-1). This is due to the effect of adjusting the harvest rate as biomass changes under the "40-10" rule. The most likely year of achieving the darkblotched rebuilding target biomass under *No Action* is 2029 or one year earlier than predicted under the *Council Interim* strategy. This compares to a predicted year of attaining the biomass target with no fishing (*Maximum Conservation*) of 2014.

4.2.1.2 Impacts of the *Maximum Conservation* Alternative

The *Maximum Conservation* alternative provides the fastest rebuilding possible for the darkblotched rockfish stock and is limited only by the potential productivity of the stock since there are no fishing-related impacts. The most likely year that the spawning stock would attain the target biomass of $B_{40\%}$ (11,618 mt) under this alternative would be 2014. The probability of successful darkblotched stock rebuilding by T_{MAX} approaches 100% under *Maximum Conservation.*

4.2.1.3 Impacts of the *Maximum Harvest* Alternative

The *Maximum Harvest* alternative provides the greatest harvest while rebuilding the stock in accordance with National Standard Guideline 1 and other legal mandates as described in Chapter 2. This alternative has the longest rebuilding period with T_{TARGET} set at T_{MAX} which is predicted to be the year 2047 in the case of darkblotched. The probability of successful stock rebuilding within T_{MAX} is 50%. Under a *Maximum Harvest* rebuilding strategy for darkblotched, some increased conservatism in management decision-making may need to be considered as 2047 is approached to ensure timely rebuilding. However, the variable nature of groundfish stock assessments and realizations thereof may be more of a factor in this decision-making than the stochastic trajectory presented in this EIS.

4.2.1.4 Impacts of the *Council Interim* Alternative

Under a *Council Interim* rebuilding strategy for darkblotched there is an 80% probability of successful darkblotched stock rebuilding by T_{MAX} with the most likely year of attaining target biomass of 2030, 17 years earlier than T_{MAX}.

The most recent Council strategy to reduce mortality of darkblotched rockfish and other overfished groundfish species has been to close areas to fishing based on the depth of highest density of these species. The current West Coast area closed to trawling (as of May 1, 2003) in order to protect darkblotched is the 50 fm to 200 fm zone from Pt. Reyes at 38° N latitude north to the U.S./Canada border which closely conforms to the latitudinal and depth range of highest darkblotched density (Table 3.1-1).

4.2.1.5 Impacts of the *Mixed Stock Exception* Alternative

Since the Council considered and rejected the *Mixed Stock Exception* alternative for darkblotched at its June 2002 meeting, this alternative was not analyzed.

4.2.1.6 Impacts of Other Alternatives Considered

The other alternatives considered for rebuilding the West Coast darkblotched rockfish stock have predicted P_{MAX} values of 60% and 70%, respectively. Therefore, there are greater risks estimated for rebuilding the stock under these alternatives than estimated under the other alternatives analyzed, except *Maximum Harvest* which has a 50% probability of rebuilding by T_{MAX}. The 70% P_{MAX} alternative was the *Council Interim* rebuilding strategy until the Council adopted 2003 groundfish management specifications (in September 2002) and decided on a more conservative darkblotched rebuilding strategy. The most likely years for rebuilding the darkblotched stock under the 60% and 70% alternatives are 2040 and 2034, respectively. The estimated duration for rebuilding the darkblotched stock (T_{TARGET}) is longer for these alternatives than the other alternatives analyzed in this EIS except under *Maximum Harvest*, where T_{TARGET} is set equal to the predicted T_{MAX} value of 2047.

4.2.2 Impacts to the Pacific Ocean Perch Stock

4.2.2.1 Impacts of the *No Action* Alternative

The West Coast POP stock does not successfully rebuild under the *No Action* alternative, at least within the 125-year horizon used to limit rebuilding simulations in the rebuilding analysis (Punt and Ianelli 2001). The predicted probability of rebuilding the POP stock within T_{MAX} is less than 1% (~0.3%), well under the 50% limit for P_{MAX} established under federal case law. Given the failure of at least 50% of the rebuilding simulations in the Punt and Ianelli (2001) rebuilding analysis to achieve $B_{40\%}$ within 125 years, there is no estimated T_{TARGET} prior to 2126 using the "40-10" rule under *No Action*. This is clearly beyond the predicted maximum allowable time to rebuild the stock by 2042.

4.2.2.2 Impacts of the *Maximum Conservation* Alternative

The *Maximum Conservation* alternative provides the fastest rebuilding possible for the POP stock and is limited only by the potential productivity of the stock since there are no fishing-related impacts. The most likely year that the spawning stock would attain the target biomass of $B_{40\%}$ (24,084 units of spawning output) under this alternative would be 2012. There is a predicted 100% probability of successful POP stock rebuilding by T_{MAX} under *Maximum Conservation*.

4.2.2.3 Impacts of the *Maximum Harvest* Alternative

The *Maximum Harvest* alternative provides the greatest harvest while rebuilding the stock in accordance with National Standard Guideline 1 and other legal mandates as described in Chapter 2. This alternative has the longest rebuilding period with T_{TARGET} set at T_{MAX} which is predicted to be the year 2042 in the case of POP. The probability of successful stock rebuilding within T_{MAX} is 50%. Under a *Maximum Harvest* rebuilding strategy for POP, some increased conservatism in management decision-making may need to be considered as 2042 is approached to ensure timely rebuilding. However, the variable nature of groundfish stock assessments and realizations thereof may be more of a factor in this decision-making than the stochastic trajectory presented in this EIS.

4.2.2.4 Impacts of the *Council Interim* Alternative

The *Council Interim* rebuilding alternative has a 70% probability of rebuilding the stock within T_{MAX}. The most likely year that the target rebuilding biomass is attained is 2027 or 15 years prior to the maximum allowable rebuilding year in accordance with National Standard Guideline 1.

4.2.2.5 Impacts of the *Mixed Stock Exception* Alternative

The *Mixed Stock Exception* alternative was not considered for POP since none of the rebuilding OYs are likely to constrain any West Coast fisheries given the constraints imposed by the need to rebuild darkblotched rockfish.

4.2.2.6 Impacts of Other Alternatives Considered

The other alternatives considered for rebuilding the West Coast POP stock have predicted P_{MAX} values of 60% and 80%, respectively. Therefore, the relative risks estimated for rebuilding the stock under these alternatives bracket those associated with the *Council Interim* alternative. The most likely years for rebuilding the POP stock under the 60% and 80% alternatives are 2034 and 2022, respectively.

4.2.3 Impacts to the Canary Rockfish Stock

4.2.3.1 Impacts of the *No Action* Alternative

The *No Action* alternative for canary rockfish would lead to quicker biomass increases in the short term since fishing mortality would be set to zero until the spawning stock biomass increases past the $B_{10\%}$ threshold (biomass in 2002 was estimated to be $B_{8\%}$, Table 2.0-1). However, with increased abundance between the $B_{10\%}$ and $B_{40\%}$ thresholds, the harvest rate increases leading to longer rebuilding horizons than any of the other rebuilding alternatives (except *Mixed Stock Exception* which does not allow rebuilding of spawning stock biomass at all). The probability of the canary stock attaining target biomass within T_{MAX} under *No Action* is estimated to be 19% with the most likely year of successful rebuilding estimated to be 2094 or 18 years beyond T_{MAX}. This obviously does not comport with National Standard Guideline 1 or other legal mandates and would thus be rejected from consideration as a viable rebuilding alternative; however, it could be viable under a mixed stock exception.

4.2.3.2 Impacts of the *Maximum Conservation* Alternative

The *Maximum Conservation* alternative provides the fastest rebuilding possible for the canary rockfish stock and is limited only by the potential productivity of the stock since there are no fishing-related impacts. The most likely year that the spawning stock would attain the target biomass of $B_{40\%}$ (12,620 mt) under this alternative would be 2057. The probability of successful canary stock rebuilding by T_{MAX} approaches 100% under *Maximum Conservation*.

4.2.3.3 Impacts of the *Maximum Harvest* Alternative

The *Maximum Harvest* alternative provides the greatest harvest while rebuilding the stock in accordance with National Standard Guideline 1 and other legal mandates as described in Chapter 2. This alternative has the longest rebuilding period with T_{TARGET} set at T_{MAX} which is predicted to be the year 2076 in the case of canary rockfish. The probability of successful stock rebuilding within T_{MAX} is 50%. Under a *Maximum Harvest* rebuilding strategy for canary, some increased conservatism in management decision-making may need to be considered as 2076 is approached to ensure timely rebuilding. However, the variable nature of groundfish stock assessments and realizations thereof may be more of a factor in this decision-making than the stochastic trajectory presented in this EIS.

4.2.3.4 Impacts of the *Council Interim* Alternative

The *Council Interim* alternative has a 60% probability of rebuilding the canary rockfish stock within T_{MAX} which is less risky than the *No Action*, *Maximum Harvest*, *Mixed Stock Exception* alternatives, but more risky than the other alternatives analyzed. This is largely due to the significant constraints to fisheries imposed by the need to rebuild canary rockfish, especially for fisheries north of Cape Mendocino. Canary rockfish tend to be incidentally caught by a variety of fishing gears operating on the shelf including bottom trawls, midwater trawls, shrimp trawls, and commercial and recreational line gears. Therefore, the harvest level adopted to rebuild canary rockfish has a significant impact on fishing opportunities targeting healthy marine resources on the West Coast. The most likely year of rebuilding the canary rockfish stock under the *Council Interim* alternative is 2074, two years earlier than the maximum period allowed under National Standard Guideline 1.

The 2003 management measures adopted for West Coast shelf fisheries, especially those north of Cape Mendocino, were designed to constrain the total catch mortality of canary rockfish to levels consistent with the *Council Interim* alternative. These management measures include adoption of closed areas (Rockfish Conservation Areas or RCAs; see Sections 3.3, 4.2.5, and 4.3.1.3), footropes restrictions on bottom trawls operating shoreward of the RCA, no commercial retention, mandatory fish excluders (BRDs) in the pink shrimp trawl fishery (see section 3.4.2.6), and a one canary rockfish recreational daily-bag-limit.

4.2.3.5 Impacts of the *Mixed Stock Exception* Alternative

Harvest under the *Mixed Stock Exception* does not allow the stock to rebuild, but does provide shorter term socioeconomic benefits as rebuilding constraints are lifted for canary rockfish allowing greater access to healthier target species such as flatfish, DTS species, and other groundfish and nongroundfish species (see Section 4.4). The harvest level for canary rockfish under this alternative is 217.3 mt, which is the OY predicted to sustain the current spawning stock biomass or spawning output at its current equilibrium for the next 100 years (Table 4.2-1). While shorter term benefits are attained by managing canary at this high level of harvest, the cost in the long term is a lower canary rockfish abundance which negatively impacts future shelf rockfish target opportunities. There is also a greater risk of stock depletion since there is also a 50% probability the stock will decline under this harvest given our current understanding of the stock's potential productivity. There is only a 42.8% probability of maintaining the current spawning stock biomass for the next 200 years under this harvest level.

4.2.3.6 Impacts of Other Alternatives Considered

The other alternatives considered for rebuilding the West Coast canary rockfish stock have predicted P_{MAX} values of 70% and 80%, respectively. Therefore, the relative risks estimated for rebuilding the stock under these alternatives are less than those associated with the *Council Interim* alternative. The most likely years for rebuilding the canary rockfish stock under the 70% and 80% alternatives are 2071 and 2068, respectively.

4.2.4 Impacts to the Lingcod Stock

4.2.4.1 Impacts of the *No Action* Alternative

The *No Action* alternative for lingcod conforms to legal mandates and the National Standards Guidelines since rebuilding is predicted to occur by 2009, within ten years of the stock being declared overfished. The probabilities of attaining lingcod B_{MSY} by T_{MAX} (2009) under *No Action* are 55% for the northern portion of the stock and 68% for the southern portion of the stock.

4.2.4.2 Impacts of the *Maximum Conservation* Alternative

The *Maximum Conservation* alternative provides the fastest rebuilding possible for the coastwide lingcod stock and is limited only by the potential productivity of the stock since there are no fishing-related impacts. The most likely year that the spawning stock will attain the target biomass of $B_{40\%}$ (9,153 mt in the north and 8,389 mt in the south) under this alternative is 2007. The predicted year of successful lingcod stock rebuilding would have been 2004 if harvest had been eliminated since 1999 when the stock was declared overfished. There is a predicted 100% probability of successful lingcod stock rebuilding by T_{MAX} under *Maximum Conservation*.

4.2.4.3 Impacts of the *Maximum Harvest* Alternative

The *Maximum Harvest* alternative has a 50% probability of rebuilding by T_{MAX} with the most likely year to achieve stock rebuilding predicted to be 2009 (T_{MAX}). Under a *Maximum Harvest* rebuilding strategy for lingcod, some increased conservatism in management decision-making may need to be considered as 2009 is approached to ensure timely rebuilding. However, the variable nature of groundfish stock assessments and realizations thereof may be more of a factor in this decision-making than the stochastic trajectory presented in this EIS.

4.2.4.4 Impacts of the *Council Interim* Alternative

The *Council Interim* alternative has a 60% probability of rebuilding by T_{MAX} with the most likely year to achieve stock rebuilding predicted to be 2009. All lingcod rebuilding trajectories predict attainment of the rebuilding biomass target within two years of T_{MAX} (*Maximum Conservation* is predicted to rebuild by 2007). In fact, the shade of difference in rebuilding trajectories among lingcod rebuilding alternatives is measured in months, not years with the southern portion of the stock rebuilding at a slightly faster rate than the northern portion of the stock. The reason for this convergence in rebuilding trajectories is largely due to the high potential productivity of the stock in terms of fast growth rates and strong recruitment patterns. These biological stock attributes indicate rebuilding is more driven by productivity than harvest management, at least within the range of rebuilding OYs considered in this EIS. Convergence of alternative rebuilding trajectories is also influenced by National Standard Guideline 1, which mandates the stock must be rebuilt within ten years if possible. The high potential productivity of the West Coast lingcod stock indicates rebuilding can occur within ten years which sets T_{MAX} at 2009 (rebuilding began in 2000 under a Council Interim strategy). Therefore, the combination of national management policy and high stock productivity explains the convergence of lingcod rebuilding alternatives in terms of relative risk and B_{MSY} attainment.

4.2.4.5 Impacts of the *Mixed Stock Exception* Alternative

The *Mixed Stock Exception* alternative was not considered for lingcod since none of the rebuilding OYs are likely to constrain any West Coast fisheries given the constraints imposed by the need to rebuild the overfished shelf rockfish species such as bocaccio in the south and canary and yelloweye rockfish coastwide.

4.2.4.6 Impacts of Other Alternatives Considered

The other alternatives considered for rebuilding the West Coast lingcod stock have predicted P_{MAX} values of 70% and 80%, respectively. Therefore, the relative risks estimated for rebuilding the stock under these alternatives are less than those associated with the *Council Interim* alternative. The most likely years for rebuilding the canary rockfish stock under the 70% and 80% alternatives are 2009 and 2008, respectively.

4.2.5 Impacts of Rebuilding Alternatives to Co-Occurring Species

Darkblotched are currently the binding constraint for slope fisheries north of Point Reyes. All co-occurring species on the slope will be affected by darkblotched rebuilding. Pacific ocean perch should recover faster with the fishery constraints imposed by measures implemented to rebuild darkblotched. The environmental conditions and exploitation rates that caused overfishing for darkblotched and Pacific ocean perch are likely to have caused overfishing for some of the other slope rockfish species as well. Of the West Coast slope rockfish species listed in Table 3.2-3, only darkblotched rockfish, Pacific ocean perch, and blackgill have been assessed. Blackgill is a principle species in the south and a secondary species in the north (Table 3.2-3). It may be that the slope rockfish species with a more northern distribution (Table 3.1-1) were more vulnerable to overfishing given the concentration of foreign and domestic trawl efforts to the north. The latitudinal distribution could account for the relative status of these three slope rockfish species. Other groundfish species affected by darkblotched and POP rebuilding include Dover sole, petrale sole, sablefish, and thornyheads.

Canary rockfish are the binding constraint to many shelf fisheries, especially north of Cape Mendocino. The environmental conditions and exploitation rates that contributed to overfishing canary rockfish have affected other shelf groundfish species. Other co-occurring overfished shelf groundfish species include bocaccio, cowcod, yelloweye rockfish, widow rockfish, and lingcod. Many other co-occurring species have not been assessed and may be overfished as well.

The significant constraints imposed in 2003 under the *Council Interim* rebuilding alternative for each of the species analyzed in this EIS have reduced the exploitation of co-occurring West Coast slope and shelf species. The most precautionary measure adopted in 2003[8/] may be the establishment of RCAs. Those species distributed within the RCAs should experience less fishing-related mortality. The degree to which

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8/ The limited entry trawl RCA was first adopted as an emergency measure in the fall of 2002, but established in a Proposed Rule in March 2003.

fishing impacts are ameliorated on co-occurring species by the different alternatives analyzed in this EIS is proportional to the amount of fishing allowed. The *Maximum Conservation* alternative allows no fishing during the course of rebuilding, and is therefore, the one most likely to positively impact co-occurring species. The ranking of alternatives relative to their impact(s) on co-occurring species is on the basis of the amount of fishing allowed on the four groundfish species analyzed in this EIS. The same ranking of alternatives should depict the relative impacts of alternatives on co-occurring species. This ranking of alternatives from most positive impact to most negative impact are *Maximum Conservation*, *80%*, *70%* or (*Council Interim*, depending on the P_{MAX} for the species in question), *60%* or (*Council Interim*, depending on the P_{MAX} for the species in question), *Maximum Harvest*, *No Action*, and *Mixed Stock Exception*.

TABLE 4.2-1. Estimated harvest levels under the *Mixed Stock Exception* alternative for sustaining the spawning stock biomass of canary rockfish on the U.S. West Coast under different likelihoods. (Page 1 of 1)

	Canary Rockfish			
Fishing Rate	0.1178	0.1157	0.1137	0.1114
OY (mt)	217.3	213.6	210.0	205.8
Probability of sustaining SSB for next 100 years	49.9	60.0	70.0	80.1
Probability of sustaining SSB for next 200 years	42.8	54.5	68.6	80.2

4.3 Impacts to the Management Regime

4.3.1 Controlling Fishing-Related Mortality of Species Subject to Rebuilding Plans Evaluated in this EIS

Successful stock rebuilding depends on the ability of management/rebuilding measures to effectively control all sources of fishing-related mortality, including landed catch and bycatch. All rebuilding alternatives analyzed in this EIS have a calculated total catch OY to accommodate landings of unavoidable incidental catch of the four species subject to rebuilding plans analyzed herein (except the *Maximum Conservation* alternative which has a total catch OY of 0 mt). The effectiveness of all rebuilding strategies (given the probabilistic trajectories of future increases in biomass relative to B_{MSY}) depends on managing fishing-related mortality within prescribed total catch OYs. Landed catch allowances for all overfished species are designed to minimize target opportunities on these species while allowing landings of unavoidable bycatch that would otherwise be discarded dead at sea. Management measures consistent with rebuilding should have harvest control rules that are enforceable and effectively stay within total catch targets. Harvest control rules and management measures commensurate with alternative rebuilding strategies are analyzed qualitatively in this EIS. Potential management measures likely to reduce sources of fishing-related mortality are also discussed.

4.3.1.1 Landed Catch Accounting and Control

Commercial landed catch accounting and control methods are considered relatively effective. There have been some violations of the fishticket reporting system in the past. To the extent landed catch is not properly monitored and reported, there will be repercussions for inseason management of overfished stocks, as well as fishery-dependent data inputs in future stock assessments and the logbook-fishticket reconciliation process that is done to help determine total catch. If this results in underestimates of total catch of overfished stocks, then rebuilding strategies could be compromised resulting in an underachievement of rebuilding progress.

4.3.1.2 Bycatch Accounting and Control

Rebuilding strategies are sensitive to the actual bycatch rate since successful rebuilding requires accurate accounting of total catch. Bycatch accounting and control has only been done for the limited entry trawl sector to date. This EIS analyzes trawl bycatch based on co-occurrence rates determined using trawl logbook records. These rates, applied to weight of landed catch of target species, may or may not be realistic. If bycatch rates are overestimated in the Hastie model, then there will be negative socioeconomic consequences of lower trip limits and/or early fishery closures. If they are underestimated, rebuilding progress will be compromised. Bycatch accounting and control has been one of the weaker elements in groundfish management. With the low OYs specified under rebuilding, improving bycatch accounting and control is critical. With the advent of data from the NMFS Groundfish Observer Program, it is anticipated that more accurate bycatch accounting data from the limited entry trawl, limited entry fixed gear, and directed open access sectors will soon be available for management. In fact, the first data report from the Observer Program was used recently for 2003 inseason management of the limited entry trawl fishery. Rebuilding strategies should always use the best available estimates of bycatch and managers should always seek to improve bycatch accounting and control mechanisms.

Such measures as full retention of bycatch and/or bycatch caps could significantly reduce fishing-related mortality of overfished groundfish species. The NMFS Groundfish Observer Program could be linked with a program of mandatory full retention of rockfish (or other overfished species that would otherwise be discarded dead at sea) during commercial fishing activities to increase accuracy in estimating total catch. This could ensure rebuilding total catch OYs are not exceeded while attempting to access harvestable groundfish species. Mandatory rockfish retention and observer coverage might allow greater flexibility for managers to consider fishing opportunities that might otherwise be considered risky. As long as total catch controls are reliable and responsive to rapid changes in the fishery, such explorations may be acceptably risk-averse. However, a management strategy of bycatch caps (the fishery is closed once landings plus bycatch reach a critical threshold, notably the total catch OY) would probably entail the need for a significantly higher observer coverage rate, perhaps 100%. This is because the distribution of fishing efforts resulting in significant bycatch is skewed to a few efforts. Given the nature of highly variable bycatch by time, area, gear, and fishing strategy, the allocational aspects of a management system relying on bycatch caps creates potentially serious repercussions. Such a system might promote derby fisheries where fishermen would compete to get their fish first before a cap is attained. This creates safety risks, a poor supply and demand marketing situation, and a contracted stream of fishery-dependent data (landings and bycatch information) that might be difficult to assimilate and react to in a timely fashion. There might also be a higher costs associated with a full retention program, especially when unmarketable species are retained and delivered. Such added costs to the industry might include disposal and/or processing costs; an economic burden imposed on an already strapped industry. One mitigative measure to consider to rationalize a management strategy that depends on bycatch caps may be to develop Individual Transferable Quotas (ITQs) for the overfished groundfish species. An ITQ system could be used to buy and sell overfished species' "OY" which would likely leverage more healthy target species landings while maintaining better accounting and control of overfished species' bycatch. The Congressional ITQ ban was lifted last year enabling the Council and NMFS to pursue such a strategy.

4.3.1.3 Potential Rebuilding Measures to Consider

Measures that would effectively displace fisheries (in time and/or area) with a relatively high incidence of overfished groundfish species' catch or other fishery/gear modifications should be considered to reduce fishing-related mortality. These measures would affect rebuilding through reducing risk of considered rebuilding alternatives in terms of achieving target fishing harvest rate (F) and the specified total catch OY. Avoidance measures through gear modification or fishing techniques should also be investigated.

Depth-Based Restrictions

Depth-based restrictions and/or incentives to fish in depths outside the depth range of greatest density of overfished species would likely reduce risk in controlling fishing-related mortality through avoidance. This was a precautionary measure adopted for 2003 groundfish management on the advice of the GMT and other Council advisors (Table 4.3-1). Given the great uncertainty in bycatch accounting and control mechanisms and the low OYs associated with rebuilding overfished groundfish stocks, this is a significantly risk-averse measure that should be considered in long term rebuilding strategies. This areal displacement is especially important if gear modifications are unable to reduce the targetability or catchability of overfished stocks. For example, in the absence of useable observer data (the current situation), there are no logbook requirements or other data systems available to inform managers of potential bycatch of overfished species in fixed gear fisheries. While historical landings of darkblotched and Pacific ocean perch indicate little interaction of these species with line gears, overfished shelf species such as bocaccio, canary rockfish, cowcod, lingcod, and yelloweye rockfish are easily targeted in the high relief habitats where they are found by line gears. Therefore, managers may need to rely more on depth-based restrictions or other area closures to protect these species rather than gear restrictions. Rebuilding measures should consider depth-based restrictions (and/or other area closures) and gear modifications to reduce fishing-related mortality.

Allowing fishing in waters outside the depths where overfished species occur could be done with a vessel monitoring system (VMS; see Section 3.3.4). Depth-based restrictions without safeguard controls like VMS raise enforcement concerns. An on the water presence is more difficult in the deeper offshore areas where the slope fishery would need to be displaced to effectively reduce darkblotched and POP bycatch. Without remote tracking of distant water vessels or effective enforcement, depth-based restrictions may not reliably reduce potential fishing pressure on these species. VMS is already used in the management of some West Coast marine fisheries such as the commercial albacore fishery. Some groundfish fisheries in the Aleutian Islands and Bering Sea currently use VMS to restrict the fishery to certain areas or depths. The cost of installing VMS to manage the deep-water trawl fleet needs to be considered. Such systems are expensive to set up, maintain, and operate. However, relative to the foregone benefits of prosecuting fisheries, this cost may be rationalized. To the extent that incentives to fish outside the depth range of darkblotched could be structured, some or all of the costs associated with implementing a VMS system for the West Coast groundfish fishery could be borne by the industry. For instance, higher landing limits for deeper water species that are considered healthy, such as longspine thornyhead (*Sebastolobus altivelis*) or any of the other DTS species could be considered with a depth-based restriction. Revenue from these higher landing limits could help offset the costs of implementing VMS.

Displacement of vessels to deeper and more distant offshore locations also raises a general safety concern. When vessels are displaced further offshore, there is a higher likelihood of accident and loss of life while conducting fishing operations. Such displacement also increases fuel and operating expenses which tend to decrease net economic benefits from the fishery. It may be that displacement of vessels further offshore will have fleet distributional effects that are not proportionally shared by all vessels. Smaller vessels may suffer a disproportionate loss of fishing opportunity. They generally have less fuel and gear capacity and are less stable working platforms in rougher offshore waters. Smaller trawl vessels may especially be negatively impacted. A greater amount of wire and other fishing gear is required to deploy bottom trawls in deeper waters. Even if a smaller vessel were to accommodate the amount of gear onboard to fish deeper waters, they would be less stable and more prone to safety risks with a higher center of gravity. What benefit may accrue to vessels fishing deeper, in terms of higher landing limits or other fishing opportunities, may not be shared by smaller vessels.

The recreational fishery in 2003 is also subject to depth-based restrictions (Table 4.3-1). South of Cape Mendocino, where measures to limit the bycatch of bocaccio constrain most shelf fishing opportunities, the recreational groundfish fishery is restricted to depths less than 20 fm. This restriction provides significant protection to canary rockfish and lingcod in the south. Recreational groundfish fisheries north of Cape Mendocino are primarily constrained by interim rebuilding measures designed to reduce fishing-related mortality of canary and yelloweye rockfish. These fisheries are subject to inseason depth restrictions if catch monitoring projects that harvest guidelines for these species will be attained. These inseason actions would restrict recreational fisheries in California north of Cape Mendocino and Oregon to depths less than 27 fm. The Washington recreational groundfish fishery would be restricted to depths less than 25 fm inseason to control impacts in that fishery. Additionally, Washington and the Council adopted the Yelloweye Rockfish Conservation Area off the north Washington coast to restrict recreational groundfish, recreational halibut, and commercial halibut fishing in a known area of high yelloweye rockfish density (PFMC 2003). This closed area will provide some additional protection for canary rockfish and lingcod as well.

Depth-based restrictions may be modified to manage for alternative harvest levels for the species subject to rebuilding plans analyzed in this EIS. The restrictions outlined in Table 4.3-1 are targeted to achieve the harvest levels of the *Council Interim* alternative in 2003. More restrictive alternatives (i.e., *Maximum Conservation*, and other alternatives considered that have higher P_{MAX} values than *Council Interim*) may require more extensive area closures while more liberal closures could be entertained for *Maximum Harvest*, *No Action*, and *Mixed Stock Exception*. The *Maximum Conservation* alternative would require fishery comprehensive closures/restrictions in the depth and latitudinal zones describing the overall distribution of overfished species. Conversely, the more liberal alternatives analyzed (i.e., *No Action* and *Mixed Stock Exception*) may not require any depth-based fishery restrictions. Such restrictions obviously need to be responsive to new data inputs (i.e., new observer data) that can be used to judge the efficacy of such management measures to achieve rebuilding targets. This flexibility also should be considered for the long term as new stock assessments update the status of overfished groundfish stocks.

Seasonal Restrictions

Seasonal fishing restrictions should be considered when developing rebuilding strategies. The Hastie trawl bycatch model (Hastie 2001) indicates a seasonality in the bycatch of overfished species. This result is derived from the logbook and EDCP observations that are used to estimate bycatch rates in the model. The latitudinal and onshore-offshore movements of many groundfish species are well documented (Beamish and McFarlane 1988; Dorn 1995; Eschmeyer *et al.* 1983; Gunderson 1977; Gunderson 1996; Hagerman 1952; Hart 1988; Jagielo 1990; Jow 1969; Love 1981; Love *et al.* 1990; Love *et al.* 2002; Mathews and LaRiviere 1987; Matthews 1992; Matthews *et al.* 1986; Miller and Lea 1972; Pearcy 1992; Pedersen 1975; Rickey 1995; Shimada and Kimura 1994; Stanley *et al.* 1994; Westrheim and Morgan 1963). Differential seasonal movements could account for seasonal differences in groundfish assemblages; a dynamic that would lead to seasonality in co-occurrence and bycatch rates. Therefore, seasonal fishing restrictions could be imposed during times and in areas when and where co-occurrence of target and overfished species is highest.

While seasonal restrictions have the potential of realizing higher landing limits of target species (more fish from healthy stocks can be caught with a lesser "cost" of bycatch of overfished species), there are some significant socioeconomic costs to consider. The Council has previously considered seasonal restrictions for the groundfish fishery (PFMC 2001), but continues to rely on other management measures due to the potential disruption in the processing/marketing sector. Filleters and other skilled personnel in the processing sector are difficult to keep employed when there are seasonal disruptions in the delivery of fish. Market gluts which drive price down also negatively impact the industry. Seasonal restrictions tend to increase the supply of fish during open seasons to the point where market glut and overall value of the fishery declines. This often leads to increased market-driven discard of fish (discard that occurs even when trip and/or cumulative landing limits are not attained due to market reasons). Such fluctuations in product (fish) availability have driven some buyers and processors out of business.

Despite the socioeconomic consequences of seasonal restrictions, the Council and West Coast state and tribal managers have adopted seasonal closures for portions of the commercial, recreational, and tribal groundfish fisheries. Seasonal restrictions were considered preferable over some of the other management measures considered such as (greater) limit reduction or area closures. However, there is the stated desire by many participants in the fishery and associated fishing industries to try to maintain year-round fishing opportunities.

Trip Limit Management

The West Coast groundfish fishery has been managed using some form of trip limit management since the early 1980s. Trip and cumulative landing limits are designed to limit the harvest of groundfish and manage for long term sustainable yield (total catch OY) and prevent overfishing (Gunderson 1979; Pikitch *et al.* 1988; Richards 1994; Tagart *et al.* 1980). It has been increasingly used since the first groundfish stocks were declared overfished under the terms of the Sustainable Fisheries Act (since 1999) to limit the bycatch of overfished species. Trip limits for overfished species are designed to allow landings of these species which would otherwise be discarded dead at sea. Allowing a limit large enough to minimize discarding and account for this bycatch, but not so large as to encourage targeting of overfished species has been the conceptual objective in West Coast groundfish trip limit management. Trip limits are also used to prevent early OY attainment and early fishery closure. Trip limits have also been designed for healthy, co-occurring target stocks to reduce the bycatch of overfished species. Reliance on trip limit management often results in the inability to harvest the OY of healthier target stocks due to the constraints imposed by measures designed to rebuild overfished stocks or prevent overfishing. However, as OYs for overfished stocks are further reduced, the potential for discarding increases. This becomes a counter-productive measure once a critical threshold of overfishing occurs. This is why the Council was compelled to consider and eventually adopt more precautionary measures like depth-based management. Trip limit management may still be an effective strategy for harvest control, but other measures need to be considered as well when stock abundance declines to a critical point. The use of observer data should provide more definitive accounting of bycatch of overfished species which could lead to more effective trip limits.

Gear Modifications

Gear modifications should be considered that might be more effective in targeting healthy species while minimizing bycatch of overfished species such as darkblotched. The small footrope restriction (trawl footropes

≤ 8 inches in diameter; no anti-chafing gear) has been used on the West Coast to minimize bycatch of overfished shelf rockfish species such as canary and yelloweye rockfish. Trawls under the small footrope restriction cannot effectively fish on the bottom in rocky habitats. Shelf rockfish landings by trawls under the small footrope restriction have been significantly reduced. Some assurance is gained by the fact that landings of shelf rockfish on a per vessel basis have been generally less than allowable trip limits. A similar small footrope restriction in slope trawl fisheries to land any slope rockfish may reduce fishing-related mortality of darkblotched and other slope rockfish. However, some slope trawl fisheries would be compromised if small footrope restrictions were imposed to land all groundfish species. Larger footropes are required to effectively fish abundant flatfish species (i.e., Dover sole, petrale sole in the winter) on the silty mud bottoms of the abyssal plain on the outer slope. Small footropes dig into these soft substrates which are softer than the sandier, more compact depositional shelf bottoms outside rocky reefs. Larger footropes tend to "float" on the mud and more effectively catch target flatfish species. If these gears could be effectively restricted to softer mud bottom habitats on the slope, darkblotched and other slope rockfish could be avoided. Spatial mapping of these habitat types does not currently exist on any reasonable scale to consider such measures.

Other gear modifications that may more cleanly target harvestable shelf species include trawls with reduced mouths (smaller height and width dimensions) and cutback headropes. The ODFW has experimented with such trawls designed to target flatfish (M. Saelens, ODFW, pers. comm.). Initial results from comparative research tows with these experimental bottom trawls (29 paired tows with experimental and conventional trawls) on the shelf off Oregon were promising (+60% Dover sole in experimental nets, -76% canary rockfish in experimental nets, and -72% redstripe rockfish in experimental nets). These preliminary results suggest this gear more efficiently catches flatfish while reducing bycatch of shelf rockfish. Further evaluation of this gear is planned in deeper water during the summer of 2002. An additional 150 hours of effort on the slope is planned with an expected catch of 0.16 mt of darkblotched rockfish. Effectiveness of this gear in catching abundant flatfish on the slope while avoiding slope rockfish will clearly benefit darkblotched rebuilding.

Gear modifications designed to target harvestable groundfish and non-groundfish species and avoid slope rockfish should be investigated further. Exempted Fishing Permits (EFPs) could be used to investigate the efficiency of such gears as the experimental flatfish trawl being tested in waters off Oregon. Effective avoidance of overfished shelf and slope rockfish through the use of modified gears would reduce fishing-related mortality of darkblotched rockfish.

Cooperative International Management

All of the overfished groundfish stocks on the West Coast are distributed across international boundaries. While the Council process is designed to provide good coordination of state and federal management systems, Council jurisdiction and authorities are limited to the EEZ of the U.S. Cooperative international management could therefore be an avenue worth exploring to aid in the rebuilding of overfished stocks. There is such an active front being pursued with Canada at the Council, NMFS, and State Department levels to improve Pacific whiting assessment and management. All groundfish stocks under rebuilding would potentially benefit if management were coordinated with our international neighbors to the north and south.

Darkblotched rockfish, POP, canary rockfish, and lingcod on the West Coast south of the U.S./Canadian border are part of larger stock assemblages, some of which are managed outside of Council jurisdiction in Canada. The relative biomass of these species across the multiple management jurisdictions in the northeast Pacific is unknown. Coordinated and consistent assessment and management should be explored with the Canadian Department of Fisheries and Oceans. Cooperative management could benefit overfished groundfish rebuilding in waters off the West Coast of the U.S. as well as in foreign waters.

TABLE 4.3-1. Depth-based restrictions used to manage the West Coast groundfish fishery in 2003. All depth-based closed areas (also known as Rockfish Conservation Areas or RCAs) are bounded by the shallow and deep depth limits. (Page 1 of 1)

Fishery Sector	Area	Time Period	Shallow Depth Limit	Deep Depth Limit
Limited entry trawl [a/]	North of 40°10' N latitude	January 1-April 30, 2003	100 fm except 75 fm in period 4	250 fm except some specified petrale fishing areas between 150 and 250 fm during periods 1 and 6.
	South of 40°10' N latitude	January 1-April 30, 2003	50 fm during period 1 and 60 fm during period 2 north of 34°27' N latitude; 100 fm along the mainland coast and shoreline around islands south of 34°27' N latitude	250 fm except 150 fm during periods 1 and 6 north of 38° N latitude; 150 fm south of 38° N latitude
	North of 40°10' N latitude	As of implementation of inseason rulemaking in May 2003[b/]	50 fm	200 fm
	South of 40°10' N latitude	As of implementation of inseason rulemaking in May 2003[b/]	Shoreline during Jul.-Aug.; 60 fm September-December north of 34°27' N latitude; 100 fm September-December south of 34°27' N latitude	200 fm
Limited entry and open access fixed gears	North of 46°16' N latitude	All periods in 2003	Shoreline	100 fm
	46°16' N latitude - 40° 10' N latitude	All periods in 2003	27 fm	100 fm
	South of 40°10' N latitude [c/]	All periods in 2003	20 fm	150 fm
Recreational	Washington	All periods in 2003	No restriction	>25 fm if harvest guideline of canary or yelloweye rockfish is attained
	California north of 40°10' N latitude and Oregon			>27 fm if harvest guideline of canary or yelloweye rockfish is attained
	South of 40°10' N latitude			>20 fm

a/ Closed to trawl fishing inside of 3 miles in Washington and California.
b/ Fishery closes inside 250 fm north of 40°10' N latitude on May 1 until implementation of inseason rulemaking.
c/ Includes a July-August Pt. Fermin/Newport South Jetty open area.

4.4 Socioeconomic Impacts

MSY proxy harvest levels used in the following economic analysis and in Chapter 5 were generally derived by simply calculating the yield that corresponds to applying the proxy F_{MSY} to $B_{40\%}$, the proxy B_{MSY}. An exception to the use of proxy estimates is the approach used to estimate F_{MSY} rates and MSY for canary rockfish (and yelloweye rockfish in Chapter 5). In this case, F_{MSY} was estimated by fitting a spawner-recruit curve and finding the fishing mortality rate at which yield is maximized. Converted to units of $F_{x\%}$, the estimate of F_{MSY} for canary rockfish is $F_{73\%}$ (and for yelloweye rockfish $F_{57\%}$) (Methot and Piner 2002a; Methot *et al.* 2002). These F_{MSY} rates were applied to the estimated $B_{40\%}$ biomass level, the target biomass level for rebuilding.

Note: These MSY estimates should be interpreted with great caution. While these proxy MSY harvest estimates were developed for the rebuilding plan economic analyses, they are an over simplification and should not be used to consider long-term management options for West Coast groundfish. Evidence of low productivity for many of the overfished rockfish stocks suggests that the proxy F_{MSY} rates may overestimate true F_{MSY} as well as MSY. For instance, the 2002 bocaccio assessment (MacCall 2002) indicated that the productivity of the bocaccio stock in waters off southern and central California was so low that rebuilding could not occur according to the National Standard Guidelines (i.e., P_{MAX} was less than 50%, even with no harvest, over more than 100 years). In other words, the current information on the productivity of bocaccio indicates that the stock would decline if fished at $F_{50\%}$ after it is rebuilt to the $B_{40\%}$ level. Clearly, a harvest rate of $F_{50\%}$ is too aggressive for such an unproductive stock, just as it is too aggressive for canary rockfish and yelloweye rockfish that had F_{MSY} estimates lower than $F_{50\%}$. Unlike canary rockfish and yelloweye rockfish, the fit of a stock-recruit curve to the spawner-recruit data for bocaccio was inadequate to allow F_{MSY} to be estimated directly. Therefore, the proxy F_{MSY} rate for bocaccio is not considered to be realistic, nor is there a straightforward way to estimate a more appropriate value. This qualification may also be true for other overfished rockfish stocks.

4.4.1 Overfished Species as a Constraint Over Time

The time period used for the analysis in this section covers the years from 2002 until T_{MAX} for each rebuilding species. Under the more conservative rebuilding alternatives (*Maximum Conservation* and *Council Interim*), rebuilding is expected to occur prior to T_{MAX}. Under the least conservative (*Maximum Harvest*) rebuilding alternative, T_{MAX} is the first year that each stock is projected to be rebuilt. Values of these parameters for the four species under the different rebuilding alternatives are shown in Table 2.0-1. For each of the four rebuilding species, projected OY and discounted revenue streams under each alternative are totaled over the period from 2002 to T_{MAX}, and over progressively shorter time intervals during the respective rebuilding periods beginning with 2002. This is done to allow consistent comparisons to be made between the alternatives for each rebuilding species over varying periods that may be of interest to decision makers.

Tables 4.4-1, 4.4-3, 4.4-5, and 4.4-7 show projected total catch optimum yields (OYs) over time under different probabilities of rebuilding within T_{MAX} for darkblotched rockfish, canary rockfish, Pacific ocean perch and lingcod, respectively. Note that the OY levels in the tables revert to the proxy MSY harvest level for each species once the median rebuilding year under each scenario (T_{TARGET}) has been reached. The tables also show sums of these OYs over varying periods of time during the rebuilding period.

Tables 4.4-2, 4.4-4, 4.4-6, and 4.4-8 show the present value of the projected OY harvests in the corresponding OY tables, assuming a 5% annual discount rate and a constant $0.50 per pound average exvessel price for rockfish (darkblotched rockfish, canary rockfish, pacific ocean perch and lingcod, respectively). Discounting diminishes the present value of revenues received in the future. The tables also show sums of the present value revenue streams over the same time periods tabulated in the OY tables. Note that these analyses don't include possible nonmarket values such as existence values, or the economic effect of possible biological interactions (positive or adverse) between these species and other ocean resources (e.g., alterations in ecological balances).

Figures 4.4-1 to 4.4-4 display for each overfished species (darkblotched rockfish, canary rockfish, Pacific ocean perch and lingcod, respectively) the relative cost of an additional unit of overfished species biomass in terms of the amount of harvest of the species that must be foregone in order to achieve that gain in biomass. Note that each comparison is on a single-species basis only and does not include the impact of the implied varying harvests of cooccurring species that are landed in conjunction with the overfished species.

Also note that while the comparisons shown in each figure are of the *Council Interim* against the *Maximum Harvest* alternative, for each rebuilding species, the annual per unit values and shape of the plots are essentially identical no matter which two alternatives are compared.

4.4.1.1 Darkblotched Rockfish

In Table 4.4-1, projected darkblotched rockfish harvests under the *Maximum Conservation* alternative are zero until the median rebuilding year 2014 ($T_{TARGET} = T_{MIN}$) is reached. Although likely to recover most quickly under this alternative, the relatively low productivity of this stock assures that aggregate harvest does not catch up with any of the other alternatives over any time period. Ranked in terms of relative impact, the *Maximum Conservation* alternative is most restrictive, followed by no action (40-10), *Council Interim* (P_{MAX} =80%), and *Maximum Harvest*, respectively. The table also shows rebuilding trajectories associated with two intermediate rebuilding scenarios. These represent 60% and 70% probabilities of rebuilding darkblotched rockfish within T_{MAX}, respectively.

Table 4.4-2 compares streams of exvessel revenue over time when a discount factor is applied. The same relative rankings of the alternatives hold as shown in Table 4.4-1. The relatively long generation time and low productivity of darkblotched rockfish stocks means that conservation in the present in order to rebuild stocks in the future does not seem to increase the commercial value of the resource. This effect is exacerbated when present value is calculated by discounting revenues received in the distant future.

Figure 4.4-1 shows how the relative cost of rebuilding darkblotched rockfish varies over time as the species rebuilds. In the early rebuilding years, the opportunity cost to the commercial fishery of each additional metric ton of biomass is slightly greater than 1 mt of potential harvest. Over time, the cost stays fairly flat at around 1 mt of harvest per mt of additional biomass until about 2019, when the cost begins to rise and fluctuate with increasingly variable annual biomass increments. After 2026, the cost in terms of foregone annual harvest generally fall toward zero as T_{TARGET} under the *Council Interim* alternative is approached. From that point on, annual harvest OYs are equal under both *Council Interim* and the *Maximum Harvest* alternatives.

4.4.1.2 Canary Rockfish

In Table 4.4-3, projected canary rockfish harvests under the *Maximum Conservation* alternative are zero until the median rebuilding year 2057 ($T_{TARGET} = T_{MIN}$) is reached. Once T_{MIN} has been reached; however, the significant jump in sustainable OY to 622 mt allows aggregate harvest over the entire rebuilding period (2002-2076) under the *Maximum Conservation* alternative to exceed all, but the *No Action* (40-10 rule) alternative. Ranked in terms of relative impact, the *Maximum Conservation* alternative is most restrictive over the first 50+ years of rebuilding. *Maximum Harvest* allows the most liberal OYs over almost any aggregate period, but is eclipsed by the *No Action* alternative in the end. The *Council Interim* in this case (P_{MAX} =60%) allows intermediate annual and aggregate harvest levels over all time periods. The table includes rebuilding trajectories associated with two intermediate rebuilding scenarios, 70% and 80% probabilities of rebuilding within T_{MAX}, respectively.

Table 4.4-4 compares streams of exvessel revenue over time when a discount factor is applied. Note that when discounting is applied to the canary rockfish harvest stream, the aggregate benefits noted in the long term under the *Maximum Conservation* alternative vanish. From a present value perspective, *Maximum Harvest* alternative looks optimal over any time period, followed by the *Council Interim* (P_{MAX} =60%).

Figure 4.4-2 shows the fluctuating relative cost of rebuilding canary rockfish throughout the rebuilding period. Over the first 50 years, the opportunity cost to the commercial fishery of each additional metric ton of biomass ranges from about 3.5 mt down to about 1 mt of potential harvest. The trend is generally downward over that period, although with significant oscillations. From about 2050 until T_{TARGET} under the *Council Interim* alternative, the fluctuations increase with increasing variability in annual biomass increments, and there is no discernible trend. From T_{TARGET} on, annual harvest OYs are equal under both *Council Interim* and the *Maximum Harvest* alternatives.

4.4.1.3 Pacific Ocean Perch

In Table 4.4-5, projected Pacific Ocean Perch harvests under the *Maximum Conservation* alternative are zero until the median rebuilding year 2012 ($T_{TARGET} = T_{MIN}$) is reached. However the *Maximum Conservation* alternative is most restrictive in aggregate only through the 2002-2014 period. In fact, in terms of aggregate harvest, the *Maximum Conservation* alternative is second only to the *No Action* (40-10 rule) alternative beginning with the 2002-2024. The *No Action* (40-10 rule) alternative doesn't rebuild by T_{MAX}, but does allow the greatest aggregate Pacific ocean perch OYs throughout the rebuilding period. The *Council Interim* alternative (P_{MAX} =70%) is intermediate over most periods, but actually allows the smallest aggregate harvest over the 2002-2024 period. Interestingly, aggregated over the entire rebuilding period (2002-2042), aggregate harvest under the *Maximum Harvest* alternative is the lowest of the alternatives shown. Note the table includes rebuilding trajectories associated with two intermediate rebuilding scenarios, 60% and 80% probabilities of rebuilding within T_{MAX}, respectively.

This picture changes only slightly when discounting is applied as shown in Table 4.4-6. Again, discounted aggregate harvest under the no action (40-10 rule) alternative is the greatest over the entire rebuilding period. The *Maximum Conservation* alternative comes in second over the later two aggregate periods displayed (2002-2034 and 2002-2042). Aggregate harvest under the *Council Interim* alternative (P_{MAX} =70%) is intermediate over all periods shown.

Figure 4.4-3 shows the relative cost of rebuilding Pacific ocean perch. In the early rebuilding years, the opportunity cost to the commercial fishery of each additional mt of biomass is about 2 mt of potential harvest. The cost generally increases over the rebuilding period to about 7 or 8 mt of harvest per mt of additional biomass, until T_{TARGET} under the *Council Interim* alternative. From that point on, annual harvest OYs are equal under both *Council Interim* and the *Maximum Harvest* alternatives and there is no additional opportunity cost of rebuilding under the more conservative harvest alternative.

4.4.1.4 Lingcod

Table 4.4-7 shows projected annual and aggregate lingcod harvests under different rebuilding alternatives. It should be noted that there is very little difference in projected rebuilding times between the alternatives. *Maximum Harvest*, *Council Interim*, and *No Action* (40-10 rule) alternatives rebuild in 2009. Consequently there is little difference in annual OYs between these three alternatives after 2004. The *Maximum Conservation* alternative would rebuild by 2007 if zero lingcod harvest had been implemented beginning 2002. From the table we see that aggregate harvests under the *Maximum Harvest* alternative are greatest in the short term, but quickly give way to the *Maximum Conservation* alternative in the 2002 through 2007 and 2002 through 2009 aggregated periods. Harvests under the *Council Interim* alternative (P_{MAX} =60%) are the second highest in the short term (2002 through 2004), and intermediate in subsequent periods.

The picture is almost identical when discounting is applied as shown in Table 4.4-8. The only difference from the previous table is that in the 2002-2004 period with discounting, aggregate harvest under the *Maximum Conservation* alternative is now slightly less than under the no action (40-10 rule) alternative. This relationship was reversed in Table 4.4-7.

Figure 4.4-4 shows the relative cost to the commercial fishery of rebuilding lingcod stocks. In the beginning the opportunity cost to the commercial fishery of each additional mt of rebuilding biomass varies between 1.1 mt and 1.3 mt of potential harvest. In the final rebuilding year, the cost per mt of rebuilding biomass climbs to around 2 mt of harvest. The two lingcod rebuilding alternatives compared in the figure both rebuild in the same year (2009).

It should be reemphasized that the analysis in this section is focused on each rebuilding species in isolation using a constant valuation, rather than in the context of cooccurring species simultaneously targeted and harvested incidentally by vessels using different fishing strategies that are changing over time. As such, there are several reasons why future harvests of each rebuilding species may be more or less valuable than current harvests. One reason is discounting over time. This concept was discussed in Section 3.4.9 and applied in the analysis in Section 4.4.1 to weight the value of future harvests according to how far in the future the harvest occurs. Using discounting, the present value of even greatly increased harvests available only after a T_{TARGET} many years in the future may be very low.

Also the true commercial value of an overfished species may lie not in harvest of the species itself, but rather in the access that the bycatch constraint implied by a particular OY level allows to harvest target species caught in conjunction with the rebuilding stock. Such is the case with many of the overfished groundfish species on the West Coast. This concept is explored in detail in Section 4.4.2. The value of a resource in terms of how much it allows or inhibits access to a target fishery is known as its "shadow price." The value or shadow price of relaxing a bycatch constraint is likely to fall as the OY for the rebuilding species increases over time. Thus an additional metric ton of rebuilding species OY is probably worth more to the commercial fishery now, when OYs are low and access is limited, than in the future when the rebuilding species is more abundant and therefore less constraining on bycatch allowed in the target fishery.

4.4.2 Complex Values and Allocation Among Sectors Over Time

The focus of this section is on values of species complexes for harvest, as opposed to existence values which may be placed on complexes of species in their natural habitat.

The Council will need to allocate the available harvest of overfished species among gear groups, target strategies and time periods. The previous section describes how the available harvest may vary over time and the relative ranking of the options under an assumption of a constant average value per unit of additional harvest. In this section, we will discuss reasons the assumption might be relaxed and the effect of relaxing the assumption on the evaluation of the alternative rebuilding options.

In any given year, the Council will recommend to NMFS harvest regulations that allocate available harvest among uses in what the Council believes is an optimal fashion. Sections 3.4.2, 3.4.4, 3.4.6, and 3.4.7 describe a variety of harvest sectors and target strategies where the overfished species may be taken. The Council will likely vary the allocation between different fisheries over the period of the rebuilding plan based on changing information about bycatch rates, changing marginal values and changes in limiting species that affect the amount of the complex available. In determining an optimal allocation, the Council is likely to take into account equity, geographic allocation, and other social factors in addition to economic efficiency.

When available harvests of overfished species are low, the economic value of each additional pound of species that may be caught is likely to be substantially greater than when available harvests are higher. For example, if the occurrence of an overfished species in a particular target strategy is rare, but the rebuilding schedule requires zero harvest mortality, then absent an ability to structure the season or change a fishing gear or practice to eliminate the possibility of harvesting the overfished species, the fishery would have to be shut down, thus eliminating all harvest-related benefits from the fishery. Such would be the case with maximum conservation alternatives for each of the overfished species associated with this amendment. On the other hand, as discussed above, quicker rebuilding enhances benefits not related to the amounts of fish harvested, such as existence values.

Indications of the possible reductions in exvessel value per pound of overfished species forgone are provided in Table 3.4-20. As an example, unless BRDs or other measures can eliminate the chance of taking bocaccio, $413,000 dollars worth of pink shrimp might have to be forgone for each pound of bocaccio saved based on 1998 data for north of Cape Mendocino. If bycatch rates are well known and additional harvest is allocated first to the lower bycatch rate fisheries that generate more exvessel revenue per unit of overfished species, and subsequently in sequence to fisheries with successively higher bycatch rates with lesser exvessel revenues per unit of overfished species, the potential economic benefits would likely diminish as harvest increases. Thus, the average value per pound of overfished species in a year in which only 20 mt of the species is available is likely to be much greater than in a year in which there are 120 mt available. Similarly, forgoing a pound of harvest of an overfished species when the allowed harvest level is already low is likely to reduce revenues substantially more than forgoing a pound of harvest when harvest levels are substantially higher.

In the previous section alternatives were ranked according to the value of the expected harvest under the assumption that the per unit value of harvest was independent of the total amount of harvest available (i.e. a constant price was used per unit of harvest). Here it is seen that, assuming rebuilding occurs, the value of an additional unit of harvest of an overfished species, in terms of the access it provides to healthy stocks, is likely to diminish over time as the amount of total available harvest of the species increases. This concept is known in economics as "diminishing marginal returns." Assuming that rebuilding will still occur, but just more slowly under the options that allow larger harvests earlier on, this concept of diminishing marginal returns tends to push the balance between the options towards alternatives with slower rebuilding rates. The available information is not sufficient to definitively determine whether the shift would be sufficient to change the ranking of the options implied by the analysis of the previous section; and other factors may tend to increase the value of future harvests over present harvests.

The remainder of this section provides more specific examples for each of the overfished species. These examples are for illustration only. The data used to generate the examples are generally trip data with bycatch information included where it is available. See Section 3.4.2.1 for important assumptions and caveats in the interpretation of this information. As more information becomes available, the actual values in these examples will change. A key point in determining the how much catch must be forgone under a particular strategy in order to reduce mortality of overfished species is whether or not gear or fishing methods can be modified to reduce overfished species mortality without reducing catch of target species. If such changes can be made, target species harvest may be maintained while still reducing overfished species mortality. However there are likely to be some increased fishing costs associated with such changes.

In evaluating the likelihood a restriction on an overfished species would affect a particular strategy, the number of trips on which the strategy was employed should be compared to the number of trips on which the overfished species was retained. A higher frequency of overfished species retention may indicate a higher likelihood of a need for management measures to restrict the fishery while a low frequency of overfished species retention may indicate employment of a secondary strategy during a particular trip, rather than co-occurrence of the overfished species with the primary target species. For each strategy, Tables 3.4-13 through 3.4-16 provide the percent of trips on which the overfished species was caught. For example, in Table 3.4-15 it can be seen that darkblotched rockfish show up in less than one twentieth of one percent of all nontrawl open access nearshore trips north of Cape Mendocino. The species composition on these trips would warrant closer examination to determine whether the darkblotched retention came from nearshore effort, or whether a combination trip occurred in which the primary effort was nearshore, but there was also some slope effort involved. In the former case, implementation of a zero take harvest policy might involve closure of the nearshore fishery. In the latter case, closure of shelf and slope opportunity might be sufficient to achieve the zero harvest mortality associated with the maximum conservation alternative.

The following is a summary of the target trips on which each of the overfished species appeared. For each species, the *Maximum Conservation* alternative would have some impact on some trips in all of the strategies identified as taking the overfished species. For some strategies, the effect might simply be that a secondary strategy could not be pursued (a strategy not identified as the primary strategy for the trip). For example, for a trip on which HMS was the primary strategy but some separate effort was targeted on groundfish, the secondary groundfish strategy might become prohibited. Or the effect may be significant reductions or changes in the fishing methods used in the primary strategy. For other rebuilding alternatives requiring harvest reductions, similar scopes of impact may accrue depending on how the harvest reductions are achieved. For example, the conservation burden could be allocated across all strategies which truly take the species as incidental catch. Or, as would be consistent with past vessel trip and cumulative limit management strategies, certain strategies may bear heavier conservation burdens than others.

Section 4.4.3 provides information comparing the relative restrictiveness expected under the rebuilding alternatives over the short term.

4.4.2.1 Darkblotched Rockfish

In 2002, darkblotched were taken in 20 primary target strategies north of Cape Mendocino and 11 strategies south of Cape Mendocino (Table 4.4-9). The darkblotched data for 1998 were not sufficient for a similar display as under only one strategy were there any actual landings of darkblotched reported in that year. Table 4.4-9 ranks the strategies from those that may have consumed the least darkblotched to those that may have consumed the most. The far left hand column of the table shows the total exvessel revenue of all species landed in a particular target strategy per pound of darkblotched landed or estimated to be present in the bycatch. This table provides a sense of the magnitude of some of the choices the Council would have to make in implementing rebuilding options. For the *Maximum Conservation* alternative, in the northern area, by revenue, 40% of all landings would at least be affected by the need to constrain darkblotched; in the southern area, by revenue, 9% of all landings would at least be affected by the need to constrain darkblotched (see discussion above).

See the introduction to this section and Section 3.4.2.1 for important caveats and assumptions.

4.4.2.2 POP

In 1998, POP were taken on trips with 33 different primary target strategies. There were no trips taking POP south of Cape Mendocino. All trips for each of these strategies taken together accounted for 65% of the 1998 north of Cape Mendocino exvessel value (Table 4.4-10). For some of these strategies, POP were landed on a very small portion of the trips. For example, in 2002 north of Cape Mendocino, POP were landed on only one tenth of one percent of the HMS trips and nine tenths of one percent of the salmon trips (Table 3.4-15). In 2002, POP were taken on trips with 16 different primary target strategies. All trips for each of these strategies taken together accounted for 39% of the 2002 north of Cape Mendocino exvessel value exvessel value (Table 4.4-10). Two strategies that together accounted for 16% of the 1998 north of Cape Mendocino exvessel value exvessel value were not on the 2002 list, HMS and salmon.

See the introduction to this section and Section 3.4.2.1 for important caveats and assumptions.

4.4.2.3 Canary Rockfish

In 1998, canary rockfish were taken on trips with 39 different primary target strategies north of Cape Mendocino. All trips for each of these strategies taken together accounted for 99% of the 1998 north of Cape Mendocino exvessel value (Table 4.4-11). For some of these strategies, canary rockfish were landed on a very small portion of the trips. For example, in 2002 north of Cape Mendocino, canary rockfish were landed on less than one twentieth of one percent of the Dungeness crab trips and on two tenths of one percent of the HMS trips (Table 3.4-15). For some of the other nongroundfish target fisheries canary rockfish were encountered more frequently. For example, almost 9% of the salmon trips included at least one canary rockfish. In 2002, canary rockfish were taken on trips with 24 different primary target strategies north of Cape Mendocino. All trips for each of these strategies taken together accounted for 47% of the 2002 north of Cape Mendocino exvessel value (Table 4.4-11). Two strategies that together accounted for 49% of the 1998 north of Cape Mendocino exvessel value were not on the 2002 list, Dungeness crab and HMS.

In 1998, canary rockfish was taken on trips with 30 different primary target strategies south of Cape Mendocino. All trips for each of these strategies taken together accounted for 50% of the 1998 south of Cape Mendocino exvessel value (Table 4.4-11). For some of these strategies, canary rockfish were landed on a very small portion of the trips. For example, in 2002 north of Cape Mendocino, canary rockfish was landed on only one tenth of one percent of the limited entry fixed gear sablefish slope, CPS, salmon and California halibut trips and on less than one twentieth of one percent of the prawn and Dungeness crab trips (Table 3.4-16). In 2002, canary rockfish was taken on trips with 10 different primary target strategies. All trips for each of these strategies taken together accounted for 14% of the 2002 south of Cape Mendocino exvessel value (Table 4.4-11). Four strategies that together accounted for 22% of the 1998 south of Cape Mendocino exvessel value were not on the 2002 list, CPS, California halibut, Dungeness crab and salmon.

See the introduction to this section and Section 3.4.2.1 for important caveats and assumptions.

4.4.2.4 Lingcod

In 1998, lingcod were taken on trips with 37 different primary target strategies north of Cape Mendocino. All trips for each of these strategies taken together accounted for 98% of the 1998 north of Cape Mendocino exvessel value (Table 4.4-12). For some of these strategies, lingcod were landed on a very small portion of the trips. For example, in 2002 north of Cape Mendocino, lingcod were landed on one tenth of one percent of HMS trips and two tenths of one percent of Dungeness crab trips (Table 3.4-15). For some of the other nongroundfish target fisheries lingcod were encountered more frequently. For example, almost 7% of the salmon trips included at least one lingcod. In 2002, lingcod were taken on trips with 30 different primary target strategies north of Cape Mendocino. All trips for each of these strategies taken together accounted for 84% of the 2002 north of Cape Mendocino exvessel value (Table 4.4-12). HMS accounted for 14% of the 1998 north of Cape Mendocino exvessel value and was not on the 2002 list.

In 1998, lingcod were taken on trips with 41 different primary target strategies south of Cape Mendocino. All trips for each of these strategies taken together accounted for 97% of the 1998 south of Cape Mendocino exvessel value (Table 4.4-12). For some of these strategies, lingcod were landed on a very small portion of the trips. For example, in 2002 north of Cape Mendocino, lingcod were landed on one tenth of one percent of the "other" crustacean trips and on less than one twentieth of one percent of the sea urchin, CPS and HMS trips (Table 3.4-16). In 2002, lingcod was taken on trips with 32 different primary target strategies. All trips for each of these strategies taken together accounted for 79% of the 2002 south of Cape Mendocino exvessel value (Table 4.4-12). The biggest reason for the drop in the percentage of revenue accounted for by gear types that took some lingcod was the increase of revenue for a primary strategy type that took lingcod in neither 1998 nor 2002. In 1998, there were $1.6 million of squid landings, 2 percent of the south of Cape Mendocino exvessel value. In 2002 there were $17.8 million of squid landings, 20 percent of the south of Cape Mendocino exvessel value.

See the introduction to this section and Section 3.4.2.1 for important caveats and assumptions.

4.4.3 Aggregate Commercial Catch and Recreational Effort for First Year of Management-Coastwide

Interactions among the rebuilding alternatives for different species will have a substantial bearing on the effects of the alternative selected for any one species. The coastwide effects of the choice among rebuilding alternatives for a suite of overfished species is more relevant to the actual expected policy impacts than examining the effects for a single overfished species. Quantification of the short-term and long-term effects of selected suites of rebuilding alternatives is provided in the Chapter 5 cumulative impact analysis.

Whether or not a particular rebuilding policy for a particular species has an impact on total harvest depends in part on whether or not the species is a constraint on the complexes in which it is harvested. For example, darkblotched rockfish and POP are both taken largely in slope complexes. If a sufficiently aggressive policy is implemented to rebuild darkblotched rockfish, POP will also receive substantial protection. Under such circumstances a more liberal POP rebuilding policy may not provide substantially greater fisheries benefits, due to the darkblotched rockfish constraint.

Figure 4.4.5 shows the rebuilding choices for darkblotched rockfish and POP. If it is assumed the harvest of a particular complex would always be constrained by the ratio of the rebuilding OY to the rebuilt biomass OY, then aggressively conserving one stock, so it is rebuilt substantially earlier than the other overfished stocks in the complex provides little benefit in terms of additional harvest. However, there may be other ecosystem benefits or benefits related to existence values that may be advanced by more rapid rebuilding. Additionally, while the idea that degree of harvest constraint might be proportional to the ratio of the rebuilding OY to the rebuilt biomass may provide some rough guidance, there are many situations and reasons to believe the assumption would not strictly hold. Overfished species occur in different ratios in different complexes. Therefore, there may be some opportunity to balance the harvest between complexes to take advantage of the stock that rebuilds more rapidly. For example, if darkblotched rockfish were taken at a higher rate relative to POP on arrowtooth flounder trips as compared to petrale sole trips, then if darkblotched rockfish were rebuilt more rapidly than POP, the advantage of the greater darkblotched OY might be realized by expanding the arrowtooth flounder fishery.

Other factors affecting the opportunities to rebuild multiple species and to expand the harvest of particular complexes as the biomass for a species is rebuilt include inter species competition for food and habitat, changing bycatch rates over time, and changing species associations with changing ocean conditions. Figures 4.4-5 and 4.4-6 illustrate rebuilding trajectories for different overfished species. The species have been grouped by the complexes with which they are predominantly associated. Figure 4.4-5 shows the rebuilding trajectory for slope species (darkblotched rockfish and POP), Figure .4.4-6 shows the trajectories for shelf species that are important coastwide (canary rockfish and lingcod).

4.4.4 Primary Seafood Producers - Commercial Vessels

In this section we will discuss the nature of the short and long term effects of rebuilding alternatives on commercial seafood vessels, identify the vessels most likely to be affected, and rank the alternatives based on the degree to which present benefits must be deferred.

4.4.4.1 Short-Term Effects

Net Profits

Initially, alternatives that rebuild stocks more rapidly will result in the imposition of more restrictive fishing regulations. Restrictions on nonoverfished species are likely to be necessary to achieve desired reduction in mortality for overfished species. Catch is likely to decline, increasing average cost per unit of harvest by increasing variable or fixed costs or reducing the total amount of harvest. Revenue will decline with reduced catch. Regulations which cause fishers to move to second or lower choice target species, fishing areas or fishing times, or require changes in fishing gear, are highly likely to reduce net profits. The distribution of impacts across variable costs, fixed costs and reduced revenues will depend on the exact measures used to achieve the needed reductions. These measures will be analyzed and established as part of annual processes or regulatory amendments.

Deferred Expenses

One short-term survival mechanism that may be exercised by some vessels is the deferment of needed maintenance for the vessel and equipment key to safe vessel operation. Such deferrals will likely be associated with increased levels of risk. While the individual fisher may be lucky enough to avoid the costs of taking such risks, when the fishing industry as a whole is considered, there will likely be some included that were not lucky. Assuming the costs of a bad outcome are greater than the reduced costs from the deferred expenditure, the fishery as a whole will likely experience some increase in cost associated with the deferred expenditures.

Continued Operation

Absent an ability to capture in the present expected increases in earnings from the future, some vessels will undoubtedly have a difficult time adjusting to reduced revenue in the short term. If harvest right markets were established and there was a reasonable degree of confidence that harvest revenues were likely to increase in the future, firms might survive the short-term harvest restrictions by selling interest in futures harvests. However, such futures trading is unlikely. If vessels can cover variable costs they will continue to fish, but their economic survival under their current ownership will depend on debt load and ability to cover fixed operation costs from groundfish or other business activities. If annual fixed costs associated with maintaining and operating a vessel can be covered along with the variable costs associated with fishing, the vessel is likely to remain active. If operating costs can be covered but the vessel cannot cover the debt load of the current ownership and the current owner does not have sufficient resources to otherwise pay the debt load, the vessel may be resold at a price that allows for financially viable operation by the buyer.

Impact on Other Fleets

The amounts of reduced groundfish revenue projected for the short term may be an indicator of the amount of dislocation and pressure that might be experienced in other fisheries. The cumulative impact analysis (Chapter 5) includes modeling of seasons to project the revenue reductions associated with actions to rebuild multiple species under combinations of rebuilding alternatives. To survive the short-term reductions in the groundfish fishery, vessels are most likely to try to recover revenue first by expanding their effort in other fisheries in which they already participate then into other fisheries for which the vessel and/or operator expertise is suited.

4.4.4.2 Long-Term Effects

Catch Per Unit Effort (CPUE)

Over time, as stock biomasses increase, CPUE is likely to increase, reducing cost per unit harvest, depending on the distribution of the additional biomass and susceptibility to harvest. In order to rebuild overfished species, other species in the catch complexes in which overfished species occur are likely to receive protection in excess of that needed for those species. Therefore, there is likely to be some increase in the biomass and decrease in harvest costs for both overfished and nonoverfished species.

Costs of Mismatches Between CPUE and Stock Assessments

If catch per unit effort accelerates before indications of increased biomass are detected in stock assessments, during the rebuilding process there may be adjustment periods during which regulations become increasingly more restrictive rather than increasingly less restrictive. These restrictions would likely increase average fishing costs and may impose reductions in the harvest of nonoverfished species until such time as the biomass increases of overfished species are detected by the stock assessment methods.

Net Profits

Once stocks are rebuilt it is anticipated that harvests will be higher than those that will be present in the fishery over the short term (see "Comparison of the Alternatives" below). All the adverse effects discussed under the short term net profits section will likely be reversed and net profits will likely be higher than would otherwise be the case without rebuilding. This anticipation is premised on the assumption that other stocks in the harvest complex will not become overfished or otherwise have their biomasses depressed and be declared in overfished condition. The cumulative impact analysis (Chapter 5) includes an attempt to project the revenue for a fishery in which all currently overfished stocks are rebuilt, and revenue for a rebuilt fishery in which an MSE alternative was chosen for canary rockfish.

Over the long term, the degree of net profit will also depend on control of capital flow into the fishery. The fishery is currently considered overcapitalized. In the near term, the effects of overcaptilization will be exacerbated if harvest is reduced to rebuild stocks. However, over the long term harvests are expected to increase to levels substantially above those observed in 2002 and to levels comparable to or above those observed in 1998 (see "Comparison of the Alternatives" below). Other efforts are underway to control and reduce capacity in the fishery such that even with no action there may be some increase in net profits. The increase in net profits is not an effect associated with the action proposed here; however, it will be addressed in the section on cumulative impacts and is a factor in evaluating the degree of industry financial stress that may be anticipated under any of the rebuilding options.

4.4.4.3 Vessels Most Affected

Vessels most dependent on slope fisheries are likely to be most affected by harvest restrictions to rebuild darkblotched and POP while vessels most dependent on shelf fisheries are likely to be most affected by harvest restrictions to rebuild canary and lingcod (Tables 3.4-35 and 3.4-36).

West Coast Nov 2000-Oct 2001	Number of Vessels and Percent of Total Revenue from the Indicated Species Group (Summary from Section 3.4.4)							
	Groundfish Fisheries							
	Limited Entry Trawl		Limited Entry Fixed Gear		Open Access >5%		Open Access <5%	
	Vessels	% Rev	Vessels	% Rev	Vessels	% Rev	Vessels	% Rev
Whiting	61	52%						
Sablefish	222	16%	158	44%	179	28%	103	1%
Nearshore Species	146	3%	57	13%	623	41%	236	0%
Shelf Species	235	20%	138	3%	301	5%	388	1%
Slope Species	225	25%	136	6%	252	2%	125	0%
	Nongroundfish Fisheries							
	Vessels	% Rev			Vessels	% Rev		
Halibut	668	5%	Salmon		1,194	22%		
Shrimp & Prawns	213	39%	HMS		1,666	35%		
Crabs	1,246	55%	CPS		289	59%		
			Other		1,468			

The complexes in which each of the overfished species are most likely to be taken are discussed in Section 4.4.2. Section 3.4.4 discusses the number of vessels that fish in the shelf and slope fisheries and the percentage of exvessel revenues that come from those fisheries for the vessels that fish in them. For example, Table 3.4-35 shows that 20 vessels between 50 feet and 60 feet in length took part in the Columbia INPFC area trawl slope fishery. Table 3.4-36 shows that these 20 vessels derived 28% of all of their exvessel revenue from this fishery. In the same area, there were 14 similar sized vessels that took part in the limited entry fixed gear sablefish fishery. These vessels derived 36% of all their West Coast revenue from the sablefish fishery. The distribution of these vessels among ports and between limited entry and open access sectors is provided in Table 3.4-34

4.4.4.4 Comparison of the Alternatives

If the Monte Carlo probability distributions adequately reflect likely outcomes, all alternatives except the *Mixed Stock Exception* (MSE) option for canary are expected to rebuild the fishery in the penultimate year (year in which, on average, rebuilding would be expected to be achieved regardless of which alternative is chosen), thus for the long term, once stocks are rebuilt, there is no difference between the alternatives in terms of the annual catches that will be available, except for the MSE alternative for canary rockfish.

The differences between the options are in the time paths for rebuilding and the short-term harvest levels. Time preferences associated with vessels are likely to reflect the need to financially survive the near term and the length of time expected to be dependent on the fishery. Harvests that occur beyond the period of an individual's financial dependence on the fishery are likely to primarily affect option or bequethal value for that individual (as opposed to use value). However, an individual departing the fishery might also receive some additional value from selling a permit if higher harvest levels are expected in the future as a result of rebuilding actions.

A simple comparison can be provided ranking the options according to which options provide the greatest harvest in the immediate future.

	Rebuilding Species			
Amount of Harvest Over the Short Term	Darkblotched	POP	Canary	Lingcod
Most Harvest	Max Harvest (190 mt)	40-10 (1,045 mt)	MSE (205 mt - 220 mt)	Max Harvest (646 mt)
2nd Most	Council Interim (158 mt)	Max Harvest (464 mt)	Max Harvest (45 mt)	Council Interim (577 mt)
3rd Most	40-10 (20 mt)	Council Interim (353 mt)	Council Interim (41 mt)	40-10 Rule (280 mt)
Least	Max Conservation (0 mt)	Max Conservation (0 mt)	40-10 Rule and Max Conservation (0 mt)	Max Conservation (0 mt)
Recent Year OYs (INPFC areas covered)				
1998	no OY (ABC was 209 mt)	650 mt (Van & Col)	878 mt (Van & Col)	838 mt (all)
2002	168 mt (all)	350 mt (Van, Col & Eur)	93 mt (all)	577 mt (all)
2003 OY (projected hvst)	172 mt (all) (98.9 mt)	377 mt (Van, Col & Eur) (109.7 mt)	44 mt (all) (44 mt)	651 mt (all) (512.8 mt)
Rebuilt OY	360 mt	1,164 mt	622 mt	1,373 mt

The aggregate amount of overfished species that would be allowed under the first year of rebuilding is an indicator of the magnitude of additional restriction that might be necessary to attain rebuilding harvest levels. Harvest levels only slightly below recent year harvests may impose little additional restriction while those substantially below recent year harvests may result in substantially more restrictive regulations and greater adverse impacts on net profits over the short term.

The maximum harvest alternative would allow the most harvest in the short term (with the exception of the MSE alternative for canary) but have the lowest probability of rebuilding in the maximum allowed time.

Probability of Rebuilding Within T_{MAX}	Darkblotched	POP	Canary	Lingcod
	Probability of Rebuilding Within T_{MAX}			
40-10 rule	74%	<1%	19%	55% North, 68% South
Maximum Conservation	approaches 100%	approaches 100%	approaches 100%	approaches 100%
Council Interim	80%	70%	60%	60%
Maximum Harvest	50%	50%	50%	50%

For the short term, the difference in harvest between the maximum harvest alternative and alternatives with a greater than 50% chance of rebuilding within T_{MAX} can be viewed as representing the opportunity cost of increasing the probability of rebuilding. This difference can be transformed to a time difference by asking the question, "If an alternative other than the maximum harvest is chosen, on average how long will it take for the year one OY under the *Maximum Harvest* alternative?" The following table provides that information.

	Darkblotched	POP	Canary	Lingcod
	Number of Years Until OY of First Year of Max Harvest Alternative is Reached			
40-10 rule	8	exceeds in 1st year	18	3
Council Interim	3	13	3	1
Maximum Conservation (rebuilt OY)	12	10	44	5

Under the mixed stock exception for canary, an OY of between 205 mt and 220 mt might be the sustained harvest level (Table 4.2-1). The year at which the 210 mt harvest level would be reached under each of the rebuilding alternatives is as follows: 40-10 rule, 2045; Council interim, 2074; maximum conservation, 2072.

Other perspectives on the temporal trade-offs are provided in Section 4.4.1. Because of uncertainty about rebuilding schedules, impacts on vessels might be more appropriately viewed as a trade-off between short-term harvests and the certainty of rebuilding, as opposed to a trade-off between short-term harvests and when a stock will have been rebuilt. The nature of this tradeoff is discussed further in Section 4.5.1.

4.4.5 Seafood Distribution Chain

4.4.5.1 Buyers and Processors

Changes in catch (output) by vessels also represent changes in raw products needed by seafood buyers and processors. Output would be expected to decline or increase in proportions roughly commensurate with the change in the key input. The tradeoffs in terms of short and long term revenue opportunity and survival for processors are similar to those discussed for vessels in Section 4.4.5. The reader should refer to Section 4.4.5 for a comparison of the alternatives.

Effects on Net Profits

The effect on net revenue will depend on changes in cost associated with the change in output and any changes in the exvessel prices and exprocessor prices. In general reduced harvest would mean reduced revenue for processors and increasing difficulty covering costs that do not decline proportionally with the level of production. Conversely, profits would be expected to increase with higher levels of production in the future. Wholesale prices and processing/wholesaling costs are not available to assess specific effects of the harvest reduction on gross or net processor revenues. In response to a reduction in the availability of raw product, buyers and processors may seek to increase revenue by bidding or finding other ways to acquire a larger portion of the available raw produce (in the groundfish or other fisheries), reducing costs, or finding ways to add value to the products they sell. Note that often adding value to a product may be more of a redistribution of profits within the food distribution chain and among competing products rather than the generation of additional value for the economy.

The specific regulations by which harvest reductions are achieved would not have as much of an impact on processors' operation costs as it does for vessels. However, there are important aspects of the regulatory regime that could increase or decrease processing costs more than proportionally with the change in harvest. One of these is the timing of harvest. A number of processors, larger ones in particular, maintain buying operations year round. There are certain costs associated with shutting down and reopening operations, many of which have to do with maintaining a skilled work force. Figures 3.4-1 to 3.4-5 show that for some areas of the coast, groundfish is one of the few fisheries that continue to operate in the late fall. In the past the Council has strived to maintain a constant flow of groundfish product to processors in order to facilitate continuous operation. This task has become increasingly difficult as harvest levels have declined. While specific measures to alter the year round fishery are not being proposed at this time, it should be anticipated that further declines in the OYs will make maintaining the year round groundfish fishery a more difficult challenge.

Processors Most Affected

A description of the seafood buying and processing sector is provided in Section 3.4.5. The numbers of processors by size (purchases) and fishery are identified along with the degree of dependence on a particular fishery.

Buyers and processors most dependent on slope fisheries are likely to be most affected by harvest restrictions to rebuild darkblotched and POP while vessels most dependent on shelf fisheries are likely to be most affected by harvest restrictions to rebuild canary and lingcod (Tables 3.4-43, 3.4-45, and 3.4-46).

West Coast Nov 2000-Oct 2001	Number of Buyers and Processors Buying from Vessel Groups and Percent of Total Purchases Revenue from the Indicated Species/Gear Group (Summary from Section 3.4.5.1)							
Groundfish Fisheries								
	Limited Entry Trawl		Limited Entry Fixed Gear		Open Access >5%		Open Access <5%	
	Byr/Proc	%Purch	Byr/Proc	%Purch	Byr/Proc	%Purch	Byr/Proc	%Purch
Whiting	30	17%						
Sablefish	74	8%	69	6%	57	1%	43	0%
Nearshore Species	59	1%	71	1%	238	4%	139	0%
Shelf Species	92	8%	90	0	230	0%	162	0%
Slope Species	82	10%	68	1%	118	0%	78	0%
Nongroundfish Fisheries								
	Byr/Proc	%Purch			Byr/Proc	%Purch		
Halibut	260	2%	Salmon		354	7%		
Shrimp & Prawns	107	12%	HMS		388	19%		
Crabs	448	34%	CPS		134	23%		
			Other		424	11%		

4.4.5.2 Seafood Markets

Effects on regional seafood markets are generally expected to be small and temporary under the rebuilding alternatives because of the many substitutes for West Coast groundfish available in the regional food distribution chain. Most super markets and restaurants do not rely on locally caught produce to stock their shelves or prepare menus. Locally caught products no longer available would be replaced with close substitutes for the local products that are obtained from elsewhere in the global supply chain.

Possible exceptions are the local fresh and live seafood markets, especially under the *Maximum Conservation* alternatives. Markets and restaurants featuring fresh and live catch supplied from local fisheries may be adversely affected by the closures necessary to implement the *Maximum Conservation* alternatives. This is especially true under lingcod and canary rockfish rebuilding, since these species are more likely than POP and darkblotched rockfish to be found in the local fresh and live seafood markets. Reduced availability of locally obtained supplies of fresh and live fish may reduce the appeal of these type of specialty markets with visitors and tourists.

4.4.6 Recreational Fishery

Because darkblotched rockfish and POP are not targeted or caught recreationally, measures implemented to rebuild these two species are not expected to significantly affect recreational fisheries. However measures to promote rebuilding of canary rockfish and lingcod are expected to restrict recreational harvest of these and possibly cooccurring species. Canary rockfish and lingcod recreational catch represent a significant share of the total OYs for these species. Table 3.4-47 shows that lingcod has been the most important of the four rebuilding species to the recreational fishery. Although concentrated in Northern California and Oregon, lingcod catch is distributed coastwide.

Under the *Maximum Conservation* alternative, no harvest of lingcod would be allowed for about 5 years, after which time total harvest OY would rise to more than 1,300 mt. The recreational allocation has recently been more than 50% of total lingcod OY, implying that after the 5-year hiatus, recreational lingcod fishing could resume to historically good levels. There would probably not be much difference to the recreational fishery between the *Maximum Harvest* and *Council Interim* alternatives, as they both rebuild in 2009 and have similar

OYs during the rebuilding period. The no action (40-10 rule) alternative would also rebuild by 2009 but shows lower harvest in the early rebuilding years and higher harvest beginning 2006 compared with the *Maximum Harvest* alternative.

Maximum Conservation alternative for canary rockfish allows no harvest for more than 50 years. This would have significant adverse short and longterm impacts on the recreational fishery, since measures to protect canary rockfish would also preclude access to other species taken in the recreational fishery. There is not much difference between the *Maximum Harvest* and *Council Interim* alternatives, since they rebuild within two years of each other and differ in OY by no more than 10 mts per year for about 50 years. While the no action 40-10 rule) alternative allows higher canary rockfish OYs each year beginning 2030, the deficit until that time compared with the *Maximum Harvest* and *Council Interim* alternatives would limit opportunities and make life considerably more difficult for the recreational fishery.

4.4.7 Tribal Fishery

Tables 3.4-49 and 3.4-50 demonstrate the importance of pacific whiting to the tribal fishery. In most recent years, whiting provided the lion's share of harvest tonnage and a major portion of exvessel revenue. Table 3.4-51 shows that there has also been some bycatch of canary rockfish and darkblotched rockfish in the tribal whiting (midwater trawl) fishery. While impacts on this fishery are not likely to be very significant under most rebuilding alternatives, there would probably be large adverse impacts under zero take measures for rebuilding canary and darkblotched rockfish under the *Maximum Conservation* alternatives. (Note also that adverse impacts on the tribal whiting fishery under widow rockfish rebuilding are expected to be even more significant due to the bycatch reported for this species.)

Table 3.4-51 also shows some lingcod bycatch in bottom trawl and salmon troll fisheries. A policy of zero allowable mortality under the *Maximum Conservation* rebuilding alternative for this species may have adverse impacts on the bottom trawl and salmon troll fisheries.

Table 3.4-52 shows bycatch of lingcod and canary rockfish in the tribal halibut fisheries. Zero allowable mortality under the *Maximum Conservation* rebuilding alternative for these species may adversely affect tribal halibut fisheries. Note that this would also apply to yelloweye rockfish rebuilding under a *Maximum Conservation* scenario.

4.4.8 Communities

Discussion in this section is focused around impacts on West Coast fishing-oriented communities resulting from anticipated near term harvest restrictions implemented to rebuild darkblotched rockfish, canary rockfish, POP, and lingcod under the different rebuilding alternatives. Impacts are descriptive in nature and consist of aggregations of the qualitative effects on recreational, tribal and commercial fisheries and associated suppliers and processors as these affect different regions and port areas on the West Coast.

Fleets most likely to be negatively affected by additional harvest restrictions under darkblotched rockfish, canary rockfish, POP, and lingcod rebuilding plans are clustered in ports along the Oregon and Washington coasts. Historically, large concentrations of limited entry trawl and limited entry fixed gear vessels fishing on the continental shelf and slope are based in these ports. While the data demonstrate the ability of many of these types of vessels to operate on the slope as well as the shelf, the array of species currently in need of rebuilding coupled with recently adopted depth-based closures will prevent vessels from easily shifting activity from one stratum or target species to another in order to continue operations.

Ports in these areas were also seen to have a high proportion relatively small buyers and processors. Since the ability to withstand downsizing or to shift processing to other species or products is more limited for smaller-volume operations than for larger buyers and processors, small operators are more likely to be adversely affected by restricted supply and likely increased handling costs under the more stringent rebuilding management measures.

Tribal fisheries that may be affected by reduced OY levels in order to rebuild these overfished species are clustered in ports along the Northwest Olympic Peninsula and Central Washington Coast. The dependence of ports along the Northwest Olympic Peninsula and Central Washington Coast on tribal fisheries will exacerbate the negative impact in these areas if the most stringent rebuilding measures are implemented.

Recreational fisheries most vulnerable to rebuilding-induced limitations and closures are located primarily along the Oregon and Northern California coasts. The vast majority of canary rockfish and lingcod recreational harvest is taken in these areas. Harvest restrictions implemented to rebuild canary rockfish and lingcod will disproportionately affect charter boat and boat rental operators located along the Oregon and Northern California coasts.

Commercial and recreational fishing support a number of additional jobs and income in coastal communities through economic linkages between vessels, crews, suppliers, buyers, processors and consumers. Relative to all commercial fishery related income, Table 3.4-55 shows that the ports most dependent on income from groundfish limited entry trawl are located in Northern California and the Oregon coast. These areas are likely to be adversely affected by near-term harvest restrictions under darkblotched rockfish, canary rockfish, POP, and lingcod rebuilding alternatives.

Table 3.4-48 shows that the proportion of income from the recreational fishery resulting from groundfish trips was highest in Oregon and North/Central California. These areas are t likely to be adversely affected by near-term harvest restrictions to rebuild canary rockfish and lingcod.

TABLE 4.4-1. Projected total catch optimum yields for Darkblotched Rockfish under different rebuilding probabilities and the default "40-10" policy. Actual catches shown for 1998 through 2001 (mt). (Note: Harvest levels assumed to revert to the estimated long-term level (360 mt) at the median rebuilding year under each rebuilding scenario.) (Page 1 of 1)

Year	"40-10"	Max. Har-vest 50%	60%*	70%*	Council Interim 80%	Max. Conser-vation 100%	Year	"40-10"	Max. Har-vest 50%	60%*	70%*	Council Interim 80%	Max. Conser-vation 100%
1998	*875*	*875*	*875*	*875*	*875*	*875*	2024	338	330	319	304	290	360
1999	*326*	*326*	*326*	*326*	*326*	*326*	2025	339	332	321	306	292	360
2000	*236*	*236*	*236*	*236*	*236*	*236*	2026	340	333	322	307	293	360
2001	*130*	*130*	*130*	*130*	*130*	*130*	2027	340	335	324	309	295	360
2002	20	190	181	169	158	0	2028	341	335	324	310	296	360
2003	42	208	198	184	172	0	2029	360	337	326	311	297	360
2004	62	223	213	198	186	0	2030	360	338	327	312	360	360
2005	86	236	225	210	198	0	2031	360	339	329	314	360	360
2006	111	246	235	220	207	0	2032	360	340	330	315	360	360
2007	136	256	244	229	216	0	2033	360	341	330	316	360	360
2008	161	263	252	237	223	0	2034	360	342	331	360	360	360
2009	184	271	260	245	231	0	2035	360	343	332	360	360	360
2010	206	279	267	252	238	0	2036	360	343	332	360	360	360
2011	225	284	272	257	243	0	2037	360	343	333	360	360	360
2012	243	290	279	263	249	0	2038	360	344	333	360	360	360
2013	259	295	284	268	254	0	2039	360	345	334	360	360	360
2014	273	300	289	273	259	360	2040	360	344	360	360	360	360
2015	284	304	293	277	263	360	2041	360	345	360	360	360	360
2016	295	307	296	281	266	360	2042	360	345	360	360	360	360
2017	302	311	299	284	270	360	2043	360	345	360	360	360	360
2018	308	314	303	287	273	360	2044	360	343	360	360	360	360
2019	315	317	306	291	277	360	2045	360	345	360	360	360	360
2020	321	321	309	294	280	360	2046	360	345	360	360	360	360
2021	325	324	313	298	284	360	2047	360	360	360	360	360	360
2022	329	327	316	301	286	360							
2023	334	329	318	303	289	360							

Period	"40-10"	Max. Harvest 50%	60%*	70%*	Council Interim 80%	Max. Conservation 100%
2002-2007	458	1,359	1,295	1,211	1,136	0
2002-2014	2,009	3,342	3,198	3,006	2,834	360
2002-2024	5,161	6,526	6,270	5,925	5,611	3,960
2002-2034	8,682	9,899	9,536	9,086	8,885	7,560
2002-2047	13,362	14,386	14,080	13,766	13,565	12,240

* While not treated as structured alternatives, these intermediate harvest levels are provided for comparison purposes.

TABLE 4.4-2. Present values of projected Darkblotched Rockfish OYs under different rebuilding probabilities and the default "40-10" policy assuming a 5% annual discount rate and a constant 50¢ per pound average exvessel price for rockfish ($,000). (Note: Harvest levels assumed to revert to the estimated long-term level (360 mt) at the median rebuilding year under each rebuilding scenario.) (Page 1 of 1)

Year	"40-10"	*Max. Har-vest* 50%	60%*	70%*	*Council Interim* 80%	*Max. Conser-vation* 100%
1998						
1999						
2000						
2001						
2002	22	209	199	186	174	0
2003	44	218	207	193	181	0
2004	62	222	212	198	185	0
2005	82	224	213	200	187	0
2006	100	222	212	199	187	0
2007	117	219	210	197	185	0
2008	131	215	206	193	182	0
2009	143	211	202	190	179	0
2010	152	206	197	186	175	0
2011	158	199	191	181	171	0
2012	163	194	186	176	167	0
2013	165	188	180	170	161	0
2014	165	182	175	165	157	218
2015	164	175	168	159	151	207
2016	161	168	162	153	146	197
2017	157	162	156	148	141	187
2018	153	155	150	142	135	178
2019	148	149	144	137	130	170
2020	144	144	139	132	125	161
2021	139	138	134	127	121	153
2022	133	133	128	122	116	146
2023	129	127	123	117	111	139
2024	124	121	117	112	106	132
2025	118	116	112	107	102	126
2026	113	111	107	102	97	119
2027	107	106	102	98	93	114
2028	103	101	97	93	89	108
2029	103	96	93	89	85	103
2030	98	92	89	85	98	98
2031	93	88	85	81	93	93
2032	89	84	81	78	89	89
2033	84	80	77	74	84	84
2034	80	76	74	80	80	80
2035	76	73	70	76	76	76
2036	72	69	67	72	72	72
2037	69	66	64	69	69	69
2038	66	63	61	66	66	66
2039	62	60	58	62	62	62
2040	59	57	59	59	59	59
2041	56	54	56	56	56	56
2042	54	51	54	54	54	54
2043	51	49	51	51	51	51
2044	49	46	49	49	49	49
2045	46	44	46	46	46	46
2046	44	42	44	44	44	44
2047	42	42	42	42	42	42
2002-2007	427	1,315	1,253	1,171	1,099	0
2002-2014	1,503	2,708	2,590	2,432	2,291	218
2002-2024	2,954	4,179	4,009	3,780	3,573	1,887
2002-2034	3,941	5,127	4,926	4,665	4,482	2,900
2002-2047	4,687	5,841	5,646	5,411	5,229	3,646

* While not treated as structured alternatives, these intermediate harvest levels are provided for comparison purposes.

TABLE 4.4-3. Projected total catch optimum yields for Canary Rockfish under different rebuilding probabilities and the default "40-10" policy. Actual catches shown for 1998 through 2001 (mt). (Note: Harvest levels assumed to revert to the estimated long-term level (622 mt) at the median rebuilding year under each rebuilding scenario.) (Page 1 of 1)

		Max. Har-vest	Council Interim			Max. Conser-vation
Year	"40-10"	50%	60%	70%*	80%*	100%
1998	*1,444*	*1,444*	*1,444*	*1,444*	*1,444*	*1,444*
1999	*883*	*883*	*883*	*883*	*883*	*883*
2000	*177*	*177*	*177*	*177*	*177*	*177*
2001	*90*	*90*	*90*	*90*	*90*	*90*
2002	0	89	89	89	89	0
2003	0	45	41	36	30	0
2004	0	46	42	37	31	0
2005	1	47	43	38	32	0
2006	2	49	45	39	33	0
2007	3	51	47	41	34	0
2008	5	53	48	43	36	0
2009	6	55	50	44	37	0
2010	8	57	52	46	39	0
2011	11	59	54	47	40	0
2012	13	60	55	49	41	0
2013	16	62	57	50	43	0
2014	19	64	59	52	44	0
2015	23	66	60	53	45	0
2016	26	68	62	55	47	0
2017	30	70	64	57	48	0
2018	34	71	65	58	49	0
2019	38	73	67	60	51	0
2020	42	75	69	62	52	0
2021	47	77	71	63	54	0
2022	51	79	73	65	55	0
2023	56	81	75	67	57	0
2024	61	83	77	69	59	0
2025	67	85	79	70	60	0
2026	72	87	81	72	62	0
2027	78	90	83	74	63	0
2028	84	92	85	76	65	0
2029	91	94	87	78	67	0
2030	97	96	89	80	68	0
2031	103	99	91	82	70	0
2032	110	101	93	84	72	0
2033	118	103	95	85	73	0
2034	125	106	98	88	75	0
2035	132	108	100	90	77	0
2036	139	111	103	92	79	0
2037	146	112	104	94	81	0
2038	155	115	106	96	82	0
2039	162	117	109	98	84	0
2040	172	119	111	100	86	0
2041	180	122	114	103	89	0
2042	188	126	117	106	91	0
2043	197	129	120	108	93	0
2044	206	131	122	110	95	0
2045	214	134	124	112	97	0
2046	223	136	127	115	99	0
2047	231	139	129	117	101	0
2048	240	141	131	119	103	0
2049	247	144	135	122	106	0
2050	255	147	137	124	108	0
2051	265	149	139	126	109	0
2052	271	151	141	127	111	0
2053	279	153	143	130	113	0
2054	289	156	145	132	115	0
2055	299	159	149	135	117	0
2056	307	162	152	137	120	0
2057	314	166	155	141	123	622
2058	322	168	157	143	124	622
2059	331	171	160	145	126	622
2060	339	174	163	148	129	622
2061	349	178	166	151	132	622
2062	357	181	169	154	134	622
2063	364	184	172	156	136	622
2064	373	186	174	158	138	622
2065	382	189	177	161	141	622
2066	388	192	180	164	143	622
2067	395	194	182	166	145	622
2068	404	198	185	169	622	622
2069	409	200	187	171	622	622
2070	418	204	191	174	622	622
2071	426	207	194	622	622	622
2072	430	210	197	622	622	622
2073	437	213	200	622	622	622
2074	442	215	622	622	622	622
2075	446	218	622	622	622	622
2076	452	622	622	622	622	622
2002-2007	6	328	307	281	250	0
2002-2014	85	738	682	612	530	0
2002-2024	493	1,482	1,366	1,220	1,046	0
2002-2034	1,437	2,436	2,248	2,009	1,723	0
2002-2049	4,270	4,319	4,000	3,589	3,087	0
2002-2076	14,012	10,288	10,505	11,055	11,571	13,062

* While not treated as structured alternatives, these intermediate harvest levels are provided for comparison purposes.

TABLE 4.4-4. Present values of projected Canary Rockfish OYs under different rebuilding probabilities and the default "40-10" policy assuming a 5% annual discount rate and a constant 50¢ per pound average exvessel price for rockfish ($,000). (Note: Harvest levels assumed to revert to the estimated long-term level (622 mt) at the median rebuilding year under each rebuilding scenario.) (Page 1 of 1)

Year	"40-10"	Max. Harvest 50%	Council Interim 60%	70%*	80%*	Max. Conser-vation 100%	Year	"40-10"	Max. Harvest 50%	Council Interim 60%	70%*	80%*	Max. Conser-vation 100%
1998							2038	28	21	19	17	15	0
1999							2039	28	20	19	17	15	0
2000							2040	28	20	18	16	14	0
2001							2041	28	19	18	16	14	0
2002	0	98	98	98	98	0	2042	28	19	17	16	14	0
2003	0	48	43	38	32	0	2043	28	18	17	15	13	0
2004	0	46	42	37	31	0	2044	28	18	16	15	13	0
2005	1	45	41	36	30	0	2045	27	17	16	14	12	0
2006	2	44	40	35	30	0	2046	27	17	15	14	12	0
2007	3	44	40	35	30	0	2047	27	16	15	14	12	0
2008	4	43	40	35	29	0	2048	26	16	15	13	11	0
2009	5	43	39	34	29	0	2049	26	15	14	13	11	0
2010	6	42	38	34	29	0	2050	26	15	14	12	11	0
2011	7	41	38	33	28	0	2051	25	14	13	12	10	0
2012	9	40	37	33	28	0	2052	25	14	13	12	10	0
2013	10	39	36	32	27	0	2053	24	13	12	11	10	0
2014	12	39	35	31	27	0	2054	24	13	12	11	9	0
2015	13	38	35	31	26	0	2055	23	12	12	10	9	0
2016	14	37	34	30	25	0	2056	23	12	11	10	9	0
2017	16	36	33	30	25	0	2057	22	12	11	10	9	44
2018	17	35	32	29	24	0	2058	22	11	11	10	8	42
2019	18	34	32	28	24	0	2059	21	11	10	9	8	40
2020	19	34	31	28	23	0	2060	21	11	10	9	8	38
2021	20	33	30	27	23	0	2061	20	10	10	9	8	36
2022	21	32	30	26	22	0	2062	20	10	9	8	7	34
2023	22	31	29	26	22	0	2063	19	10	9	8	7	32
2024	22	31	28	25	21	0	2064	18	9	9	8	7	31
2025	23	30	27	24	21	0	2065	18	9	8	8	7	29
2026	24	29	27	24	20	0	2066	17	9	8	7	6	28
2027	25	28	26	23	20	0	2067	17	8	8	7	6	27
2028	25	28	26	23	20	0	2068	16	8	8	7	25	25
2029	26	27	25	22	19	0	2069	16	8	7	7	24	24
2030	26	26	24	22	19	0	2070	15	7	7	6	23	23
2031	27	25	24	21	18	0	2071	15	7	7	22	22	22
2032	27	25	23	21	18	0	2072	14	7	7	21	21	21
2033	28	24	22	20	17	0	2073	14	7	6	20	20	20
2034	28	23	22	20	17	0	2074	13	6	19	19	19	19
2035	28	23	21	19	16	0	2075	13	6	18	18	18	18
2036	28	22	21	19	16	0	2076	12	17	17	17	17	17
2037	28	21	20	18	15	0							
							2002-2007	5	325	305	280	251	0
							2002-2014	59	612	568	512	447	0
							2002-2024	240	954	882	791	684	0
							2002-2034	498	1,219	1,127	1,011	872	0
							2002-2049	912	1,501	1,389	1,247	1,076	0
							2002-2076	1,425	1,777	1,673	1,554	1,413	568

* While not treated as structured alternatives, these intermediate harvest levels are provided for comparison purposes.

TABLE 4.4-5. Projected total catch optimum yields (mt) for Pacific Ocean Perch under different rebuilding probabilities and the default "40-10" policy. Actual catches shown for 1998-2001 (mt). (Note: Harvest levels assumed to revert to the estimated long-term level (1,164 mt) at the median rebuilding year under each rebuilding scenario.) (Page 1 of 1)

		Max. Harvest		Council Interim		Max. Conservation
Year	"40-10"	50%	60%*	70%	80%*	100%
1998	*602*	*602*	*602*	*602*	*602*	*602*
1999	*544*	*544*	*544*	*544*	*544*	*544*
2000	*270*	*270*	*270*	*270*	*270*	*270*
2001	*303*	*303*	*303*	*303*	*303*	*303*
2002	773	464	410	353	290	0
2003	930	496	438	377	311	0
2004	1,045	518	458	396	327	0
2005	1,106	533	472	408	338	0
2006	1,128	542	481	416	345	0
2007	1,131	550	489	424	352	0
2008	1,131	557	496	430	358	0
2009	1,131	565	503	437	364	0
2010	1,129	572	509	443	369	0
2011	1,129	577	515	448	374	0
2012	1,120	582	520	453	379	1,164
2013	1,117	587	525	458	383	1,164
2014	1,112	592	530	463	387	1,164
2015	1,098	594	532	465	390	1,164
2016	1,081	596	534	467	392	1,164
2017	1,066	597	535	469	394	1,164
2018	1,056	597	536	470	395	1,164
2019	1,046	599	537	472	397	1,164
2020	1,035	599	539	473	398	1,164
2021	1,028	599	538	473	398	1,164
2022	1,018	599	539	474	1,164	1,164
2023	1,003	599	539	474	1,164	1,164
2024	992	599	539	475	1,164	1,164
2025	988	598	539	475	1,164	1,164
2026	980	599	540	475	1,164	1,164
2027	978	600	541	1,164	1,164	1,164
2028	977	602	543	1,164	1,164	1,164
2029	973	602	543	1,164	1,164	1,164
2030	966	602	543	1,164	1,164	1,164
2031	965	602	544	1,164	1,164	1,164
2032	964	601	543	1,164	1,164	1,164
2033	954	601	543	1,164	1,164	1,164
2034	952	603	1,164	1,164	1,164	1,164
2035	955	605	1,164	1,164	1,164	1,164
2036	953	605	1,164	1,164	1,164	1,164
2037	945	605	1,164	1,164	1,164	1,164
2038	945	606	1,164	1,164	1,164	1,164
2039	947	606	1,164	1,164	1,164	1,164
2040	948	605	1,164	1,164	1,164	1,164
2041	950	608	1,164	1,164	1,164	1,164
2042	946	1,164	1,164	1,164	1,164	1,164
2002-2007	6,113	3,104	2,747	2,373	1,964	0
2002-2014	13,984	7,136	6,345	5,505	4,578	3,492
2002-2024	24,407	13,113	11,714	10,216	10,834	15,132
2002-2034	34,105	19,121	17,757	20,479	22,474	26,772
2002-2042	41,694	24,525	27,069	29,791	31,786	36,084

* While not treated as structured alternatives, these intermediate harvest levels are provided for comparison purposes.

TABLE 4.4-6. Present values of projected Pacific Ocean Perch OYs under different rebuilding probabilities and the default "40-10" policy assuming a 5% annual discount rate and a constant 50¢ per lb average exvessel price for rockfish ($,000). (Note: Harvest levels assumed to revert to the estimated long-term level (1,164 mt) at the median rebuilding year under each rebuilding scenario.) (Page 1 of 1)

		Max. Har-vest		*Council Interim*		*Max. Conser-vation*			*Max. Har-vest*		*Council Interim*		*Max. Conser-vation*
Year	**"40-10"**	**50%**	**60%***	**70%**	**80%**	**100%**	**Year**	**"40-10"**	**50%**	**60%***	**70%**	**80%**	**100%**
1998							2021	438	255	229	201	170	496
1999							2022	412	243	218	192	472	472
2000							2023	387	231	208	183	449	449
2001							2024	364	219	198	174	427	427
2002	852	512	451	388	320	0	2025	344	209	188	166	406	406
2003	974	519	459	395	326	0	2026	325	199	179	158	386	386
2004	1,041	516	457	394	326	0	2027	309	189	171	367	367	367
2005	1,048	505	447	387	320	0	2028	293	181	163	349	349	349
2006	1,017	489	434	376	311	0	2029	278	172	155	332	332	332
2007	970	472	419	363	302	0	2030	262	163	148	316	316	316
2008	923	455	404	351	292	0	2031	249	155	140	301	301	301
2009	878	438	390	339	282	0	2032	237	148	134	286	286	286
2010	834	422	376	327	273	0	2033	223	140	127	272	272	272
2011	793	405	361	315	263	0	2034	212	134	259	259	259	259
2012	748	389	347	303	253	778	2035	202	128	246	246	246	246
2013	710	373	333	291	244	740	2036	192	122	234	234	234	234
2014	672	358	320	280	234	704	2037	181	116	223	223	223	223
2015	631	341	306	267	224	669	2038	172	110	212	212	212	212
2016	591	326	292	256	214	637	2039	164	105	202	202	202	202
2017	555	310	278	244	205	606	2040	156	100	192	192	192	192
2018	523	296	265	233	196	576	2041	149	95	182	182	182	182
2019	492	282	253	222	187	548	2042	141	173	173	173	173	173
2020	464	268	241	212	178	521							
							2002-2007	5,903	3,013	2,667	2,303	1,905	0
							2002-2014	11,461	5,853	5,200	4,508	3,745	2,221
							2002-2024	16,317	8,625	7,689	6,692	6,466	7,620
							2002-2034	19,050	10,315	9,352	9,498	9,741	10,895
							2002-2042	20,406	11,264	11,016	11,162	11,405	12,559

* While not treated as structured alternatives, these intermediate harvest levels are provided for comparison purposes.

TABLE 4.4-7. Projected total catch optimum yields for Lingcod under different rebuilding probabilities and the default "40-10" policy. Actual catches shown for 1998 through 2001 (mt). (Note: Harvest levels assumed to revert to the estimated long-term level (1,373 mt) at the median rebuilding year under each rebuilding scenario.)

Year	"40-10"	*Max. Harvest* 50%	*Council Interim* 60%	70%*	80%*	*Max. Conservation* 100%
1998	*720*	*720*	*720*	*720*	*720*	*720*
1999	*807*	*807*	*807*	*807*	*807*	*807*
2000	*508*	*508*	*508*	*508*	*508*	*508*
2001	*611*	*611*	*611*	*611*	*611*	*611*
2002	280	646	577	535	489	0
2003	434	725	651	606	555	0
2004	616	815	735	685	629	0
2005	805	901	817	761	701	0
2006	987	979	891	831	766	0
2007	1,155	1,055	963	899	830	1,373
2008	1,309	1,117	1,022	954	1,373	1,373
2009	1,373	1,373	1,373	1,373	1,373	1,373

* While not treated as structured alternatives, these intermediate harvest levels are provided for comparison purposes.

2002-2004	1,330	2,186	1,963	1,826	1,673	0
2002-2007	4,277	5,121	4,634	4,317	3,970	1,373
2002-2009	6,959	7,611	7,029	6,644	6,716	4,119

TABLE 4.4-8. Present values of projected Lingcod OYs under different rebuilding probabilities and the default "40-10" policy assuming a 5% annual discount rate and a constant 50¢ per lb average exvessel price for rockfish ($,000). (Note: Harvest levels assumed to revert to the estimated long-term level (1,373 mt) at the median rebuilding year under each rebuilding scenario.)

Year	"40-10"	*Max. Harvest* 50%	*Council Interim* 60%	70%*	80%*	*Max. Conservation* 100%
1998						
1999						
2000						
2001						
2002	308	711	635	589	539	0
2003	455	760	682	635	581	0
2004	614	812	732	683	627	0
2005	763	854	774	721	664	0
2006	890	883	803	749	691	0
2007	991	905	826	771	712	1,178
2008	1,068	911	834	778	1,120	1,120
2009	1,066	1,066	1,066	1,066	1,066	1,066

* While not treated as structured alternatives, these intermediate harvest levels are provided for comparison purposes.

2002-2004	1,377	2,283	2,050	1,907	1,747	0
2002-2007	4,021	4,925	4,454	4,148	3,814	1,178
2002-2009	6,154	6,902	6,353	5,992	6,000	3,363

TABLE 4.4-9. Catch and/or landed catch of darkblotched rockfish and exvessel revenue by trip target type (2002).[a/] (Page 1 of 1)

Primary Target for Trip	Trips with Primary Target	Percent of Primary Targe Trips with Darkblotched in Landing	Total Exvessel Revenue for All Species Landed	Darkblotched Landed (mt)	Darkblotched Landed or Estimated Catch (mt)	Cumulative Darkblotched (mt)	Total Exvessel Revenue for Area: Percent of Total	Total Exvessel Revenue for Area: Cumulative Percent	Exvessel Revenue/ Pounds (Landed & Bycatch)
North of Cape Mendocino									
Limited Entry Trawl, Canary	1	100.0%	83	0.000	0.000	0.002	0%	0%	83
Open Access, Shelf	381	0.3%	96,087	0.002	0.002	0.002	0%	0%	24,022
Open Access, Nearshore	4,229	0.0%	1,501,444	0.005	0.005	0.005	1%	1%	136,495
Other Groundfish (plurality, but <50%)	336	0.6%	791,167	0.010	0.010	0.010	1%	2%	37,675
Limited Entry Trawl, Whiting	632	0.5%	4,824,800	0.010	0.010	0.010	4%	6%	209,774
Open Access, Sablefish, Slope	216	0.9%	1,100,262	0.014	0.014	0.014	1%	6%	35,492
Open Access, Slope	2	50.0%	1,175	0.015	0.015	0.015	0%	6%	37
Limited Entry Trawl, Lingcod	8	12.5%	3,899	0.034	0.034	0.034	0%	6%	52
Limited Entry Fixed Gear Sablefish, Shelf	105	3.8%	905,116	0.044	0.044	0.044	1%	7%	9,428
Limited Entry Fixed Gear Sablefish, Slope	316	3.5%	2,068,272	0.143	0.143	0.143	2%	9%	6,545
Limited Entry Trawl, Midwater (Yellowtaill and Widow)	63	4.8%	601,804	0.149	0.177	0.177	0%	9%	1,543
Other Species	3,880	0.1%	7,786,606	0.205	0.205	0.205	6%	15%	17,189
Pink Shrimp	1,963	0.8%	15,093,298	0.590	0.590	0.590	12%	27%	11,601
Open Access Trawl, Other, >50% Groundfish	135	8.9%	510,025	1.485	1.485	1.485	0%	27%	156
Limited Entry Trawl, Slope Rockfish	19	26.3%	108,415	1.500	1.500	1.500	0%	27%	33
Limited Entry Trawl, Left Over	158	1.3%	491,678	0.129	2.509	2.509	0%	27%	89
Limited Entry Trawl, Arrowtooth	184	45.1%	2,345,701	5.100	4.915	4.915	2%	29%	216
Limited Entry Trawl, Petrale Sole	229	25.3%	1,570,707	9.880	18.324	18.324	1%	30%	39
Limited Entry Trawl, DTS	1,020	20.6%	7,477,358	31.913	29.709	29.709	6%	36%	114
Limited Entry Trawl, Flatfish	1,275	12.1%	4,975,044	15.364	82.652	82.652	4%	40%	27
Total All Northern Fisheries[b/]	43,556		131,046,019	66.591	142.343	142.343			
South of Cape Mendocino									
Open Access Trawl, Other, >50% Groundfish	29	3.4%	29,406	0.003	0.003	0.00	0%	0%	4,901
Open Access, Sablefish, Slope	281	0.4%	180,345	0.003	0.003	0.01	0%	0%	25,764
Open Access, Slope	269	0.4%	185,765	0.008	0.008	0.01	0%	0%	10,927
Open Access, Nearshore	3,838	0.1%	1,760,441	0.011	0.011	0.02	2%	2%	70,418
Limited Entry Trawl, Left Ove[c/]	3	0.0%	10,750	0.000	0.058	0.08	0%	2%	84
Open Access, Shelf	928	0.5%	250,132	0.059	0.059	0.14	0%	3%	1,909
Limited Entry Trawl, Chilipepper	54	3.7%	137,730	0.177	0.177	0.32	0%	3%	353
Limited Entry Trawl, Petrale Sole	53	1.9%	287,972	0.012	7.903	8.22	0%	3%	17
Limited Entry Trawl, Slope Rockfish	53	9.4%	250,821	8.172	8.172	16.39	0%	3%	14
Limited Entry Trawl, Flatfish	369	3.8%	1,025,588	0.309	12.232	28.63	1%	5%	38
Limited Entry Trawl, DTS	625	6.4%	4,279,277	3.356	26.460	55.09	5%	9%	73
Total All Southern Fisheries[b/]	61,427		88,511,363	12.110	55.087				729

a/ See text for important caveats.
b/ Includes primary strategies not listed in the table.
c/ Estimated bycatch only, not trips with retained bycatch.

TABLE 4.4-10. Catch and/or landed catch of Pacific ocean perch and exvessel revenue by trip target type north of Cape Mendocino (1998 and 2002).(Page 1 of 2)

Primary Target for Trip	Trips	Percent of Primary Target Trips with Pacific Ocean Perch in Landing	Total Exvessel Revenue for All Species Landed	Pacific Ocean Perch Landed (mt)	Pacific Ocean Perch Landed or Estimated Catch (mt)	Cumulative Pacific Ocean Perch (mt)	Total Exvessel Revenue for Area: Percent of Total	Total Exvessel Revenue for Area: Cumulative Percent	Exvessel Revenue/ Pounds (Landed & Bycatch)
North of Cape Mendocino									
1998									
Limited Entry Fixed Gear Sablefish, No Strata	600	0.2%	1,487,843	0.002	0.002	0.002	1%	1%	371,961
Pacific Halibut	214	1.9%	755,531	0.010	0.010	0.011	1%	2%	35,978
Other Species	1,428	0.1%	9,261,628	0.014	0.014	0.025	8%	10%	308,721
Open Access, Nearshore	2,201	0.3%	498,681	0.014	0.014	0.039	0%	11%	16,623
Open Access, Sablefish, Slope	109	2.8%	1,076,573	0.014	0.014	0.053	1%	12%	34,728
Open Access, Sablefish, Shelf	94	3.2%	198,436	0.014	0.014	0.067	0%	12%	6,401
HMS Plan Species	1,533	0.3%	15,868,173	0.030	0.030	0.097	14%	26%	236,838
Limited Entry Fixed Gear, Other Groundfish, Nearsh	215	8.4%	119,541	0.037	0.037	0.134	0%	26%	1,476
Salmon	4,027	0.9%	2,763,425	0.156	0.156	0.289	2%	29%	8,057
Limited Entry Fixed Gear Sablefish, Shelf	182	15.4%	710,550	0.271	0.271	0.560	1%	29%	1,190
Open Access, Slope	11	54.5%	1,768	0.307	0.307	0.867	0%	29%	3
Limited Entry Fixed Gear, Other Groundfish, Slope	7	57.1%	5,649	0.482	0.482	1.349	0%	29%	5
Other Groundfish (plurality but <50%)	179	12.3%	241,047	0.626	0.626	1.975	0%	30%	175
Limited Entry Trawl, Midwater (Yellowtaill and Wido	255	45.9%	1,461,986	50.083	0.852	2.827	1%	31%	778
Other Crustaceans	2,060	1.3%	1,421,789	0.951	0.951	3.778	1%	32%	678
Groundfish/Shrimp Combinations	11	18.2%	16,294	1.031	1.031	4.810	0%	32%	7
Limited Entry Fixed Gear Sablefish, Slope	436	9.9%	1,567,177	1.050	1.050	5.860	1%	34%	677
Open Access, Shelf	1,265	7.9%	556,667	2.015	2.015	7.875	0%	34%	125
Limited Entry Fixed Gear, Other Groundfish, Shelf	313	51.4%	295,262	2.948	2.948	10.823	0%	34%	45
Pink Shrimp	1,105	14.8%	4,960,814	5.833	5.833	16.655	4%	39%	386
Limited Entry Trawl, Canary	35	51.4%	159,373	6.909	6.909	23.565	0%	39%	10
Limited Entry Trawl, Left Over	106	18.9%	330,150	13.908	7.071	30.636	0%	39%	21
Open Access Trawl, Other, >50% Groundfish	43	32.6%	172,602	8.932	8.932	39.567	0%	39%	9
Limited Entry Trawl, Petrale Sole	115	49.6%	630,545	15.882	10.093	49.660	1%	40%	28
Limited Entry Trawl, Yellowtail	93	55.9%	399,104	18.522	18.522	68.183	0%	40%	10
Limited Entry Trawl, Whiting	1,326	25.3%	5,399,567	33.367	33.367	101.549	5%	45%	73
Limited Entry Trawl, Pacific Ocean Perch	14	100.0%	67,290	50.950	50.950	152.500	0%	45%	1
Limited Entry Trawl, Flatfish	957	36.1%	4,000,469	124.164	72.589	225.089	4%	49%	25
Limited Entry Trawl, DTS	1,627	43.0%	10,067,097	241.894	76.556	301.645	9%	58%	60
Limited Entry Trawl, Widow	144	70.1%	1,583,364	77.259	77.259	378.904	1%	59%	9
Limited Entry Trawl, Other Rockfish	165	62.4%	1,393,426	110.025	110.025	488.929	1%	61%	6
Limited Entry Trawl, Arrowtooth	257	88.7%	3,574,020	219.747	190.743	679.672	3%	64%	8
Limited Entry Trawl, Slope Rockfish	212	64.2%	1,325,816	252.107	252.107	931.779	1%	65%	2
Total All Northern Fisheriesb/	37,630		111,519,070	1,240	931.779				54

TABLE 4.4-10. Catch and/or landed catch of Pacific ocean perch and exvessel revenue by trip target type north of Cape Mendocino (1998 and 2002).a/ (Page 2 of 2)

Primary Target for Trip	Trips	Percent of Primary Target Trips with Pacific Ocean Perch in Landing	Total Exvessel Revenue for All Species Landed	Pacific Ocean Perch Landed (mt)	Pacific Ocean Perch Landed or Estimated Catch (mt)	Cumulative Pacific Ocean Perch (mt)	Total Exvessel Revenue for Area: Percent of Total	Total Exvessel Revenue for Area: Cumulative Percent	Exvessel Revenue, Pounds (Landed & Bycatch)
2002									
Limited Entry Trawl, Yellowtail	10	10.0%	9,255	0.001	0.001	0.001	0%	0%	4,628
Limited Entry Trawl, Canary	1	100.0%	83	0.004	0.004	0.005	0%	0%	9
Pacific Halibut	379	0.3%	1,564,532	0.006	0.006	0.011	1%	1%	120,349
Open Access, Nearshore	4,229	0.0%	1,501,444	0.012	0.012	0.023	1%	2%	57,748
Other Species	3,880	0.1%	7,786,606	0.019	0.019	0.041	6%	8%	189,917
Limited Entry Fixed Gear Sablefish, Shelf	105	2.9%	905,116	0.021	0.021	0.063	1%	9%	19,258
Pink Shrimp	1,963	0.2%	15,093,298	0.032	0.032	0.095	12%	20%	212,582
Limited Entry Fixed Gear Sablefish, Slope	316	2.2%	2,068,272	0.186	0.186	0.280	2%	22%	5,057
Open Access Trawl, Other, >50% Groundfish	135	2.2%	510,025	0.214	0.214	0.494	0%	22%	1,081
Limited Entry Trawl, Whiting	632	1.7%	4,824,800	0.221	0.221	0.715	4%	26%	9,907
Limited Entry Trawl, Slope Rockfish	19	42.1%	108,415	3.365	3.365	4.081	0%	26%	15
Limited Entry Trawl, Leftover	158	2.5%	491,678	0.518	3.802	7.883	0%	27%	59
Limited Entry Trawl, Petrale Sole	229	17.0%	1,570,707	8.077	14.435	22.318	1%	28%	49
Limited Entry Trawl, DTS	1,020	18.9%	7,477,358	60.566	37.779	60.097	6%	34%	90
Limited Entry Trawl, Arrowtooth	184	69.6%	2,345,701	43.282	39.727	99.824	2%	35%	27
Limited Entry Trawl, Flatfish	1,275	11.4%	4,975,044	29.703	81.958	181.783	4%	39%	28
Total All Northern Fisheries b/	43,556		131,046,019	146	181.783				327

a/ See text for important caveats.
b/ Includes primary strategies not listed in the tab

TABLE 4.4-11. Catch and/or landed catch of canary rockfish and exvessel revenue by trip target type (1998 and 2002)a/. (Page 1 of 4)

Primary Target for Trip	Trips	Percent of Primary Target Trips with Canary Rockfish in Landing	Total Exvessel Revenue for All Species Landed	Canary Rockfish Landed (MT)	Canary Rockfish Landed or Estimated Catch (MT)	Cumulative Canary Rockfish (MT)	Total Exvessel Revenue for Area: Percent of Total	Total Exvessel Revenue for Area: Cumulative Percent	Exvessel Revenue/Pounds (Landed & Bycatch)
North of Cape Mendocino									
1998									
Open Access, Sablefish, Nearshore	7	14.3%	2,092	0.001	0.001	0.001	0%	0%	1,046
Dungeness Crab	15,336	0.0%	38,526,779	0.002	0.002	0.003	35%	33%	9,192,759
California Halibut	3	33.3%	20,195	0.002	0.002	0.005	0%	33%	10,674
Open Access, Sablefish, Slope	109	1.8%	1,076,573	0.004	0.004	0.008	1%	34%	134,572
Limited Entry Fixed Gear Sablefish, No Strata	600	0.2%	1,487,843	0.009	0.009	0.017	1%	36%	112,084
Limited Entry Trawl, Lingcod	2	50.0%	302	0.009	0.009	0.026	0%	36%	15
Limited Entry Fixed Gear Sablefish, Nearshore	6	50.0%	2,884	0.011	0.011	0.037	0%	36%	115
Open Access, Slope	11	27.3%	1,768	0.024	0.024	0.062	0%	51%	583,843
HMS Plan Species	1,533	0.2%	15,868,173	0.037	0.037	0.099	14%	51%	33
Limited Entry Fixed Gear Sablefish, Slope	436	1.4%	1,567,177	0.057	0.057	0.156	1%	52%	14,749
No landing wt or two species groups of equal wt	186	0.5%	43,916	0.076	0.076	0.232	0%	53%	3,335
Limited Entry Fixed Gear, Other Groundfish, Slope	7	42.9%	5,649	0.109	0.109	0.342	0%	53%	25
Pacific Halibut	214	6.5%	755,531	0.293	0.293	0.635	1%	53%	17
Groundfish/Shrimp Combinations	11	54.5%	16,294	0.432	0.432	1.067	0%	53%	325
Limited Entry Trawl, Leftover	106	39.6%	330,150	11.318	0.460	1.527	0%	53%	127
Open Access, Sablefish, Shelf	94	33.0%	198,436	0.711	0.711	2.238	0%	54%	337
Limited Entry Trawl, Petrale Sole	115	28.7%	630,545	1.872	0.848	3.087	1%	59%	2,792
Limited Entry Trawl, Whiting	1,326	12.4%	5,399,567	0.877	0.877	3.964	5%	60%	686
Other Crustaceans	2,060	1.0%	1,421,789	0.957	0.957	4.921	1%	60%	25
Limited Entry Trawl, POP	14	57.1%	67,290	1.201	1.201	6.121	0%	61%	201
Limited Entry Fixed Gear Sablefish, Shelf	182	26.4%	710,550	1.636	1.636	7.757	1%	69%	2,167
Other Species	1,428	3.3%	9,261,628	1.952	1.952	9.709	8%	72%	585
Salmon	4,027	8.9%	2,763,425	2.168	2.168	11.876	2%	72%	21
Limited Entry Fixed Gear, Other Groundfish, Nearsh	215	72.1%	119,541	2.819	2.819	14.696	0%	72%	72
Open Access, Nearshore	2,201	20.9%	498,681	3.073	3.073	17.769	0%	76%	234
Limited Entry Trawl, Flatfish	957	47.1%	4,000,469	67.099	7.977	25.745	4%	76%	10
Open Access Trawl, Other, >50% Groundfish	43	37.2%	172,602	8.000	8.000	33.745	0%	80%	215
Pink Shrimp	1,105	40.2%	4,960,814	10.473	10.473	44.219	4%	82%	56
Limited Entry Trawl, Midwater (Yellowtaill and Wido	255	65.1%	1,461,986	75.006	11.918	56.137	1%	91%	280
Limited Entry Trawl, DTS	1,627	38.0%	10,067,097	101.033	16.348	72.485	9%		
Other Groundfish (plurality, but <50%)	179	52.5%	241,047	23.947	23.947	96.432	0%	91%	6
Limited Entry Trawl, Slope Rockfish	212	70.8%	1,325,816	33.540	33.540	129.972	1%	92%	18
Limited Entry Trawl, Yellowtail	93	82.8%	399,104	36.209	36.209	166.181	0%	93%	5
Limited Entry Trawl, Canary	35	100.0%	159,373	61.553	61.553	227.734	0%	93%	1
Limited Entry Fixed Gear, Other Groundfish, Shelf	313	93.6%	295,262	69.138	69.138	296.872	0%	93%	2
Limited Entry Trawl, Widow	144	83.3%	1,583,364	90.985	90.985	387.857	1%	94%	8
Open Access, Shelf	1,265	71.1%	556,667	121.210	121.210	509.067	0%	95%	2
Limited Entry Trawl, Other Rockfish	165	80.6%	1,393,426	122.242	122.242	631.309	1%	96%	5
Limited Entry Trawl, Arrowtooth	257	87.9%	3,574,020	216.881	202.560	833.868	3%	99%	8
Total all Northern Fisheriesb/	37,630		111,519,070	1,066.966	833.868				61

TABLE 4.4-11. Catch and/or landed catch of canary rockfish and exvessel revenue by trip target type (1998 and 2002)a/ (Page 2 of 4)

Primary Target for Trip	Trips	Percent of Primary Target Trips with Canary Rockfish in Landing	Total Exvessel Revenue for All Species Landed	Canary Rockfish Landed (MT)	Canary Rockfish Landed or Estimated Catch (MT)	Cumulative Canary Rockfish (MT)	Total Exvessel Revenue for Area: Percent of Total	Total Exvessel Revenue for Area: Cumulative Percent	Exvessel Revenue/Pounds (Landed & Bycatch)
South of Cape Mendocino									
1998									
Limited Entry Fixed Gear Sablefish, Slope	690	0.1%	669,160	0.003	0.003	0.00	1%	1%	95,594
Limited Entry Trawl, Leftover	12	16.7%	38,218	0.015	0.003	0.01	0%	1%	5,460
CPS Plan Species	2,768	0.1%	6,693,748	0.007	0.007	0.01	8%	8%	446,250
Open Access, Sablefish, Shelf	22	4.5%	10,482	0.010	0.010	0.02	0%	8%	499
California Halibut	3,194	0.1%	1,829,470	0.011	0.011	0.03	2%	11%	76,228
Dungeness Crab	3,786	0.0%	7,722,346	0.013	0.013	0.05	9%	19%	275,798
Groundfish/Shrimp Combinations	1	100.0%	332	0.015	0.015	0.06	0%	19%	10
Limited Entry Fixed Gear, Other Groundfish, Slope	830	0.1%	648,550	0.020	0.020	0.08	1%	20%	14,412
No landing wt or two species groups of equal wt	605	0.2%	235,323	0.025	0.025	0.11	0%	20%	4,279
Salmon	7,526	0.1%	3,004,940	0.029	0.029	0.13	3%	24%	47,697
Prawns	3,132	0.0%	6,235,599	0.045	0.045	0.18	7%	31%	62,356
Limited Entry Trawl, Petrale Sole	41	17.1%	115,007	0.233	0.051	0.23	0%	31%	1,018
Other Species	3,114	0.1%	3,211,706	0.091	0.091	0.32	4%	35%	15,979
Pink Shrimp	70	5.7%	323,932	0.093	0.093	0.42	0%	35%	1,580
Limited Entry Trawl, DTS	548	13.3%	3,415,746	6.431	0.104	0.52	4%	39%	14,916
Other Groundfish (plurality, but <50%)	333	0.9%	243,485	0.199	0.199	0.72	0%	39%	555
Limited Entry Fixed Gear Sablefish, Shelf	27	11.1%	23,517	0.244	0.244	0.96	0%	39%	44
Open Access, Slope	166	7.2%	86,129	0.254	0.254	1.22	0%	39%	154
Limited Entry Trawl, Flatfish	386	12.2%	1,151,322	1.449	0.538	1.76	1%	41%	970
Limited Entry Trawl, Midwater (Yellowtaill and Wido	16	31.3%	87,598	0.845	0.845	2.60	0%	41%	47
Limited Entry Trawl, Chilipepper	111	13.5%	747,542	1.391	1.391	3.99	1%	41%	244
Limited Entry Fixed Gear, Other Groundfish, Nearsh	169	20.1%	160,641	1.466	1.466	5.46	0%	42%	50
Limited Entry Trawl, Yellowtail	3	33.3%	11,596	3.455	3.455	8.91	0%	42%	2
Limited Entry Trawl, Slope Rockfish	316	8.2%	1,791,897	3.581	3.581	12.49	2%	44%	227
Open Access, Nearshore	6,201	3.0%	2,559,930	4.184	4.184	16.68	3%	47%	277
Limited Entry Fixed Gear, Other Groundfish, Shelf	312	16.7%	352,549	7.014	7.014	23.69	0%	47%	23
Limited Entry Trawl, Canary	5	100.0%	28,778	9.815	9.815	33.51	0%	47%	1
Limited Entry Trawl, Widow	29	51.7%	265,582	10.048	10.048	43.56	0%	47%	12
Limited Entry Trawl, Other Rockfish	141	33.3%	854,102	18.434	18.434	61.99	1%	48%	21
Open Access, Shelf	2,441	10.0%	1,655,175	26.233	26.233	88.22	2%	50%	29
Total all Southern Fisheriesb/	63,298		88,009,673	95.654	88.222				452

TABLE 4.4-11. Catch and/or landed catch of canary rockfish and exvessel revenue by trip target type (1998 and 2002)[a]. (Page 3 of 4)

Primary Target for Trip	Trips	Percent of Primary Target Trips with Canary Rockfish in Landing	Total Exvessel Revenue for All Species Landed	Canary Rockfish Landed (MT)	Canary Rockfish Landed or Estimated Catch (MT)	Cumulative Canary Rockfish (MT)	Total Exvessel Revenue for Area: Percent of Total	Total Exvessel Revenue for Area: Cumulative Percent	Exvessel Revenue/Pounds (Landed & Bycatch)
North of Cape Mendocino									
2002									
Limited Entry Fixed Gear Sablefish, Slope	316	0.3%	2,068,272	0.001	0.001	0.001	2%	2%	689,424
Other Groundfish (plurality but <50%)	336	1.2%	791,167	0.010	0.010	0.012	1%	2%	34,399
Open Access, Sablefish, Slope	216	0.5%	1,100,262	0.021	0.021	0.033	1%	3%	23,410
Open Access, Nearshore	4,229	0.2%	1,501,444	0.031	0.031	0.064	1%	4%	21,760
Limited Entry Trawl, Canary	1	100.0%	83	0.061	0.061	0.126	0%	4%	1
Pacific Halibut	379	1.3%	1,564,532	0.102	0.102	0.227	1%	5%	6,985
Open Access, Sablefish, Shelf	128	3.9%	311,694	0.166	0.166	0.393	0%	6%	854
Other Species	3,880	0.3%	7,786,606	0.211	0.211	0.604	6%	12%	16,709
Limited Entry Trawl, Slope Rockfish	19	21.1%	108,415	0.239	0.239	0.843	0%	12%	206
Limited Entry Trawl, Other Rockfish	1	100.0%	2,233	0.251	0.251	1.094	0%	12%	4
Limited Entry Trawl, Leftover	158	20.9%	491,678	0.844	0.257	1.351	0%	12%	867
Open Access, Shelf	381	1.3%	96,087	0.262	0.262	1.613	0%	12%	167
Limited Entry Fixed Gear Sablefish, Shelf	105	4.8%	905,116	0.272	0.272	1.885	1%	13%	1,509
Limited Entry Trawl, Yellowtail	10	50.0%	9,255	0.286	0.286	2.171	0%	13%	15
Limited Entry Trawl, Whiting	632	14.2%	4,824,800	0.433	0.433	2.604	4%	16%	5,052
Salmon	8,390	0.2%	7,139,761	0.445	0.445	3.049	5%	22%	7,278
Limited Entry Trawl, DTS	1,020	12.3%	7,477,358	5.174	0.908	3.957	6%	28%	3,737
Pink Shrimp	1,963	4.8%	15,093,298	1.214	1.214	5.171	12%	39%	5,638
Limited Entry Fixed Gear, Other Groundfish, Shelf	52	1.9%	225,343	1.333	1.333	6.504	0%	39%	77
Limited Entry Trawl, Petrale Sole	229	21.8%	1,570,707	2.224	1.399	7.903	1%	40%	509
Open Access Trawl, Other, >50% Groundfish	135	32.6%	510,025	2.316	2.316	10.219	0%	41%	100
Limited Entry Trawl, Midwater (Yellowtaill and Wido	63	36.5%	601,804	1.128	2.649	12.868	0%	41%	103
Limited Entry Trawl, Arrowtooth	184	57.1%	2,345,701	12.271	12.224	25.092	2%	43%	87
Limited Entry Trawl, Flatfish	1,275	34.7%	4,975,044	15.696	14.353	39.446	4%	47%	157
Total All Northern Fisheries[b]	43,556		131,046,019	44.991	39.446				1,507

TABLE 4.4-11. Catch and/or landed catch of canary rockfish and exvessel revenue by trip target type (1998 and 2002)[a] (Page 4 of 4)

Primary Target for Trip	Trips	Percent of Primary Target Trips with Canary Rockfish in Landing	Total Exvessel Revenue for All Species Landed	Canary Rockfish Landed (MT)	Canary Rockfish Landed or Estimated Catch (MT)	Cumulative Canary Rockfish (MT)	Total Exvessel Revenue for Area: Percent of Total	Total Exvessel Revenue for Area: Cumulative Percent	Exvessel Revenue/Pounds (Landed & Bycatch)
South of Cape Mendocino									
2002									
Other Groundfish (plurality, but <50%)	180	0.6%	170,145	0.002	0.002	0.002	0%	0%	34,029
Limited Entry Trawl, Other Rockfish	28	3.6%	193,986	0.003	0.003	0.005	0%	0%	32,331
Limited Entry Trawl, Widow	1	100.0%	3,728	0.009	0.009	0.014	0%	0%	196
Open Access, Shelf	928	0.3%	250,132	0.010	0.010	0.024	0%	1%	10,875
Prawns	2,083	0.1%	3,990,047	0.028	0.028	0.052	5%	5%	65,411
Limited Entry Trawl, Slope Rockfish	53	1.9%	250,821	0.036	0.036	0.088	0%	5%	3,175
Open Access, Nearshore	3,838	0.2%	1,760,441	0.046	0.046	0.133	2%	7%	17,430
Limited Entry Trawl, DTS	625	7.7%	4,279,277	1.492	0.186	0.320	5%	12%	10,412
Limited Entry Trawl, Flatfish	369	6.2%	1,025,588	0.748	0.415	0.735	1%	13%	1,121
Limited Entry Trawl, Chilipepper	54	25.9%	137,730	0.698	0.698	1.433	0%	14%	89
Total All Southern Fisheries[b]	61,427		88,511,363	3.147	1.433				28,019

a/ See text for important caveats.

b/ Includes primary strategies not listed in the tat

TABLE 4.4-12. Catch and/or landed catch of lingcod and exvessel revenue by trip target type (1998 and 2002). a/ (Page 1 of 4)

Primary Target for Trip	Trips	Percent of Primary Target Trips with Lingcod in Landing	Total Exvessel Revenue for All Species Landed	Lingcod Landed (MT)	Lingcod Landed or Estimated Catch (MT)	Cumulative Lingcod (MT)	Total Exvessel Revenue for Area: Percent of Total	Total Exvessel Revenue for Area: Cumulative Percent	Exvessel Revenue/Pounds (Landed & Bycatch)
North of Cape Mendocino									
1998									
HMS Plan Species	1,533	0.1%	15,868,173	0.002	0.002	0.00	14.2%	14%	3,173,635
California Halibut	3	66.7%	20,195	0.015	0.015	0.02	0.0%	14%	631
Open Access, Sablefish, Slope	109	1.8%	1,076,573	0.020	0.020	0.04	1.0%	15%	24,468
Limited Entry Fixed Gear, Other Groundfish, Slope	7	28.6%	5,649	0.031	0.031	0.07	0.0%	15%	83
No landing wt or two species groups of equal wt	186	2.7%	43,916	0.070	0.070	0.14	0.0%	15%	283
Limited Entry Fixed Gear Sablefish, Nearshore	6	66.7%	2,884	0.070	0.070	0.21	0.0%	15%	19
Limited Entry Fixed Gear Sablefish, Slope	436	0.9%	1,567,177	0.102	0.102	0.31	1.4%	17%	6,965
Open Access, Slope	11	36.4%	1,768	0.105	0.105	0.42	0.0%	17%	8
Dungeness Crab	15,336	0.2%	38,526,779	0.122	0.122	0.54	34.5%	51%	143,757
Limited Entry Trawl, Lingcod	2	100.0%	302	0.166	0.166	0.70	0.0%	51%	1
Limited Entry Trawl, Whiting	1,326	1.1%	5,399,567	0.262	0.262	0.96	4.8%	56%	9,358
Groundfish/Shrimp Combinations	11	36.4%	16,294	0.338	0.338	1.30	0.0%	56%	22
Limited Entry Trawl, Lingcod	14	57.1%	67,290	0.465	0.465	1.77	0.1%	56%	66
Open Access, Sablefish, Shelf	182	13.2%	710,550	0.477	0.477	2.25	0.6%	57%	675
Limited Entry Fixed Gear Sablefish, Shelf	94	17.0%	198,436	0.498	0.498	2.74	0.2%	57%	181
Open Access Trawl, Other, >50% Groundfish	43	48.8%	172,602	1.228	1.228	3.97	0.2%	57%	64
Other Crustaceans	2,060	1.5%	1,421,789	1.304	1.304	5.28	1.3%	58%	495
Pacific Halibut	214	13.6%	755,531	1.428	1.428	6.70	0.7%	59%	240
Limited Entry Trawl, Leftover	106	42.5%	330,150	3.190	1.992	8.70	0.3%	59%	75
Limited Entry Trawl, Petrale Sole	115	66.1%	630,545	3.441	1.997	10.69	0.6%	60%	143
Other Groundfish (plurality, but <50%)	179	31.3%	241,047	2.270	2.270	12.96	0.2%	60%	48
Limited Entry Trawl, Canary	35	65.7%	159,373	2.686	2.686	15.65	0.1%	60%	27
Salmon	4,027	6.9%	2,763,425	3.106	3.106	18.75	2.5%	63%	404
Other Species	1,428	7.6%	9,261,628	3.163	3.163	21.92	8.3%	71%	1,328
Limited Entry Trawl, Midwater (Yellowtaill and Widc	255	55.7%	1,461,986	10.471	3.954	25.87	1.3%	72%	168
Limited Entry Fixed Gear, Other Groundfish, Nears	215	63.7%	119,541	5.256	5.256	31.13	0.1%	72%	10
Limited Entry Trawl, Yellowtail	93	81.7%	399,104	5.772	5.772	36.90	0.4%	73%	31
Pink Shrimp	1,105	32.5%	4,960,814	6.453	6.453	43.35	4.4%	77%	349
Limited Entry Trawl, Widow	144	68.1%	1,583,364	9.363	9.363	52.72	1.4%	79%	77
Limited Entry Fixed Gear, Other Groundfish, Shelf	313	67.7%	295,262	10.009	10.009	62.73	0.3%	79%	13
Limited Entry Trawl, Slope Rockfish	212	70.8%	1,325,816	11.228	11.228	73.95	1.2%	80%	54
Limited Entry Trawl, Other Rockfish	165	73.3%	1,393,426	12.812	12.812	86.77	1.2%	81%	49
Open Access, Nearshore	2,201	35.6%	498,081	14.219	14.219	100.99	0.4%	82%	16
Limited Entry Trawl, Arrowtooth	257	71.2%	3,574,020	23.250	20.204	121.19	3.2%	85%	80
Open Access, Shelf	1,265	52.3%	556,667	27.804	27.804	148.99	0.5%	86%	9
Limited Entry Trawl, DTS	1,627	52.3%	10,067,097	56.988	39.208	188.20	9.0%	95%	116
Limited Entry Trawl, Flatfish	957	63.8%	4,000,469	34.336	40.402	228.60	3.6%	98%	45
Total All Northern Fisheriesb/	37,630		111,519,070	252.523	228.604				221

TABLE 4.4-12. Catch and/or landed catch of lingcod and exvessel revenue by trip target type (1998 and 2002). [a/] (Page 2 of 4)

Primary Target for Trip	Trips	Percent of Primary Target Trips with Lingcod in Landing	Total Exvessel Revenue for All Species Landed	Lingcod Landed (MT)	Lingcod Landed or Estimated Catch (MT)	Cumulative Lingcod (MT)	Total Exvessel Revenue for Area: Percent of Total	Total Exvessel Revenue for Area: Cumulative Percent	Exvessel Revenue/Pounds (Landed & Bycatch)
South of Cape Mendocino									
1998									
CPS Plan Species	2,768	0.0%	6,693,748	0.002	0.002	0.00	7.6%	8%	1,338,750
Groundfish/Shrimp Combinations	1	100.0%	332	0.004	0.004	0.01	0.0%	8%	37
HMS Plan Species	2,783	0.0%	24,316,147	0.005	0.005	0.01	27.6%	35%	2,026,346
Sea Urchins	7,981	0.0%	7,897,996	0.005	0.005	0.02	9.0%	44%	658,166
Limited Entry Fixed Gear Sablefish, Nearshore	8	25.0%	3,037	0.005	0.005	0.02	0.0%	44%	253
Pink Shrimp	70	4.3%	323,932	0.017	0.017	0.04	0.4%	45%	8,525
Open Access Trawl, Halibut, >50% Groundfish	284	1.8%	95,758	0.029	0.029	0.07	0.1%	45%	1,520
Open Access, Sablefish, Shelf	22	9.1%	10,482	0.034	0.034	0.10	0.0%	45%	140
Limited Entry Trawl, Lingcod	1	100.0%	461	0.034	0.034	0.14	0.0%	45%	6
Pacific Halibut	3	33.3%	4,248	0.036	0.036	0.17	0.0%	45%	54
Other Crustaceans	9,856	0.1%	7,214,809	0.037	0.037	0.21	8.2%	53%	87,985
Limited Entry Fixed Gear Sablefish, Slope	690	0.7%	669,160	0.107	0.107	0.32	0.8%	54%	2,847
No landing wt or two species groups of equal wt	605	1.8%	235,323	0.136	0.136	0.45	0.3%	54%	787
LE Fxd Gr, Oth GF, Slope	830	0.5%	648,550	0.144	0.144	0.60	0.7%	55%	2,039
Limited Entry Trawl, Leftover	12	58.3%	38,218	0.269	0.156	0.75	0.0%	55%	111
Open Access Trawl, Other, >50% Groundfish	129	7.8%	28,139	0.185	0.185	0.94	0.0%	55%	69
Dungeness Crab	3,786	0.3%	7,722,346	0.209	0.209	1.15	8.8%	64%	16,751
Limited Entry Trawl, Yellowtail	3	100.0%	11,596	0.220	0.220	1.37	0.0%	64%	24
Other Species	3,114	1.3%	3,211,706	0.234	0.234	1.60	3.6%	67%	6,224
Salmon	7,526	0.5%	3,004,940	0.256	0.256	1.86	3.4%	71%	5,328
California Sheephead	860	1.6%	695,882	0.305	0.305	2.16	0.8%	71%	1,034
Limited Entry Fixed Gear Sablefish, Shelf	27	48.1%	23,517	0.320	0.320	2.48	0.0%	71%	33
Open Access Trawl, Prawn, >50% Groundfish	38	28.9%	85,181	0.330	0.330	2.81	0.1%	72%	117
Gillnet Complex	2,272	2.9%	1,167,329	0.436	0.436	3.25	1.3%	73%	1,215
Limited Entry Trawl, Canary	5	80.0%	28,778	0.439	0.439	3.69	0.0%	73%	30
Limited Entry Trawl, Petrale Sole	41	34.1%	115,007	0.298	0.506	4.19	0.1%	73%	103
Open Access, Slope	166	15.7%	86,129	0.517	0.517	4.71	0.1%	73%	76
Prawns	3,132	1.4%	6,235,599	0.679	0.679	5.39	7.1%	80%	4,165
Limited Entry Trawl, Midwater (Yellowtaill and Widov	16	68.8%	87,598	0.764	0.764	6.15	0.1%	80%	52
Other Groundfish (plurality, but <50%)	333	17.7%	243,485	1.047	1.047	7.20	0.3%	81%	105
Limited Entry Trawl, DTS	548	35.0%	3,415,746	10.428	1.190	8.39	3.9%	84%	1,302
Limited Entry Fixed Gear, Other Groundfish, Nearsh	169	51.5%	160,641	1.466	1.466	9.85	0.2%	85%	50
California Halibut	3,194	5.0%	1,829,470	1.633	1.633	11.49	2.1%	87%	508
Limited Entry Trawl, Widow	29	72.4%	265,582	1.649	1.649	13.14	0.3%	87%	73
Limited Entry Trawl, Chilipepper	111	53.2%	747,542	4.334	4.334	17.47	0.8%	88%	78
Limited Entry Trawl, Flatfish	386	40.9%	1,151,322	6.259	4.366	21.84	1.3%	89%	120
Limited Entry Trawl, Other Rockfish	141	63.1%	854,102	5.962	5.962	27.80	1.0%	90%	65
Limited Entry Trawl, Slope Rockfish	316	42.4%	1,791,897	6.002	6.002	33.80	2.0%	92%	135
Limited Entry Fixed Gear, Other Groundfish, Shelf	312	46.8%	352,549	6.452	6.452	40.25	0.4%	93%	25
Open Access, Nearshore	6,201	23.6%	2,559,930	21.503	21.503	61.75	2.9%	95%	54
Open Access, Shelf	2,441	24.4%	1,655,175	24.763	24.763	86.52	1.9%	97%	30
Total All Southern Fisheriesb/	63,298		88,009,673	97.556	86.518				461

TABLE 4.4-12. Catch and/or landed catch of lingcod and exvessel revenue by trip target type (1998 and 2002)[a/] (Page 3 of 4)

Primary Target for Trip	Trips	Percent of Primary Target Trips with Lingcod in Landing	Total Exvessel Revenue for All Species Landed	Lingcod Landed (MT)	Lingcod Landed or Estimated Catch (MT)	Cumulative Lingcod (MT)	Total Exvessel Revenue for Area: Percent of Total	Total Exvessel Revenue for Area: Cumulative Percent	Exvessel Revenue/Pounds (Landed & Bycatch)
North of Cape Mendocino									
2002									
North of Cape Mendocino									
California Halibut	115	0.9%	18,893	0.003	0.003	0.00	0.0%	0%	2,699
Dungenes Crab	13,725	0.0%	48,706,889	0.018	0.018	0.02	37.2%	37%	1,217,672
OA, SF, Nearshore	7	14.3%	8,507	0.101	0.101	0.12	0.0%	37%	38
OA, SF, Slope	216	6.9%	1,100,262	0.127	0.127	0.25	0.8%	38%	3,916
No landing wt or two species groups of equal wt	8	62.5%	2,671	0.129	0.129	0.38	0.0%	38%	9
Limited Entry Trawl, Yellowtail	10	60.0%	9,255	0.149	0.149	0.53	0.0%	38%	28
Limited Entry Trawl, Whiting	632	10.1%	4,824,800	0.216	0.216	0.74	3.7%	42%	10,136
Limited Entry Trawl, Midwater (Yellowtaill and Widov	63	7.9%	601,804	0.042	0.216	0.96	0.5%	42%	1,264
Limited Entry Trawl, Slope Rockfish	19	31.6%	108,415	0.359	0.359	1.32	0.1%	42%	137
Limited Entry Fixed Gear, Other Groundfish, Slope	21	19.0%	35,190	0.408	0.408	1.73	0.0%	42%	39
Limited Entry Trawl, Other Rockfish	1	100.0%	2,233	0.435	0.435	2.16	0.0%	42%	2
Limited Entry Fixed Gear, Other Groundfish, Shelf	52	36.5%	225,343	0.890	0.890	3.05	0.2%	42%	115
Limited Entry Fixed Gear Sablefish, Slope	316	13.9%	2,068,272	0.953	0.953	4.00	1.6%	44%	984
Limited Entry Trawl, Lingcod	8	100.0%	3,899	1.016	1.016	5.02	0.0%	44%	2
Other Species	3,880	0.6%	7,786,606	1.153	1.153	6.17	5.9%	50%	3,064
Limited Entry Trawl, Leftover	158	48.1%	491,678	3.113	1.310	7.48	0.4%	50%	170
Open Access, Sablefish, Shelf	128	27.3%	311,694	1.650	1.650	9.13	0.2%	51%	86
Other Groundfish (plurality, but <50%)	336	28.0%	791,167	2.411	2.411	11.54	0.6%	51%	149
Limited Entry Fixed Gear Sablefish, Shelf	105	58.1%	905,116	2.898	2.898	14.44	0.7%	52%	142
Limited Entry Fixed Gear, Other Groundfish, Nearsh	185	53.0%	174,051	2.907	2.907	17.35	0.1%	52%	27
Pacific Halibut	379	19.3%	1,564,532	3.870	3.870	21.22	1.2%	53%	183
Salmon	8,390	3.2%	7,139,761	3.892	3.892	25.11	5.4%	59%	832
Open Access Trawl, Other, >50% Groundfish	135	50.4%	510,025	4.903	4.903	30.02	0.4%	59%	47
Pink Shrimp	1,963	12.3%	15,093,298	6.224	6.224	36.24	11.5%	71%	1,100
Limited Entry Trawl, Petrale Sole	229	38.4%	1,570,707	6.069	6.731	42.97	1.2%	72%	106
Limited Entry Trawl, DTS	1,020	19.6%	7,477,358	16.140	9.203	52.17	5.7%	77%	369
Limited Entry Trawl, Arrowtooth	184	55.4%	2,345,701	14.223	14.564	66.74	1.8%	79%	73
Open Access, Shelf	381	95.5%	96,087	18.248	18.248	84.99	0.1%	79%	2
Open Access, Nearshore	4,229	35.3%	1,501,444	25.193	25.193	110.18	1.1%	80%	27
Limited Entry Trawl, Flatfish	1,275	59.1%	4,975,044	42.286	67.423	177.60	3.8%	84%	33
Total All Northern Fisheriesb/	43,556		131,046,019	160.026	177.600				335

TABLE 4.4-12. Catch and/or landed catch of lingcod and exvessel revenue by trip target type (1998 and 2002)[a/] (Page 4 of 4)

Primary Target for Trip	Trips	Percent of Primary Target Trips with Lingcod in Landing	Total Exvessel Revenue for All Species Landed	Lingcod Landed (MT)	Lingcod Landed or Estimated Catch (MT)	Cumulative Lingcod (MT)	Total Exvessel Revenue for Area: Percent of Total	Total Exvessel Revenue for Area: Cumulative Percent	Exvessel Revenue/Pounds (Landed & Bycatch)
South of Cape Mendocino									
2002									
Prawns	2,083	0.1%	3,990,047	0.005	0.005	0.01	4.5%	5%	332,504
Dungeness Crab	3,242	0.0%	7,482,080	0.007	0.007	0.01	8.5%	13%	498,805
CPS Plan Species	2,867	0.0%	7,157,169	0.008	0.008	0.02	8.1%	21%	397,621
Sea Cucumber	1,177	0.1%	790,470	0.010	0.010	0.03	0.9%	22%	35,930
Limited Entry Fixed Gear Sablefish, Slope	697	0.4%	614,030	0.012	0.012	0.04	0.7%	23%	23,617
Limited Entry Trawl, Leftover	3	33.3%	10,750	0.194	0.013	0.05	0.0%	23%	384
Open Access, Sablefish, Slope	281	0.7%	180,345	0.025	0.025	0.08	0.2%	23%	3,220
No landing wt or two species groups of equal wt	105	2.9%	692,760	0.027	0.027	0.11	0.8%	24%	11,742
Open Access, Slope	269	1.1%	185,765	0.029	0.029	0.14	0.2%	24%	2,903
Sea Urchins	9,720	0.1%	9,845,830	0.030	0.030	0.17	11.1%	35%	149,179
Limited Entry Fixed Gear Sablefish, Shelf	4	25.0%	3,909	0.030	0.030	0.20	0.0%	35%	58
Other Crustaceans	8,529	0.1%	6,400,611	0.044	0.044	0.24	7.2%	42%	65,312
Limited Entry Fixed Gear, Other Groundfish, Slope	756	0.3%	744,983	0.050	0.050	0.29	0.8%	43%	6,773
HMS Plan Species	1,968	0.5%	9,075,799	0.077	0.077	0.37	10.3%	53%	53,387
Other Species	3,600	0.2%	2,999,637	0.081	0.081	0.45	3.4%	57%	16,758
Gillnet Complex	2,770	0.6%	1,495,529	0.083	0.083	0.53	1.7%	58%	8,172
California Sheephead	389	2.8%	378,433	0.115	0.115	0.65	0.4%	59%	1,496
Limited Entry Trawl, Other Rockfish	28	10.7%	193,986	0.144	0.144	0.79	0.2%	59%	612
Limited Entry Trawl, Slope Rockfish	53	3.8%	250,821	0.204	0.204	0.99	0.3%	59%	557
Limited Entry Fixed Gear, Other Groundfish, Nearsh	56	19.6%	56,212	0.229	0.229	1.22	0.1%	59%	111
Open Access, Sablefish, Shelf	7	57.1%	3,628	0.337	0.337	1.56	0.0%	59%	5
Other Groundfish (plurality, but <50%)	196	6.6%	271,096	0.348	0.348	1.91	0.3%	60%	353
Salmon	8,129	0.6%	7,067,130	0.469	0.469	2.38	8.0%	68%	6,835
California Halibut	4,296	1.8%	1,795,391	0.791	0.791	3.17	2.0%	70%	1,030
Limited Entry Trawl, Lingcod	6	100.0%	3,680	0.818	0.818	3.99	0.0%	70%	2
Limited Entry Trawl, Petrale Sole	53	30.2%	287,972	1.562	0.904	4.89	0.3%	70%	144
Limited Entry Fixed Gear, Other Groundfish, Shelf	177	6.2%	69,150	1.393	1.393	6.28	0.1%	70%	23
Limited Entry Trawl, DTS	625	11.4%	4,279,277	6.056	1.428	7.71	4.8%	75%	1,359
Limited Entry Trawl, Chilipepper	54	44.4%	137,730	1.857	1.857	9.57	0.2%	75%	34
Limited Entry Trawl, Flatfish	369	15.7%	1,025,588	4.279	2.983	12.55	1.2%	76%	156
Open Access, Shelf	932	32.2%	250,959	9.829	9.829	22.38	0.3%	77%	12
Open Access, Nearshore	3,852	36.7%	1,762,533	15.545	15.545	37.93	2.0%	79%	51
Total All Southern Fisheries[b/]	190,012		88,511,363	44.688	37.926				1,059

a/ See text for important caveats.

b/ Includes primary strategies not listed in the table

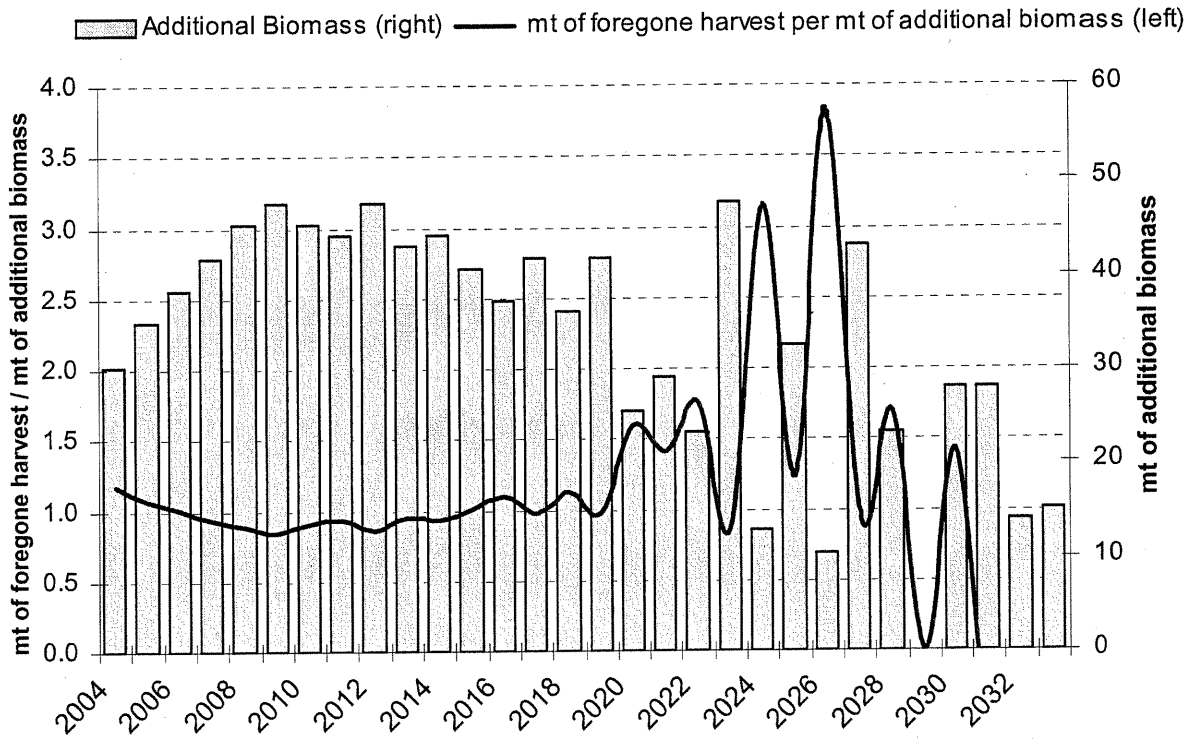

FIGURE 4.4-1. Darkblotched rockfish rebuilding cost over time: Cost of additional darkblotched rockfish biomass in terms of the amount of darkblotched rockfish harvest OY foregone (*Council Interim* compared with *Max Harvest*).

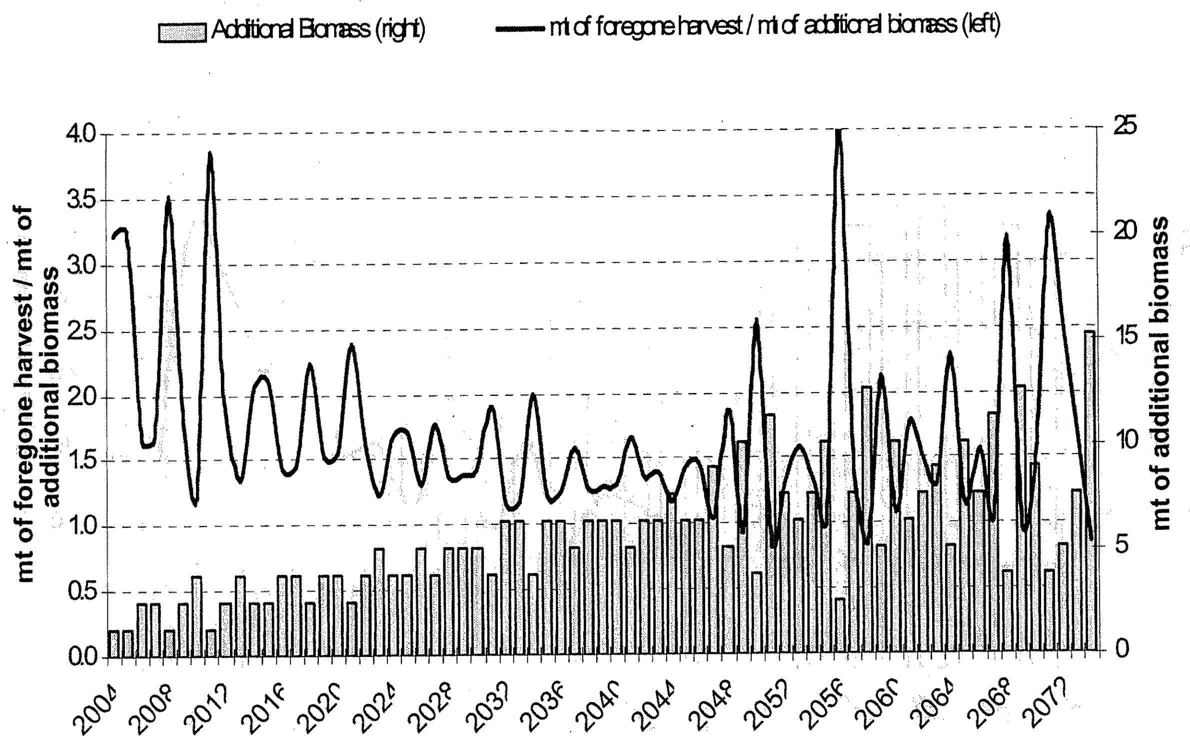

FIGURE 4.4-2. Canary rockfish rebuilding cost over time: Cost of additional canary rockfish biomass in terms of the amount of canary rockfish harvest OY foregone (*Council Interim* compared with *Max Harvest*).

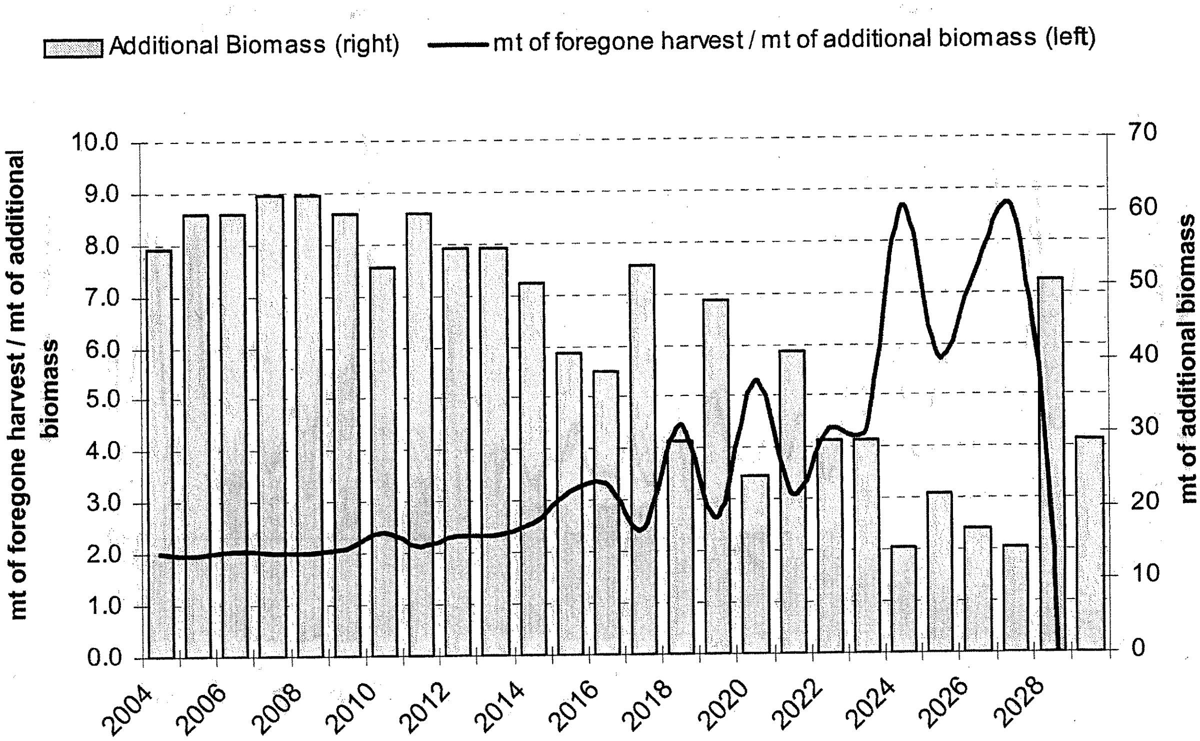

FIGURE 4.4-3. Pacific ocean perch rebuilding cost over time: Cost of additional Pacific ocean perch biomass in terms of the amount of Pacific ocean perch harvest OY foregone (*Council Interim* compared with *Max Harvest*).

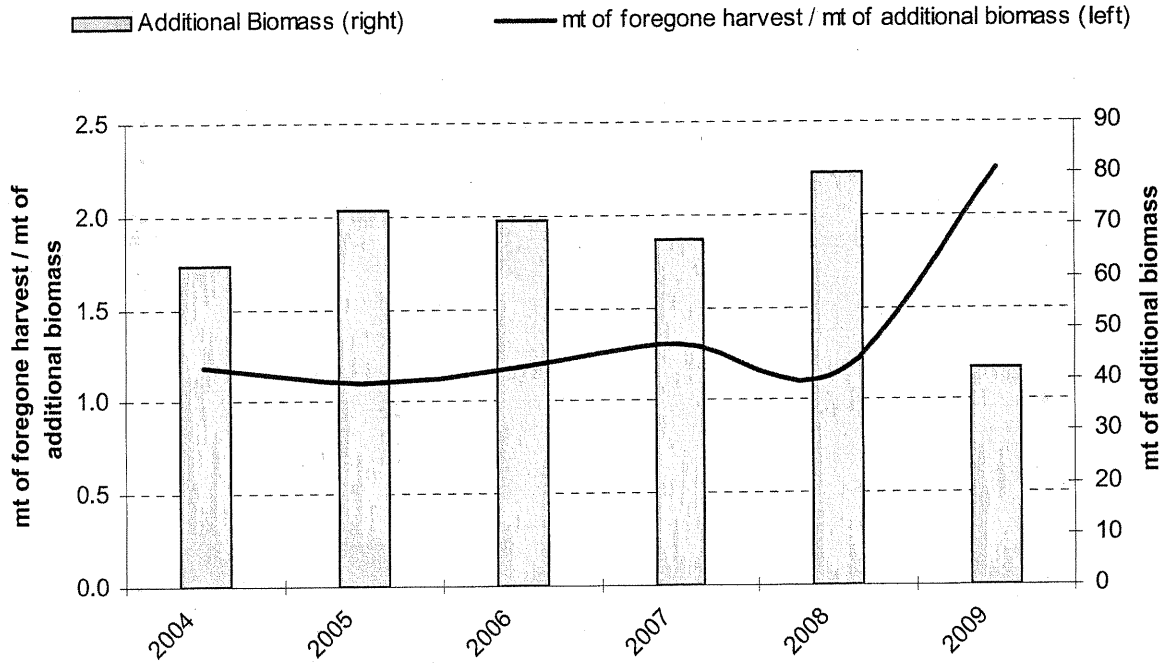

FIGURE 4.4-4. Lingcod rebuilding cost over time: Cost of additional lingcod biomass in terms of the amount of lingcod harvest OY foregone (*Council Interim* compared with *Max Harvest*).

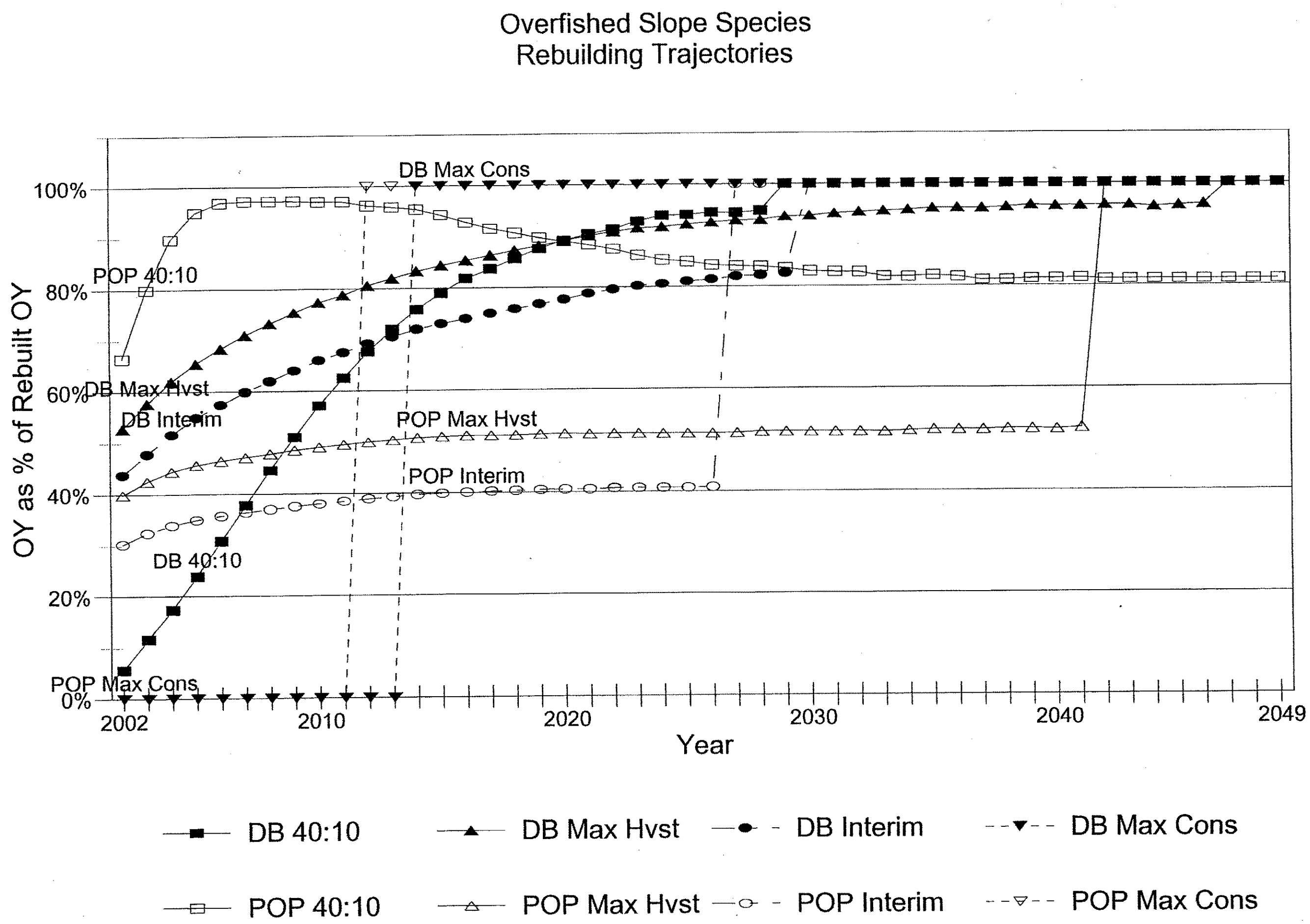

FIGURE 4.4-5. Rebuilding OYs for slope species (darkblotched rockfish and Pacific ocean perch) under different rebuilding alternatives.

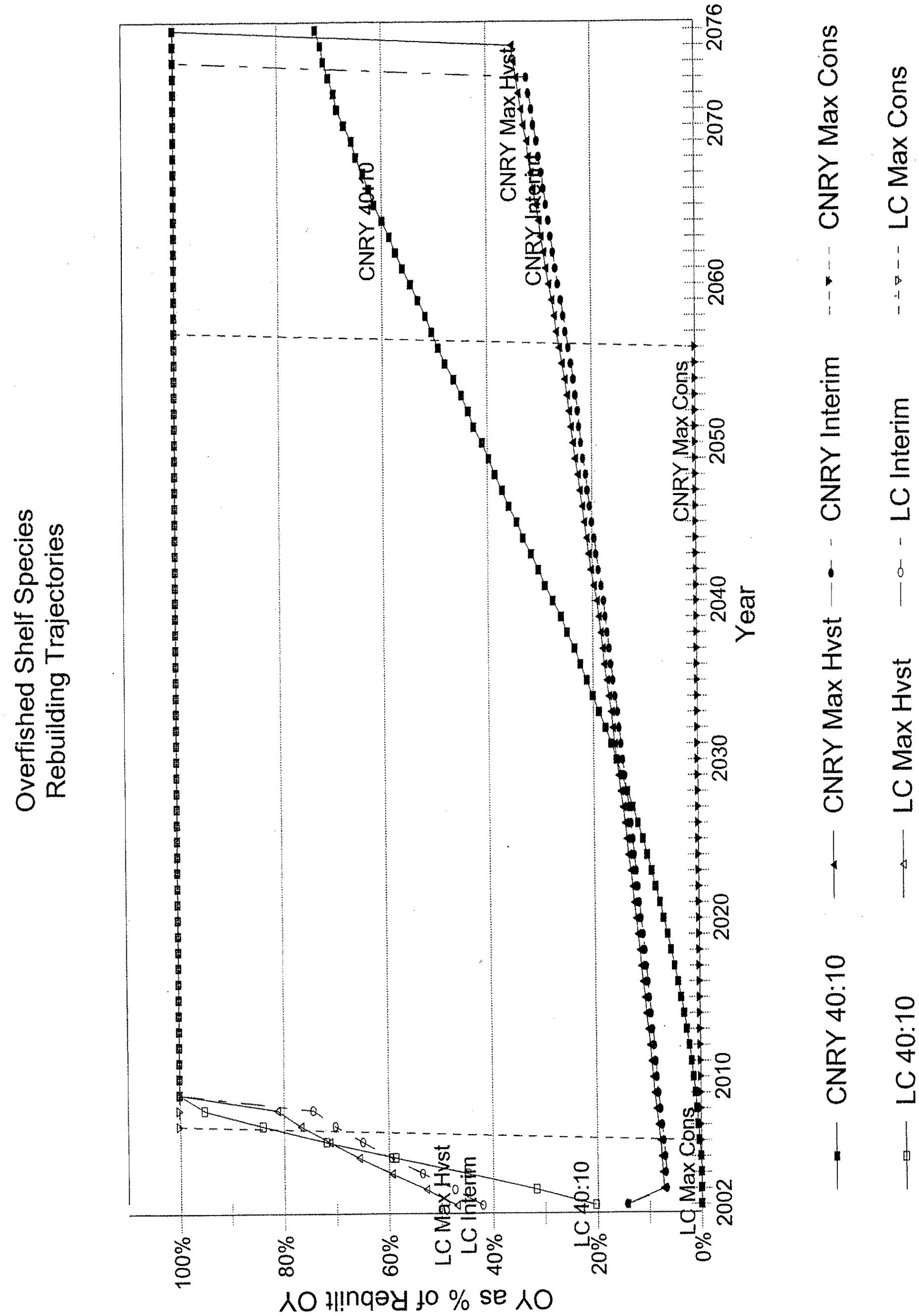

FIGURE 4.4-6. Rebuilding OYs for shelf species (canary rockfish and lingcod) under different rebuilding alternatives.

4.5 Social Cost Benefit Analysis

4.5.1 Overall Approach

4.5.1.1 Cost-Benefit vs. Cost Effectiveness

Cost-benefit analysis is conducted to evaluate net social benefits attributed to taking a particular action as opposed to not taking the action. With respect to regulatory actions, changes in net benefits are measured as the difference in the present value of the discounted stream of costs and benefits accruing with the regulatory action compared with the stream that would have occurred without the action. In situations where a specific outcome is mandated, a cost-effectiveness analysis may be used to compare alternatives rather than a cost-benefit analysis. A cost effectiveness analysis seeks to find the regulatory design that minimizes costs rather than evaluating whether or not the action is warranted. The advantage of a cost-effectiveness analysis is that there is no need to evaluate the benefits of the mandated policy outcome (in this case, rebuilt stocks). Many of the benefits of rebuilt stocks are intangible or difficult to measure, for example the value of ecosystem services and existence values.

In certain contexts, performing a cost-effectiveness analysis has advantages over presenting a cost-benefit analysis, however, the presence of the mixed stock exception alternative in this document requires using a cost-benefit method rather than a cost-effectiveness method. While most of the alternatives to no action are designed to rebuild populations of overfished species, the mixed stock exception can be invoked by demonstrating that greater net benefits to the nation would result by not rebuilding a particular species, so long as the continued existence of the species would not be threatened. In this analysis, a mixed stock exception is considered for canary rockfish. The mixed stock exception opens the possibility of dispensing with the rebuilding action in order to gain greater benefits to the nation.

4.5.1.2 Social vs. Private Cost Benefit Analyses

Cost-benefit analysis conducted for public decisions, such as fishery management, generally assess net social benefits. Social costs and benefits differ from private costs and benefits in that social costs and benefits include total economic costs and benefits while private costs and benefits measure only those effects that show up on the balance sheet of a firm or agency or as a financial or consumption effect to the consumer.

For example, in an environment of high unemployment, if a vessel hires an unemployed worker, that vessel incurs an accounting cost in the form of the additional wages it must pay. However, from a social point of view, there may be little cost if the individual would have otherwise been unemployed. From a social point of view, no productive output was forgone in order to employ the worker, so there was no opportunity cost. On the other hand, in an environment of low unemployment, if a worker is taken away from some other productive employment in order to work on the vessel, then the loss in production from the worker's previous role is considered a cost to society, an opportunity cost.

4.5.1.3 Quality of Results

The minimum standard for a cost-benefit analysis is a qualitative listing of positive and negative impacts. From there, an attempt is made to quantify or provide some indicators of the scale of the impacts and, if possible, to assign a monetary value to those changes.

There is not sufficient information on West Coast groundfish fisheries for a complete enumeration of net economic benefits from the fishery. However, by examining the elements that go into a net benefits analysis, it is possible to show qualitatively how net social benefits are likely to be affected under different policy options. Additionally, a sense of the magnitude of the impacts can be gauged by examining quantitative information on certain components (e.g., variable amounts of fish available for harvest over time), and for some elements it may be possible to associate a dollar value with some of the quantified changes. The dollar value provides some sense of the potential magnitude of effect compared with activities in other sectors of the economy. However, the values available are usually only some of the elements that would go into a full quantification of costs and benefits. For example, a dollar measure frequently available is the ex-vessel revenue from sales to seafood handlers and processors. While this is an important item in the calculation of producer surplus, it is only one of the elements necessary for a full determination of costs and benefits.

4.5.2 Key Trade-Off for Analysis

The choice of alternatives before the Council involves a trade-off between the probability that a stock will rebuild and the costs and benefits associated with that probability. In general, a higher probability of rebuilding within T_{MAX} is achieved by reducing annual harvest rates. However lower annual harvests reduce income and employment generating opportunities in fishing communities. Conversely while higher annual harvest rates generally imply a lower probability of rebuilding within T_{MAX}, the higher harvests are better able to sustain fishing communities during the rebuilding period.

4.5.2.1 Risk vs. Uncertainty

Risk is generally defined as a situation in which a different outcomes are possible but the probability of a particular outcome is known. Uncertainty is a situation in which the probability of different outcomes is unknown. There are often many influences that lead to a particular outcome. To the degree that the relationship between the influences and outcome is known, and the variability of the influences can be modeled, uncertainty can be reduced to measures of absolute risk.

Measures of absolute risk are difficult to develop. But we do know enough about population dynamics to say something about the relative risk among the different harvest policy alternatives. Few would argue that under overfished stock conditions lower harvests increase the probability of higher stock biomass in the future. Thus we can rank the harvest policies relative to one another in terms of the risk that stocks will not rebuild. Notwithstanding all the other sources of uncertainty about the exact outcome of a particular harvest policy, those policies with higher harvests in the short term have a lower probability of rebuilding biomass over the long term.

4.5.2.2 Risk and Probability

Quantitative comparisons are more informative when uncertainty can be portrayed as a quantified risk by establishing reasonable probability distribution for factors generating the uncertainty. One of the key areas of uncertainty with respect to future rebuilding outcomes is recruitment or recruits per spawner that may be expected from a given stock in a given year. In that regard, an attempt has been made in the rebuilding analyses to reduce uncertainty to risk by assuming a probability distribution from a range of historic observations.

In the rebuilding analyses, the probability of rebuilding within certain time frames was modeled using "Monte Carlo simulations." For a given harvest policy, this method projects future population trends hundreds of times in separate computer simulations. Each simulation is different because the assumed annual recruitments (or recruits per spawner relationships) are drawn randomly from a range of historic observations. Taken together these simulations depict a distribution of possible biomass and OY levels each year under the harvest policy.

The probability of rebuilding by a particular year is taken as the percentage of simulations that show projected biomass levels at least equal to the rebuilt level in or before that year. A lower annual harvest causes a greater number of simulations to reach the rebuilt biomass level by a particular year, and so a greater probability of achieving stock rebuilding by that year (and *vice versa*). Several of the alternatives are identified by the associated P_{MAX}, the probability that the stocks will be rebuilt by the maximum year allowed under the law, as computed by the proportion of the Monte Carlo runs projecting that the stock will be rebuilt by or before that year. (Note that some of the scenarios modeled under the no action (40-10 rule) and mixed stock exception alternative do not rebuild within T_{MAX} and so are not "rebuilding alternatives.") The "target year" for each rebuilding alternative is the first year in which 50% of the runs reached rebuilt biomass levels. Thus the target year has been equated with the median rebuilding year under each rebuilding alternative. In this situation, median refers to the value where exactly 50% of the biomass projections were greater than the rebuilt value, and 50% were lower. Note that this also implies that about 50% of the time we would not expect to achieve rebuilding by the nominal target year.

4.5.2.3 Outcomes (Costs and Benefits)

Estimated costs and benefits for each harvest policy alternative are based on these median results from the Monte Carlo simulations. To assess the harvest policy alternative in terms of its effect on future harvest, the expected median biomass each year is used along with the associated median OY. The biomass and OY values under a particular harvest policy represent the median of the values from the distribution of biomass and OY levels from Monte Carlo simulations of that harvest policy. While this measure is used to indicate the likely harvest level each year under the rebuilding policy, it should also be noted that in almost half the simulations under the rebuilding policy, rebuilding failed to occur by the target year.

4.5.3 Factors Considered in Assessing Net Social Benefits

Social net benefit analysis uses measures of costs and benefits to all entities affected by an action in order to assess the net effect on the nation. Net benefits from groundfish fisheries consist of producer surplus and consumer surplus accrued over time. If there are no market distortions[9/] and all goods are traded in markets, consumer surplus and producer surplus can at least theoretically be measured or approximated by market demand and supply curves (NMFS 2000). Producer surplus can also be calculated from revenue and cost data using opportunity costs rather than accounting costs (see Section 4.5.1 for additional background on differences between social opportunity costs and private accounting costs).

Benefits and costs may accrue to consumers or producers not only through their own direct activity, but also through changes in public expenditures (NMFS 2000). For example, the governmental expense to administer a VMS program is ultimately covered by a transfer payment from consumers or producers to the government (taxes). Thus rather than the economy producing a good demanded directly by producers or consumers, the economy produces a VMS monitoring system demanded indirectly by producers and consumers through actions taken to achieve social objectives administered by the government. In some cases, the cost of a new governmental activity is not met by a transfer through taxes but rather by a reprogramming of existing governmental assets. For example, if budgets are not increased when there is a new regulation requiring increased enforcement effort, then the opportunity cost of increased enforcement activity may be the benefits lost from other activities forgone in order to pursue fishery enforcement.

4.5.3.1 Producer Surplus

Total producer surplus is the difference between the amounts producers actually receive for providing goods and services and the economic costs producers bear to do so. Economic costs are measured by the opportunity cost of all resources including the raw materials, physical capital and human capital used in the process of supplying these goods and services to consumers (NMFS 2000).

The main capital investment for which a return must be earned is the vessel and associated fishing permits. On an individual fishing business basis, producer surplus is the difference between gross revenues and all costs, including payments to labor and owners of the business. At the industry or fishery level, producer surplus is the sum of net economic rent accruing to owners who control the relatively fixed factors of production (e.g., vessels, permits, fishing rights, specific knowledge, entrepreneurial capacity). Producer surplus in the fishing sector can increase through a reduction in unit harvesting costs (improved economic efficiency) or an increase in exvessel prices received.

Vessel as Proxy for the Seafood Fishing Firm

Because information is readily available on fishing vessels but not the businesses that own those vessels, we generally use the fishing vessel as a proxy for the fishing business. For analytical purposes, the vessel is viewed as a profit center owned by the fishing business that must cover all fishing costs, including materials and equipment, payments to captain and crew, and a return to the owners.

Other Affected Producers

In addition to commercial fishing vessels, other fishery-dependent businesses include buyers who act as intermediaries between the vessels and consumers, processors who purchase raw materials from commercial vessels to produce seafood products for shipment to regional, national and/or export markets, and charter or party vessels that provide recreational fishing experience for paying customers. A thorough accounting of

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9/ The prices paid for goods and quantities consumed reflected true opportunity costs as described in section 4.5.1.

net benefits would include measurement of producer surpluses accruing in these business sectors as well as the fishing vessels.

4.5.3.2 Consumer Surplus

Consumer surplus is the net value of products to the consumer, or the difference between what the consumer actually pays and what they would be willing to pay (i.e., the value to the consumer over and above the actual purchase price). Consumer surplus can increase through a reduction in prices paid, an increase in the quantities consumed or improvement in product quality. Consumer surplus exists because, while some people would be willing to pay more than the going price, the forces of supply and demand in competitive markets determine a single price for a good at any given time. Consumer surplus can, therefore, be loosely interpreted as the extra income available for spending on other items, because some individuals pay less than they would be willing to pay.

Not all goods and services important to consumers are exchanged through markets with market prices.

Market Consumer Goods

Seafood: For goods sold in markets where a consumer price can be determined, for example the market for seafood, available price and quantity information can allow estimation of the amount consumers might be willing to pay above the purchase price. However, if changes in the quantity of fish available are not expected to change prices because of ready availability of imports or other protein substitutes, a given regulatory action may have little or no impact on consumers.

Charter and Headboat Recreational Fisher Trips: On charter and headboats, individuals pay fees to participate in a recreational fishing trip. Price and quantity information from markets for these trips might allow estimation of the amount consumers are willing to pay above the purchase price. However, charter trips may often be purchased as part of a bundle of goods and services that include other nonfishing recreational activities for the participant or other members of his or her party. Therefore, the consumer surplus estimation problems may be on a par with those described below for private recreational trips.

Non-Market Consumer Goods - Consumptive (Use Values)

For other consumer goods, especially bundles of goods and services like a recreational fishing trip taken on a private vessel, the prices and quantities associated with each transaction are much more difficult to determine.

Private Recreational Fisher Trips: The term "private" is used to designate a recreational fisher fishing from a private vessel, the shore, bank or a public pier. This term is used to distinguish private fishers from those who take part in trips on charter vessels. For the private recreationalist the amount spent on fishing gear, licenses and other goods necessary to carry out a particular fishing trip is difficult to separate. Additionally, depending on the value a particular individual places on alternatives to fishing, the consumer surplus associated with the trip may far exceed actual trip expenditures.

Non-Market Consumer Goods - Non-Consumptive

Nonconsumptive users may experience benefits from the use and nonuse values provided by the resource. A use value would be wildlife viewing or the derivation of secondary benefits from ecosystem services. One or more of the following nonuse benefits may accrue to some consumers from preservation of fish stocks at higher levels of abundance (1) existence value derived from knowing a fish population or ecosystem is protected without intent to harvest, observe, or otherwise derive direct benefits from the resource; (2) option value placed on knowing a fish population, habitat, or ecosystem has been protected and is available for use, regardless of whether the resources are actually used; and (3) bequethal value placed on knowing a fish population, habitat, or ecosystem is protected for the benefit of future generations. These values may be closely related and overlap with values the general public places on wildlife and natural parks.

Relationship between Use/Non-use and Consumptive/Non-consumptive Activities		
	Consumptive	Non-Consumptive
Use	Recreational Fishing	Wildlife Viewing
Non-use	N/A	Existence Value, Options Value, Bequethal Value

The existence of coastal fishing communities in themselves may have intrinsic social value. For example the Newport Beach dory fishing fleet, founded in 1891, is a historical landmark designated by the Newport Beach Historical Society. The city grants the dory fleet use of the public beach in return for the business and tourism this unique fishery generates.

4.5.4 Results Summary

4.5.4.1 Introduction

The general approach in this section is to summarize for each alternative the qualitative and quantitative private costs and benefits, as covered in previous sections of the socioeconomic analysis, and where applicable, to point out how social costs and benefits may diverge from private ones (see Section 4.5.1 for a discussion of the difference between private and social costs and benefits). This summary will cover information presented in parts of Section 4.4 and some of the socioeconomic effects discussed in Section 4.3, "Impacts on the Management Regime." Where possible, the analysis will indicate the performance of the alternatives relative to one another and the magnitude of the difference in economic effects that may separate the alternatives.

The specific measures for achieving desired harvest levels will be adopted each year (or biennium) as part of the annual (biennial) specifications process. When measures of a new kind, such as a VMS system, are introduced, a separate process and analyses will be conducted to evaluate the effects of the proposed new measure. For the purposes of this analysis it is assumed that OYs will be managed through measures similar to those imposed for the 2003 fishery.

The economic effects of the proposed actions evaluated in the social net benefit analysis below arise from two direct impacts, (1) the impacts on current and future stock biomass, and (2) the impacts on current and future harvests. The following discussion summarizes the analyses shown for the individual species subject to this rebuilding plan (Tables 4.5-1 through 4.5-4).

4.5.4.2 Impacts: Biomass and Harvest Levels

Producer Surplus

Commercial Vessels

Over time, harvest costs will be reduced through increased CPUE. This effect will enhance producer surplus. In the long term this benefit will be equivalent between alternatives. Alternatives that rebuild faster have a higher probability of achieving these benefits sooner. However in the near term there will be much higher adjustment costs under the *Maximum Conservation* alternatives as more vessels must switch to second best alternatives or are idled. In the long term there may also be secondary benefits to the harvesting sector derived from an enhanced condition of the marine ecosystem.

Buyers and Processors

Increased abundance and average size of rebuilding species may increase product recovery rates and thereby reduce processing costs in the long run. While alternatives that rebuild faster may realize these benefits sooner, there will be much higher adjustment costs in the near term under the *Maximum Conservation* alternatives as processors must switch to second best alternatives or are forced to idle excess capacity.

Recreational Charter Vessels

Likely near-term closures for species caught in the recreational fishery under the *Maximum Conservation* alternatives for canary rockfish and lingcod will increase adjustment costs for charter vessels, and may push some operators into second best activities, such as excursions or wildlife viewing, or out of business. In the long run as stocks rebuild there should be increased demand from consumers for recreational experiences, both consumptive fishing and non-consumptive viewing.

Consumer Surplus

Seafood Consumers

In the near term under the *Maximum Conservation* and low OY alternatives, some consumers may experience a reduction in consumer surplus as the availability of live fish in restaurants and speciality seafood markets is greatly reduced or eliminated. This applies primarily to lingcod and canary rockfish rebuilding. In the long term and for consumers of fresh and frozen seafood products, there should be no difference between the alternatives since locally caught products no longer available would be replaced with close substitutes obtained from elsewhere in the global supply chain.

Recreational Fishers

For species caught recreationally, in the long run, there should be higher recreational CPUEs as stocks are rebuilt. This may lead to higher value of trips. Likely near term closures under the *Maximum Conservation* alternatives for canary rockfish and lingcod will reduce consumer surplus for recreational fishers as reduced supply of fishing opportunities moves them to second best recreational experiences.

Non-consumptive Users

In the long run, increased stocks may indirectly enhance the value of wildlife viewing experience for non-consumptive users. Presumably faster rebuilding will enhance their benefits.

Nonusers

In the long run, increased stocks may enhance nonuse values. Increases in existence value, options value and bequethal value for nonusers may be proportional to the probability of rebuilding within T_{MAX}.

Public Expenditures Affecting Either Consumer or Producer Surplus

Enforcement issues

Higher enforcement intensity in the near term may be necessary in order to discriminate between OY levels for alternatives other than *Maximum Conservation*. (*Maximum Conservation* would imply closures in the near term, which may be cheaper to enforce). In the long term, once overfished stocks are rebuilt, enforcement costs should be identical under the alternatives.

Science and Monitoring Costs

Zero harvest and relatively low harvest alternatives will reduce the quantity of fisheries dependant data gathered. This may necessitate higher expenditures for collection of fisheries independent data. In the long term, once overfished stocks are rebuilt, there is no difference between the alternatives.

TABLE 4.5-1. Summary of net social benefit analysis for impacts of the darkblotched rockfish rebuilding alternatives.

Socioeconomic Effect **(Note: Higher number implies higher net benefits)**	Alternatives: *No Action ("40-10")*	*Maximum Conservation*	*Maximum Harvest*	*Council Interim*
PRODUCER SURPLUS				
Seafood Harvesters				
Catch Per Unit Effort (rankings based on number of years until rebuilt : 1= lowest CPUE (slowest rebuilding), 4 = highest CPUE (fastest rebuilding))	3	4	1	2
Adjustment costs (rankings based on present value of OYs over rebuilding period: 1 = highest adjustment cost (lowest PV), 4 = lowest adjustment cost (highest PV))	2	1	4	3
Seafood Processors and Handlers				
Product recovery rates (rankings based on number of years until rebuilt : 1 = slowest rebuilding (lower PRR), 4 = fastest rebuilding (higher PRR))	3	4	1	2
Adjustment costs (rankings based on present value of OYs over rebuilding period: 1 = highest adjustment cost (lowest PV), 4 = lowest adjustment cost (highest PV))	2	1	4	3
Recreational Charter Vessels				
Ability to supply higher quality experience (rankings based on probability of rebuilding within T_{MAX} : 1 = lowest probability, 4 = highest probability)	NA	NA	NA	NA
Adjustment costs (rankings based on sum of OYs during first six years of rebuilding: 1 = highest adjustment cost (lowest OY), 4 = lowest adjustment cost (highest OY))	NA	NA	NA	NA
CONSUMER SURPLUS				
Seafood Consumers				
Availalbility of live catch (sum of OYs during first six years of rebuilding, if applicable)	NA	NA	NA	NA
Availalbility of fresh and frozen products	NA	NA	NA	NA
Recreational Fishers				
Supply of recreational opportunities (rankings based on sum of OYs over rebuilding period: 1 = lowest OY, 4 = highest OY))	NA	NA	NA	NA
Recreational CPUEs (rankings based on number of years until rebuilt : 1=slowest rebuilding (lower CPUE), 4 = fastest rebuilding (higher CPUE))	NA	NA	NA	NA
Nonconsumptive Users				
Value of wildlife viewing experience (rankings based on number of years until rebuilt : 1 = slowest rebuilding (lower value), 4 = fastest rebuilding (higher value))	3	4	1	2
Nonconsumptive, Nonusers				
Option, existence and bequethal values in long term (rankings based on probability of rebuilding within T_{MAX} : 1 = lowest probability, 4 = highest probability)	2	4	1	3
PUBLIC EXPENDITURES[a/]				
Enforcement costs (1 = higher, 2 = lower)	1	2	1	1
Survey and monitoring costs (rankings based on sum of OYs over rebuilding period: 1 = highest cost (lowest OY), 4 = lowest cost (highest OY))	2	1	4	3

a/ Public expenditures may affect either consumer of producer surpluses.

TABLE 4.5-2. Summary of net social benefit analysis for impacts of the Pacific ocean perch rebuilding alternatives.

Socioeconomic Effect **(Note: Higher number implies higher net benefits)**	Alternatives			
	No Action ("40-10")	*Maximum Conservation*	*Maximum Harvest*	*Council Interim*
PRODUCER SURPLUS				
Seafood Harvesters				
Catch Per Unit Effort (rankings based on number of years until rebuilt : 1= lowest CPUE (slowest rebuilding), 4 = highest CPUE (fastest rebuilding))	1	4	2	3
Adjustment costs (rankings based on present value of OYs over rebuilding period: 1 = highest adjustment cost (lowest PV), 4 = lowest adjustment cost (highest PV))	4	3	2	1
Seafood Processors and Handlers				
Product recovery rates (rankings based on number of years until rebuilt : 1 = slowest rebuilding (lower PRR), 4 = fastest rebuilding (higher PRR))	1	4	2	3
Adjustment costs (rankings based on present value of OYs over rebuilding period: 1 = highest adjustment cost (lowest PV), 4 = lowest adjustment cost (highest PV))	4	3	2	1
Recreational Charter Vessels				
Ability to supply higher quality experience (rankings based on probability of rebuilding within T_{MAX} : 1 = lowest probability, 4 = highest probability)	NA	NA	NA	NA
Adjustment costs (rankings based on sum of OYs during first six years of rebuilding: 1 = highest adjustment cost (lowest OY), 4 = lowest adjustment cost (highest OY))	NA	NA	NA	NA
CONSUMER SURPLUS				
Seafood Consumers				
Availalbility of live catch (sum of OYs during first six years of rebuilding, if applicable)	NA	NA	NA	NA
Availalbility of fresh and frozen products	NA	NA	NA	NA
Recreational Fishers				
Supply of recreational opportunities (rankings based on sum of OYs over rebuilding period: 1 = lowest OY, 4 = highest OY))	NA	NA	NA	NA
Recreational CPUEs (rankings based on number of years until rebuilt : 1=slowest rebuilding (lower CPUE), 4 = fastest rebuilding (higher CPUE))	NA	NA	NA	NA
Nonconsumptive Users				
Value of wildlife viewing experience (rankings based on number of years until rebuilt : 1 = slowest rebuilding (lower value), 4 = fastest rebuilding (higher value))	1	4	2	3
Nonconsumptive, Nonusers				
Option, existence and bequethal values in long term (rankings based on probability of rebuilding within T_{MAX} : 1 = lowest probability, 4 = highest probability)	1	4	2	3
PUBLIC EXPENDITURES[a/]				
Enforcement costs (1 = higher, 2 = lower)	1	2	1	1
Survey and monitoring costs (rankings based on sum of OYs over rebuilding period: 1 = highest cost (lowest OY), 4 = lowest cost (highest OY))	4	3	1	2

a/ Public expenditures may affect either consumer of producer surpluses.

TABLE 4.5-3. Summary of net social benefit analysis for impacts of the canary rockfish rebuilding alternatives.

Socioeconomic Effect **(Note: Higher number implies higher net benefits)**	Alternatives			
	No Action ("40-10")	*Maximum Conservation*	*Maximum Harvest*	*Council Interim*
PRODUCER SURPLUS				
Seafood Harvesters				
Catch Per Unit Effort (rankings based on number of years until rebuilt : 1= lowest CPUE (slowest rebuilding), 4 = highest CPUE (fastest rebuilding))	1	4	2	3
Adjustment costs (rankings based on present value of OYs over rebuilding period: 1 = highest adjustment cost (lowest PV), 4 = lowest adjustment cost (highest PV))	2	1	4	3
Seafood Processors and Handlers				
Product recovery rates (rankings based on number of years until rebuilt : 1 = slowest rebuilding (lower PRR), 4 = fastest rebuilding (higher PRR))	1	4	2	3
Adjustment costs (rankings based on present value of OYs over rebuilding period: 1 = highest adjustment cost (lowest PV), 4 = lowest adjustment cost (highest PV))	2	1	4	3
Recreational Charter Vessels				
Ability to supply higher quality experience (rankings based on probability of rebuilding within T_{MAX} : 1 = lowest probability, 4 = highest probability)	1	4	2	3
Adjustment costs (rankings based on sum of OYs during first six years of rebuilding: 1 = highest adjustment cost (lowest OY), 4 = lowest adjustment cost (highest OY))	2	1	4	3
CONSUMER SURPLUS				
Seafood Consumers				
Availalbility of live catch (sum of OYs during first six years of rebuilding, if applicable)	2	1	4	3
Availalbility of fresh and frozen products	NA	NA	NA	NA
Recreational Fishers				
Supply of recreational opportunities (rankings based on sum of OYs over rebuilding period: 1 = lowest OY, 4 = highest OY))	4	3	1	2
Recreational CPUEs (rankings based on number of years until rebuilt : 1=slowest rebuilding (lower CPUE), 4 = fastest rebuilding (higher CPUE))	1	4	2	3
Nonconsumptive Users				
Value of wildlife viewing experience (rankings based on number of years until rebuilt : 1 = slowest rebuilding (lower value), 4 = fastest rebuilding (higher value))	1	4	2	3
Nonconsumptive, Nonusers				
Option, existence and bequethal values in long term (rankings based on probability of rebuilding within T_{MAX} : 1 = lowest probability, 4 = highest probability)	1	4	2	3
PUBLIC EXPENDITURES[a/]				
Enforcement costs (1 = higher, 2 = lower)	1	2	1	1
Survey and monitoring costs (rankings based on sum of OYs over rebuilding period: 1 = highest cost (lowest OY), 4 = lowest cost (highest OY))	4	3	1	2

a/ Public expenditures may affect either consumer of producer surpluses.

TABLE 4.5-4. Summary of net social benefit analysis for impacts of the Lingcod rebuilding alternatives.

Socioeconomic Effect **(Note: Higher number implies higher net benefits)**	Alternatives: *No Action ("40-10")*	*Maximum Conservation*	*Maximum Harvest*	*Council Interim*
PRODUCER SURPLUS				
Seafood Harvesters				
Catch Per Unit Effort (rankings based on number of years until rebuilt : 1= lowest CPUE (slowest rebuilding), 4 = highest CPUE (fastest rebuilding))	1	2	1	1
Adjustment costs (rankings based on present value of OYs over rebuilding period: 1 = highest adjustment cost (lowest PV), 4 = lowest adjustment cost (highest PV))	2	1	4	3
Seafood Processors and Handlers				
Product recovery rates (rankings based on number of years until rebuilt : 1 = slowest rebuilding (lower PRR), 4 = fastest rebuilding (higher PRR))	1	2	1	1
Adjustment costs (rankings based on present value of OYs over rebuilding period: 1 = highest adjustment cost (lowest PV), 4 = lowest adjustment cost (highest PV))	2	1	4	3
Recreational Charter Vessels				
Ability to supply higher quality experience (rankings based on probability of rebuilding within T_{MAX} : 1 = lowest probability, 4 = highest probability)	3	4	1	2
Adjustment costs (rankings based on sum of OYs during first six years of rebuilding: 1 = highest adjustment cost (lowest OY), 4 = lowest adjustment cost (highest OY))	2	1	4	3
CONSUMER SURPLUS				
Seafood Consumers				
Availability of live catch (sum of OYs during first six years of rebuilding, if applicable)	2	1	4	3
Availability of fresh and frozen products	NA	NA	NA	NA
Recreational Fishers				
Supply of recreational opportunities (rankings based on sum of OYs over rebuilding period: 1 = lowest OY, 4 = highest OY))	2	1	4	3
Recreational CPUEs (rankings based on number of years until rebuilt : 1=slowest rebuilding (lower CPUE), 4 = fastest rebuilding (higher CPUE))	1	2	1	1
Nonconsumptive Users				
Value of wildlife viewing experience (rankings based on number of years until rebuilt : 1 = slowest rebuilding (lower value), 4 = fastest rebuilding (higher value))	1	2	1	1
Nonconsumptive, Nonusers				
Option, existence and bequethal values in long term (rankings based on probability of rebuilding within T_{MAX} : 1 = lowest probability, 4 = highest probability)	3	4	1	2
PUBLIC EXPENDITURES[a/]				
Enforcement costs (1 = higher, 2 = lower)	1	2	1	1
Survey and monitoring costs (rankings based on sum of OYs over rebuilding period: 1 = highest cost (lowest OY), 4 = lowest cost (highest OY))	2	1	4	3

a/ Public expenditures may affect either consumer of producer surpluses.

5.0 COMBINED EFFECTS ACROSS STOCKS AND CUMULATIVE EFFECTS

This section will be available as supplemental material the June Council meeting

6.0 Summary of Environmental Management Issues

Based on the environmental impacts disclosed in Chapter 4 and 5, this chapter summarizes a range of issues that an EIS must address. These issues are identified at 40 CFR 1502.6, describing the analysis of environmental consequences in an EIS.

6.1 Short-term Uses Versus Long-term Productivity

Balancing short-term use and long-term productivity is the essence of the proposed action. The Magnuson-Stevens Act and National Standard Guidelines establish a framework for rebuilding overfished stocks—establishing long-term productivity—while recognizing short-term use as reflected in the needs of fishing communities. National Standard 1 guidelines establish outer boundaries for balancing this tradeoff: T_{MIN}, which places greatest emphasis on rapidly returning to maximum long-term productivity (MSY), and T_{MAX}, which places greatest emphasis on short-term use while rebuilding stocks. The specific tradeoff between short-term use and long-term productivity is expressed by the choice of a target year, T_{TARGET}, which must fall within these boundaries. If a T_{TARGET} closer to T_{MAX} is chosen, harvest rates will be higher and short-term use is thus favored. If a T_{TARGET} closer to T_{MIN} is chosen, harvest rates will be lower and the stock is more likely to rapidly rebuild, favoring long-term productivity. The *Mixed Stock Exception*, identified in National Standard 1 guidelines and used as the basis of one of the alternatives in this EIS favors short-term use, in terms of sustainable harvests of healthy stocks in a complex, over a return to B_{MSY} for selected stocks. Under the *Mixed Stock Exception* selected stocks would be managed to prevent further declines in population size, but not to achieve long-term maximum productivity as represented by B_{MSY} stock size.

The preferred alternative will be assessed in terms of this tradeoff.

6.2 Irreversible Resource Commitments

An irreversible commitment represents some permanent loss of an environmental attribute or service. The use of non-renewable resources are irreversible; unsustainable renewable resource use may be irreversible if future production is permanently reduced or, at the extreme, is extinguished.

The use of non-renewable energy resources, such as fossil fuel, represents a pervasive irreversible commitment associated with the proposed action, because fishing vessels are mechanically powered. The use of energy is discussed below in section 6.4.

The proposed action, however, does not by itself represent an irreversible commitment, because renewable resources are being managed within an adaptive framework. If a stock were extirpated or species went extinct, this would represent an irreversible resource commitment. Although the proposed action is intended to rebuild stocks there is some risk, albeit very small, that measurement or model error would lead to mis-specification of harvest rates. Such mis-specification would have to occur over a long period of time in order to drive stocks down to a level where the population was no longer viable and entered an extinction spiral. Even if stocks do not go extinct, however, stock condition could result in an irreversible resource commitment. First, although not conclusively demonstrated for the four overfished stocks considered in this EIS, ecological relationships can produce a depensation effect (Walters and Kitchell 2001). Smaller-sized co-occurring species whose population is kept in check due to predation by adults of the overfished stock are released from this constraint. They then prey on larvae and juveniles of the overfished stock, thus suppressing recruitment. If such a situation pertains, stocks may be very slow to rebuild even if fishing mortality is substantially decreased. A very long recovery period, amounting to hundreds of years, may be considered irreversible from a practical standpoint. Although the stock may eventually recover, it would have little relevance to any policy or planning time horizon.

6.3 Irretrievable Resource Commitments

A resource is irretrievably committed if its use is lost for time, but is not actually or practically lost permanently. The proposed action establishes a framework for setting harvest rates that allow overfished stocks to recover to target biomass over some time period. Rebuilding targets indirectly constrain fish harvests based on the harvest specifications necessary to rebuild stocks. The fish that are harvested represent an irretrievable resource commitment, as do the inputs in terms of capital and labor (including energy and resources) needed to harvest and market these fish.

6.4 Energy Requirements and Conservation Potential of the Alternatives

The proposed action indirectly affects energy use primarily in the form of fossil fuels used to power surveillance craft and fishing vessels. Energy used in at-sea and aerial monitoring and enforcement activities is a direct effect. Change in the level of this type of monitoring is hard to predict because it depends on the types of management measures that will be implemented annually (for 2004), biennially (for 2005 through 2006 onwards) and inseason. Generally, the use of depth-based restrictions, which were brought into use in late 2002, would require more surveillance to be effective. Vessel monitoring systems, which will be implemented for the groundfish fishery in August 2003, would compensate somewhat for the increased surveillance need. Finally, the availability of ships and aircraft to conduct surveillance, which is partly contingent on U.S. Coast Guard mission priorities, will also dictate the level the number of patrols, affecting energy use. For these reasons, it is difficult to predict how energy use would change from baseline conditions. The proposed action indirectly affects fishing activity, and thus, the consumption of fuel by fishing vessels. Fuel consumption is likely to correlate with harvest levels, which are in part determined by the effect of rebuilding measures. For example, the *Maximum Conservation* alternative would likely sharply reduce or eliminate much commercial and recreational fishing on the West Coast, with a corresponding reduction in vessel fuel consumption. The other alternatives would allow higher harvest levels, but it is not possible to forecast how they might affect fuel consumption.

The proposed action could affect overall production efficiency, including energy consumption. Production efficiency can be likened to catch per unit effort (CPUE), except that the effort measure would account for all energy consumption, not just energy consumed during gear deployment.[10/] Although overfished species may account for a small part of the production side of the balance sheet, they act as constraining stocks, limiting the amount of target species that can be caught on a given fishing trip due to restrictive management measures. Lower harvest limits for overfished species could, therefore, translate into lower overall production efficiency. All of the action alternatives are intended to allow stocks to return to B_{MSY}, so production efficiency should increase over time. Under the *Maximum Conservation* alternative groundfish fishing would largely cease until stocks recovered; production efficiency would not apply until recovery at which time higher production efficiency would presumably obtain. The *Maximum Harvest* alternative would result in a longer period of lower production efficiency as fishing occurred during stock recovery. Of course these scenarios do not account for a wide range of mitigating factors that could affect efficiency. For example, the number of fishing vessels is likely to decrease, either through policy initiatives such as vessel buyback and permit retirement in limited entry fisheries, or fisheries reaching a new, lower open access equilibrium. In response to increases in cost resulting from lower production efficiency, fishermen could also invest in new technology, depending on availability and cost, that might reduce energy consumption (and thereby costs). This might happen over the long term but even a general trend is not predictable, because of the various countervailing factors that could affect this type of capital investment.

6.5 Urban Quality, Historic Resources, and the Design of the Built Environment

The Newport Beach dory fleet, which would be affected by the proposed action, is considered a historic resource locally. Although the proposed action does not directly affect urban quality, other historic resources, or the design of the built environment it may have indirect effects. Fishing fleets add to the character of many West Coast communities and are a determining factor in investment in port infrastructure, including the maintenance of navigation channels. Aside from any broad effects on community income, a decline in the number of vessels, which is likely to occur under more restrictive management measures, could affect infrastructure investment and might contribute to changes in the character of waterfront areas.

10/ The unit value of the effort term can be highly variable, depending on what measures are available. If effort were measured by total days at sea then fishing effort and production efficiency would be closely correlated. However, if effort is measured as the amount of time fishing gear is deployed then various "fixed cost" commitments, such as energy used transiting to fishing grounds and searching for fish to set on, would not be accounted for.

6.6 Possible Conflicts Between the Proposed Action and Other Plans and Policies For the Affected Area

Overfished groundfish species are caught incidentally in fisheries managed under other Council FMPs (for salmon and coastal pelagic species, and highly migratory species, which is pending completion). Very restrictive measures, such as those that would be required to meet the rebuilding targets in the *Maximum Conservation* alternative, are likely to affect these fisheries and thus conflict with some of the objectives of these FMPs. (FMPs try to strike a balance between conservation and utilization, so they include objectives related to resource use.)

6.7 Mitigation

6.8 Adverse Effects That Cannot Be Avoided

7.0 Consistency With the Groundfish FMP and Magnuson-Stevens Act National Standards

7.1 FMP Goals and Objectives

The groundfish FMP goals and objectives are listed below. They way in which Amendment 16-2 addresses each objective is briefly described in italics below the relevant statement.

Management Goals.

Goal 1 - Conservation. Prevent overfishing by managing for appropriate harvest levels and prevent any net loss of the habitat of living marine resources.

Goal 2 - Economics. Maximize the value of the groundfish resource as a whole.

Goal 3 - Utilization. Achieve the maximum biological yield of the overall groundfish fishery, promote year-round availability of quality seafood to the consumer, and promote recreational fishing opportunities.

Objectives. To accomplish these management goals, a number of objectives will be considered and followed as closely as practicable:

Conservation.

Objective 1. Maintain an information flow on the status of the fishery and the fishery resource which allows for informed management decisions as the fishery occurs.

Measures in this amendment may affect this objective. Currently, stock assessments depend in part on data derived from fisheries. Reduction or elimination of fisheries would affect the availability of these data and require new, fishery independent assessment methods.

Objective 2. Adopt harvest specifications and management measures consistent with resource stewardship responsibilities for each groundfish species or species group.

Measures in this amendment indirectly affect this objective. Rebuilding plans establish a strategy based on specific targets. Harvest specifications adopted subsequently must be consistent with the rebuilding strategy.

Objective 3. For species or species groups which are below the level necessary to produce maximum sustainable yield (MSY), consider rebuilding the stock to the MSY level and, if necessary, develop a plan to rebuild the stock.

Rebuilding plans directly address this objective.

Objective 4. Where conservation problems have been identified for nongroundfish species and the best scientific information shows the groundfish fishery has a direct impact on the ability of that species to maintain its long-term reproductive health, the Council may consider establishing management measures to control the impacts of groundfish fishing on those species. Management measures may be imposed on the groundfish fishery to reduce fishing mortality of a nongroundfish species for documented conservation reasons. The action will be designed to minimize disruption of the groundfish fishery, in so far as consistent with the goal to minimize the bycatch of nongroundfish species and will not preclude achievement of a quota, harvest guideline, or allocation of groundfish, if any, unless such action is required by other applicable law.

Measures in this amendment do not affect this objective.

Objective 5. Describe and identify essential fish habitat (EFH), adverse impacts on EFH, and other actions to conserve and enhance EFH, and adopt management measures that minimize, to the extent practicable, adverse impacts from fishing on EFH.

Although actions specifically intended to conserve or enhance EFH are not part of the proposed action, habitat impacts are discussed in the EIS as part of the evaluation of alternatives. New EFH protection measures could be implemented as part of a separate, future action in support of rebuilding.

Economics.

Objective 6. Attempt to achieve the greatest possible net economic benefit to the nation from the managed fisheries.

Net benefits are evaluated for the different alternatives considered in the EIS. Inclusion of an alternative based on the Mixed Stock Exception requires an assessment of net economic benefit to the nation under National Standard 1 guidelines. Rebuilding plan implementation should increase net benefits in the long term.

Objective 7. Identify those sectors of the groundfish fishery for which it is beneficial to promote year-round marketing opportunities and establish management policies that extend those sectors fishing and marketing opportunities as long as practicable during the fishing year.

Management measures required to achieve the rebuilding targets identified in this amendment may require re-evaluation of the feasibility of year-round fisheries. Implementation of management measures is not part of the proposed action, but measures affecting the objective of a year-round fishery could be implemented in the future in order to achieve targets adopted by this amendment.

Objective 8. Gear restrictions to minimize the necessity for other management measures will be used whenever practicable.

Although the adoption of rebuilding plan-specific management measures is not part of the proposed action, gear restrictions are discussed in the EIS as part of the evaluation of the alternatives. New gear restrictions may be implemented as part of a separate, future action in support of rebuilding targets.

Utilization.

Objective 9. Develop management measures and policies that foster and encourage full utilization (harvesting and processing) of the Pacific Coast groundfish resources by domestic fisheries.

Although management measures are not part of the proposed action, the effect of the alternatives on full utilization is evaluated as part of the EIS.

Objective 10. Recognizing the multispecies nature of the fishery and establish a concept of managing by species and gear or by groups of interrelated species.

Rebuilding plans are species- or stock-specific, although associated management measures will necessarily affect more abundant stocks that co-occur with overfished stocks. These effects are considered in evaluating the alternatives in the EIS.

Objective 11. Strive to reduce the economic incentives and regulatory measures that lead to wastage of fish. Also, develop management measures that minimize bycatch to the extent practicable and, to the extent that bycatch cannot be avoided, minimize the mortality of such bycatch. In addition, promote and support monitoring programs to improve estimates of total fishing-related mortality and bycatch, as well as those to improve other information necessary to determine the extent to which it is practicable to reduce bycatch and bycatch mortality.

Rebuilding plans must take into account total fishing mortality including bycatch mortality.

Objective 12. Provide for foreign participation in the fishery, consistent with the other goals to take that portion of the optimum yield (OY) not utilized by domestic fisheries while minimizing conflict with domestic fisheries.

This objective is no longer relevant, because the fishery has been declared fully utilized.

Social Factors.

Objective 13. When conservation actions are necessary to protect a stock or stock assemblage, attempt to develop management measures that will affect users equitably.

Rebuilding plans may discuss allocation among sectors. Potential allocation is discussed as part of the evaluation of alternatives in the EIS. Separate, future actions supporting the targets adopted in this amendment could affect allocation.

Objective 14. Minimize gear conflicts among resource users.

Measures in this amendment do not address this objective.

Objective 15. When considering alternative management measures to resolve an issue, choose the measure that best accomplishes the change with the least disruption of current domestic fishing practices, marketing procedures, and environment.

Disruption of fishing, marketing and the environment is discussed as part of the evaluation of alternatives in the EIS. Some disruption is unavoidable.

Objective 16. Avoid unnecessary adverse impacts on small entities.

Rebuilding plan measures may entail adverse impacts, but these are necessary to rebuild overfished stocks. Impacts on small entities are discussed as part of the evaluation of alternatives in the EIS

Objective 17. Consider the importance of groundfish resources to fishing communities, provide for the sustained participation of fishing communities, and minimize adverse economic impacts on fishing communities to the extent practicable.

The evaluation of alternatives in the EIS considers impacts to communities. Inclusion of an alternative based on the Mixed Stock Exception allows consideration of the tradeoff between stock rebuilding and community impacts.

Objective 18. Promote the safety of human life at sea.

The evaluation of alternatives in the EIS considers impacts to safety.

7.2 National Standards

A FMP or plan amendment and any pursuant regulations must be consistent with ten national standards contained in the Magnuson-Stevens Act (§301). These are:

National Standard 1 states that conservation and management measures shall prevent overfishing while achieving, on a continuing basis, the optimum yield from each fishery for the United States fishing industry.

This amendment supports National Standard 1 by adopting rebuilding plans for four overfished species. Rebuilding plans lay out a strategy for stock rebuilding. Management measures implemented to achieve rebuilding must constrain harvests to a level below the overfishing threshold (maximum fishing mortality rate) for a given overfished species. Thus, in addition to establishing a strategy for stock rebuilding they also dictate the implementation of measures to prevent overfishing.

National Standard 2 states that conservation and management measures shall be based on the best scientific information available.

Rebuilding plans are based on rebuilding analyses that use the most recent stock assessment data and incorporate statistical measures of the likelihood that overfished stocks will recover within a mandated time period. These stock assessments and analyses are conducted by state and federal agency staff scientists with expertise in Pacific groundfish biology, ecology, and fishery science. They employ the best available data.

National Standard 3 states that, to the extent practicable, an individual stock of fish shall be managed as a unit throughout its range, and interrelated stocks of fish shall be managed as a unit or in close coordination.

Pacific groundfish are managed on the basis of known stocks when these can be differentiated from the total range of the species. Overfished species are managed individually in that harvest levels are determined for each stock; but managers recognize that many groundfish stocks share common habitats and ecosystems, and fishers may catch them as part of a multi-species complex. This allows unit management of interrelated stocks. Thus management measures are applied to more abundant stocks co-occurring with overfished species that may limit harvests of the healthy stock below optimum yield in order to ensure rebuilding of the associated overfished stocks.

National Standard 4 states that conservation and management measures shall not discriminate between residents of different states. If it becomes necessary to allocate or assign fishing privileges among various United States fishermen, such allocation shall be (A) fair and equitable to all such fishermen; (B) reasonably calculated to promote conservation; and (C) carried out in such manner that no particular individual, corporation, or other entity acquires an excessive share of such privileges. The proposed measures will not discriminate between residents of different states.

Rebuilding plans should contain a discussion of potential or likely allocations among sectors and allocation decisions may be guided by rebuilding plan objectives and specific policies described in the plans. To the degree that rebuilding plans specify allocation between sectors, they will do so in a fair and equitable manner. These decisions are made through the Council process and accordance with its established procedures and policies. In addition, the evaluation of alternatives in the EIS considers their effect on allocation between sectors.

National Standard 5 states that conservation and management measures shall, where practicable, consider efficiency in the utilization of fishery resources; except that no such measure shall have economic allocation as its sole purpose.

Rebuilding plans do not address this National Standard directly, except that no measures are intended to allocate groundfish resources solely for the purpose of economic efficiency.

National Standard 6 states that conservation and management measures shall take into account and allow for variations among, and contingencies in, fisheries, fishery resources, and catches.

Rebuilding plans recognize the differences between the various groundfish fishery sectors. Different sectors may have different catch levels for overfished species and capacity to avoid or minimize catch of overfished species. Although the primary purpose of targets described in this amendment are to allow overfished stocks to recover, differential impacts were considered when formulating them. Contingencies considered in the EIS include variation in stock assessment results, the effect of long-term changes in ocean conditions, and the stock-recruitment relationship for overfished groundfish stocks.

National Standard 7 states that conservation and management measures shall, where practicable, minimize costs and avoid unnecessary duplication.

Rebuilding plan measures are implemented through the harvest specifications and management measures process developed for the whole groundfish fishery. This approach is intended to minimize cost and duplication.

National Standard 8 states that conservation and management measures shall, consistent with the conservation requirements of this Act (including the prevention of overfishing and rebuilding of overfished stocks), take into account the importance of fishery resources to fishing communities in order to (A) provide for the sustained participation of such communities, and (B) to the extent practicable, minimize adverse economic impacts on such communities.

The analyses supporting the adoption of individual rebuilding plans through this amendment (organized around NEPA requirements) consider the socioeconomic impacts of rebuilding to fishing communities. Rebuilding plans generally do not employ a policy that would rebuild stocks in the minimum time period, which *would very likely require a complete cessation of many fisheries. This is meant to minimize impacts to communities by allowing some level of fishing mortality on overfished stocks while identifying a trajectory that will lead to their eventual recovery.*

National Standard 9 states that conservation and management measures shall, to the extent practicable, (A) minimize bycatch and (B) to the extent bycatch cannot be avoided, minimize the mortality of such bycatch.

Most overfished species are no longer targeted and in many cases only constitute bycatch due to regulatory discards. Because rebuilding plans must account for total fishing mortality, strategies must minimize bycatch. The environmental impact analysis for this amendment evaluates the impact of alternative management measures on bycatch.

National Standard 10 states that conservation and management measures shall, to the extent practicable, promote the safety of human life at sea.

The evaluation of alternatives in the EIS considers impacts to safety.

7.3 Other Applicable Magnuson-Stevens Act Provisions

This amendment and associated rebuilding plans conform to Section 304(e)–Rebuild Overfished Fisheries. Rebuilding plans contain the elements required by Section 304(e)(4) and discussed in National Standards Guidelines (50 CFR 600.310).

8.0 CROSS-CUTTING MANDATES

In addition to being prepared in accordance with the requirements of the Magnuson-Stevens Act and the National Environmental Policy Act, this document also addresses requirements of other applicable federal laws and Executive Orders. These laws and orders are described here and their applicability to this action assessed.

8.1 Other Federal Laws

8.1.1 Coastal Zone Management Act

Section 307(c)(1) of the federal Coastal Zone Management Act (CZMA) of 1972 requires all federal activities that directly affect the coastal zone be consistent with approved state coastal zone management programs to the maximum extent practicable. The *Preferred Alternative* would be implemented in a manner that is consistent to the maximum extent practicable with the enforceable policies of the approved coastal zone management programs of Washington, Oregon, and California. This determination has been submitted to the responsible state agencies for review under section 307(c)(1) of the CZMA. The relationship of the groundfish FMP with the CZMA is discussed in Section 11.7.3 of the groundfish FMP. The groundfish FMP has been found to be consistent with the Washington, Oregon, and California coastal zone management programs. The recommended action is consistent and within the scope of the actions contemplated under the framework FMP.

Under the CZMA, each state develops its own coastal zone management program which is then submitted for federal approval. This has resulted in programs which vary widely from one state to the next. Rebuilding plans adopted under Amendment 16-2 establish strategies for rebuilding four overfished groundfish stocks and are not expected to affect any state's coastal management program.

8.1.2 Endangered Species Act

NMFS issued Biological Opinions under the ESA on August 10, 1990, November 26, 1991, August 28, 1992, September 27, 1993, May 14, 1996, and December 15, 1999 pertaining to the effects of the groundfish fishery on chinook salmon (Puget Sound, Snake River spring/summer, Snake River fall, upper Columbia River spring, lower Columbia River, upper Willamette River, Sacramento River winter, Central Valley spring, California coastal), coho salmon (Central California coastal, southern Oregon/northern California coastal), chum salmon (Hood Canal summer, Columbia River), sockeye salmon (Snake River, Ozette Lake), and steelhead (upper, middle and lower Columbia River, Snake River Basin, upper Willamette River, central California coast, California Central Valley, south-central California, northern California, southern California). During the 2000 Pacific whiting season, the whiting fisheries exceeded the chinook bycatch amount specified in the Pacific whiting fishery Biological Opinion's (BO) (December 15, 1999) incidental take statement estimate of 11,000 fish, by approximately 500 fish. In the 2001 whiting season, however, the whiting fishery's chinook bycatch was about 7,000 fish, which approximates the long-term average. After reviewing data from, and management of, the 2000 and 2001 whiting fisheries (including industry bycatch minimization measures), the status of the affected listed chinook, environmental baseline information, and the incidental take statement from the 1999 whiting BO, NMFS determined in a letter dated April 25, 2002 that a re-initiation of the 1999 whiting BO was not required. NMFS has concluded that implementation of the FMP for the Pacific Coast groundfish fishery is not expected to jeopardize the continued existence of any endangered or threatened species under the jurisdiction of NMFS, or result in the destruction or adverse modification of critical habitat. The proposed action is within the scope of these consultations.

8.1.3 Marine Mammal Protection Act

The Marine Mammal Protection Act (MMPA) of 1972 is the principle federal legislation that guides marine mammal species protection and conservation policy in the United States. Under the MMPA, NMFS is responsible for the management and conservation of 153 stocks of whales, dolphins, porpoise, as well as seals, sea lions, and fur seals; while the U.S. Fish and Wildlife Service is responsible for walrus, sea otters, and the West Indian manatee.

Off the West Coast, the Steller sea lion (*Eumetopias jubatus*) Eastern stock, Guadalupe fur seal (*Arctocephalus townsendi*), and Southern sea otter (*Enhydra lutris*) California stock are listed as threatened under the ESA and the sperm whale (*Physeter macrocephalus*) Washington, Oregon, and California (WOC) Stock, humpback whale (*Megaptera novaeangliae*) WOC - Mexico Stock, blue whale (*Balaenoptera musculus*) Eastern north Pacific stock, and Fin whale (*Balaenoptera physalus*) WOC Stock are listed as depleted under the MMPA. Any species listed as endangered or threatened under the ESA is automatically considered depleted under the MMPA.

The West Coast groundfish fisheries are considered a Category III fishery, indicating a remote likelihood of or no known serious injuries or mortalities to marine mammals, in the annual list of fisheries published in the *Federal Register*. Based on its Category III status, the incidental take of marine mammals in the West Coast groundfish fisheries does not significantly impact marine mammal stocks. Amendment 16-2 adopts rebuilding plans establishing targets for rebuilding four overfished groundfish stocks. These rebuilding strategies may indirectly affect the intensity, duration and location of groundfish fisheries through subsequent management measures implemented to achieve strategic targets. But these changes would not change the effects of the groundfish fisheries on marine mammals.

8.1.4 Migratory Bird Treaty Act

The Migratory Bird Treaty Act of 1918 was designed to end the commercial trade of migratory birds and their feathers that, by the early years of the 20th century, had diminished populations of many native bird species. The Act states that it is unlawful to take, kill, or possess migratory birds and their parts (including eggs, nests, and feathers) and is a shared agreement between the United States, Canada, Japan, Mexico, and Russia to protect a common migratory bird resource. The Migratory Bird Treaty Act prohibits the directed take of seabirds, but the incidental take of seabirds does occur. The proposed action is unlikely to affect the incidental take of seabirds protected by the Migratory Bird Treaty Act.

8.1.5 Paperwork Reduction Act

The proposed action, as implemented by any of the alternatives considered in this EIS, does not require collection-of-information subject to the PRA.

8.1.6 Regulatory Flexibility Act

The purpose of the Regulatory Flexibility Act (RFA) is to relieve small businesses, small organizations, and small governmental entities of burdensome regulations and record-keeping requirements. Major goals of the RFA are; (1) to increase agency awareness and understanding of the impact of their regulations on small business, (2) to require agencies communicate and explain their findings to the public, and (3) to encourage agencies to use flexibility and to provide regulatory relief to small entities. The RFA emphasizes predicting impacts on small entities as a group distinct from other entities and the consideration of alternatives that may minimize the impacts while still achieving the stated objective of the action. An initial regulatory flexibility analysis (IRFA) is conducted unless it is determined that an action will not have a "significant economic impact on a substantial number of small entities." The RFA requires that an initial regulatory flexibility analysis (IRFA) include elements that are similar to those required by EO 12866 and NEPA. Therefore, the IRFA has been combined with the RIR and NEPA analyses.

Section 8.3 (below) summarizes the analytical conclusions specific to the RFA and EO 12866.

8.2 Executive Orders

8.2.1 EO 12866 (Regulatory Impact Review)

EO 12866, Regulatory Planning and Review, was signed on September 30, 1993, and established guidelines for promulgating new regulations and reviewing existing regulations. The EO covers a variety of regulatory policy considerations and establishes procedural requirements for analysis of the benefits and costs of regulatory actions. Section 1 of the Order deals with the regulatory philosophy and principles that are to guide agency development of regulations. It stresses that in deciding whether and how to regulate, agencies should assess all of the costs and benefits across all regulatory alternatives. Based on this analysis, NMFS should choose those approaches that maximize net benefits to society, unless a statute requires another regulatory approach.

The RIR and IRFA determinations are part of the combined summary analysis in Section 8.3 of this document.

8.2.2 EO 12898 Environmental Justice

EO 12898 obligates federal agencies to identify and address "disproportionately high adverse human health or environmental effects of their programs, policies, and activities on minority and low-income populations in the United States" as part of any overall environmental impact analysis associated with an action. NOAA guidance, NAO 216-6, at §7.02, states that "consideration of EO 12898 should be specifically included in the NEPA documentation for decision making purposes." Agencies should also encourage public participation—especially by affected communities—during scoping as part of a broader strategy to address environmental justice issues.

The environmental justice analysis must first identify minority and low-income groups that live in the project area and may be affected by the action. Typically, census data are used to document the occurrence and distribution of these groups. Agencies should be cognizant of distinct cultural, social, economic, or occupational factor that could amplify the adverse effects of the proposed action. (For example, if a particular kind of fish is an important dietary component, fishery management actions affecting the availability or price of that fish could have a disproportionate effect.) In the case of Indian tribes, pertinent treaty or other special rights should be considered. Once communities have been identified and characterized and potential adverse impacts of the alternatives are identified, the analysis must determine whether these impacts are disproportionate. Because of the context in which environmental justice developed, health effects are usually considered and three factors may be used in an evaluation: whether the effects are deemed significant, as the term is employed by NEPA; whether the rate or risk of exposure to the effect appreciably exceeds the rate for the general population or some other comparison group; and whether the group in question may be affected by cumulative or multiple sources of exposure. If disproportionately high adverse effects are identified, mitigation measures should be proposed. Community input into appropriate mitigation is encouraged.

The EIS prepared for 2003 groundfish specifications and management measures (PFMC 2003) describes coastal communities affected by the proposed action and impacts to those communities. Available demographic data show that, coastal counties where these communities are located are variable in terms of social indicators like income, employment and race and ethnic composition. However, equivalent data specific to the groups directly affected by the proposed action are not available. Treaty tribes harvesting West Coast groundfish are part of the Council's decision-making process on groundfish management issues and tribes with treaty rights to salmon, groundfish, or halibut have a seat on the Council.

The proposed action indirectly affects groundfish allocations or harvest levels that could in turn disproportionately impact low income and minority populations. Actions pursuant to this amendment, most importantly the development of harvest specifications and management measures needed to ensure stock rebuilding could result in changes to coastal communities' income with possible disproportionate effects on low income and minority populations. These actions will be subject to future NEPA analyses in which environmental justice implications can be evaluated.

8.2.3 EO 13132 (Federalism)

Executive Order 13132, which revoked EO 12612, an earlier federalism Executive Order, enumerates eight "fundamental federalism principles." The first of these principles states "Federalism is rooted in the belief that issues that are not national in scope or significance are most appropriately addressed by the level of government closest to the people." In this spirit, the Executive Order directs agencies to consider the implications of policies that may limit the scope of or preempt states' legal authority. Preemptive action having such "federalism implications" is subject to a consultation process with the states; such actions should not create unfunded mandates for the states; and any final rule published must be accompanied by a "federalism summary impact statement."

The Council process offers many opportunities for states (through their agencies, Council appointees, consultations, and meetings) to participate in the formulation of management measures. This process encourages states to institute complementary measures to manage fisheries under their jurisdiction that may affect federally-managed stocks.

The proposed action does not have federalism implications subject to EO 13132.

8.2.4 EO 13175 (Consultation and Coordination With Indian Tribal Government)

Executive Order 13175 is intended to ensure regular and meaningful consultation and collaboration with tribal officials in the development of federal policies that have tribal implications, to strengthen the United States government-to-government relationships with Indian tribes, and to reduce the imposition of unfunded mandates upon Indian tribes.

The Secretary recognizes the sovereign status and co-manager role of Indian tribes over shared federal and tribal fishery resources. At Section 302(b)(5), the Magnuson-Stevens Act reserves a seat on the Council for a representative of an Indian tribe with federally-recognized fishing rights from California, Oregon, Washington, or Idaho.

The U.S. government formally recognizes the four Washington Coastal Tribes (Makah, Quileute, Hoh, and Quinault) have treaty rights to fish for groundfish. In general terms, the quantification of those rights is 50% of the harvestable surplus of groundfish available in the tribes' usual and accustomed (U and A) fishing areas (described at 50 CFR 660.324). Each of the treaty tribes has the discretion to administer their fisheries and to establish their own policies to achieve program objectives. Accordingly, tribal allocations and regulations have been developed in consultation with the affected tribe(s) and, insofar as possible, with tribal consensus.

The alternatives under consideration for Amendment 16-2 do not directly affect tribal groundfish allocations.

8.2.5 EO 13186 (Responsibilities of Federal Agencies to Protect Migratory Birds)

Executive Order (EO) 13186 supplements the Migratory Bird Treaty Act (above) by requiring federal agencies to work with the U.S. Fish and Wildlife Service to develop memoranda of agreement to conserve migratory birds. NMFS is scheduled to implement its memorandum of understanding by January 2003. The protocols developed by this consultation will guide agency regulatory actions and policy decisions in order to address this conservation goal. The EO also directs agencies to evaluate the effects of their actions on migratory birds in environmental documents prepared pursuant to the National Environmental Policy Act.

The proposed action will not directly affect protected species, including seabirds.

8.3 Regulatory Impact review and regulatory Flexibility Analysis

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Appendix A. Rebuilding Analysis for Darkblotched Rockfish

Rebuilding Analysis for Darkblotched Rockfish

November, 2001

Richard Methot and Jean Rogers
NOAA Fisheries - NWFSC
Seattle, WA and Newport, OR

The west coast stock of darkblotched rockfish was assessed in 2000 using data through 1999 (Rogers et al. 2000). The assessment used the length-based stock synthesis model (Methot 2000) to analyze fishery size and age composition data and trends in abundance from the shelf and slope trawl surveys. The assessment determined that abundance of darkblotched rockfish had declined below the overfished threshold, 25% of the estimated unfished level of abundance, which triggered initiation of a rebuilding plan to restore this stock to its MSY level of abundance, which is provisionally set at 40% of the unfished level. The rebuilding analysis documented here is intended to provide information for use by the PFMC and NMFS in designing a rebuilding plan for this stock.

A slope trawl survey was conducted in the fall of 2000, after completion of the darkblotched rockfish stock assessment but prior to the rebuilding analyses. The SSC recommended in June 2001 that the darkblotched rebuilding analysis should be based on an assessment update that included that 2000 survey data, and recruitments during the more recent era should be the basis for the rebuilding rate. This document provides the recommended analyses. Rebuilding projections are presented based upon two scenarios for estimating the virgin recruitment level and, for each of these scenarios, two scenarios for estimating future recruitment levels. Here, the term "virgin" represents the average stock condition that would occur in the absence of fishing. Of these four scenarios, the recommended result is based upon virgin recruitment estimated from the entire time series and future recruitment estimated from the more recent portion of the time series. Analyses utilize the methodology developed by Punt (2001).

The 2000 survey biomass estimate was similar to the 1997 slope survey biomass estimate and lower than the 1999 slope survey biomass estimate. Updating the assessment model with the 2000 data results in a downward revision in the estimated recruitment and abundance throughout the time series (Figures 1-3, Table 1). The major change is in the level of recruitment since the mid-1980s (Table 2). In the original assessment model, the mean level of recruitment was similar in the early (1963-1982) and late (1983-1996) eras of the time series. With the updated model, the mean recruitment in 1983-1996 is only 67% of the earlier level. This decline in recruitment results in the estimated level of spawn output projected to the beginning of 2002 to be only 12-14% of the virgin level, depending upon whether the virgin level is taken from the initial conditions of the assessment or from the mean level of recruitment during 1963-1996, respectively.

The rebuilding time frame is determined by assuming fishing mortality for darkblotched rockfish can be stopped as of 2002. If the median time to rebuild the spawn to 40% of the unfished level is less than 10 years with no fishing then the maximum allowable rebuilding time is ten years. If it is at least 10 years without fishing, then it is the time to rebuild plus one generation time. A generation time is: (age x survival x spawn) summed for all ages/(survival x spawn) summed for all ages.

The updated assessment model has the same basic life history parameters as the original model (Table 3). With these parameters, F50% is 0.0321; generation time is 33 years; and the unfished level of spawn output per recruit is 18.42.

This rebuilding analysis uses recruitments from 1983-1996 for the forecast. The addition of 2000 survey data makes it reasonable to include recruitments through 1996 since these fish are well represented in the survey. The early year began in 1983 to delineate the shift from higher to lower recruitment level. Although the updated assessment provides abundance estimates through 2001, the recruitments for the last few years are not precisely estimated. The 1997-1999 values are based on few data, and the 2000-2001 recruitment values are simply set at an assumed level for the assessment. Therefore, for the rebuilding analysis the calculations start with the estimated numbers at age in 1998, generate recruitments with a random pattern beginning in 1999, and use the observed or extrapolated catch level for 1999, 2000, and 2001.

There are three plausible alternatives for generating estimates of future recruitment from recent (1983-1996) recruitments. One is to simply resample from the estimated recruitments in 1983-1996, second is to resample from the recruits per spawner then multiply by the projected future spawner level, third is to resample deviations from an estimated spawner-recruitment curve. The third option is not yet available because a spawner-recruitment curve has not yet been developed for this stock. Table 2 illustrates that recent recruitment has been lower than historical recruitment, and that recent recruits per spawner have been higher than in the past. Projections here will be based upon resampling directly from recruitments which exhibits no apparent trend over the 1983-1996 time period (Figure 2), whereas the recruits per spawner (Figure 3) shows an upward trend with strong spikes in recent years.

Table 1. Time series for darkblotched rockfish in 2001 updated assessment.

YEAR	SPAWN	RECRUIT	EXPLOIT	CATCH	R/S
VIRGIN	34355	1865	0.000	0	
INIT EQ	28036	1865	0.007	200	0.054
63	28036	4143	0.012	315	0.148
64	27908	10	0.009	246	0.000
65	27858	10	0.018	474	0.000
66	27552	10	0.090	2405	0.000
67	25090	3965	0.151	3659	0.144
68	21287	330	0.095	1982	0.013
69	19389	6646	0.029	560	0.312
70	19053	45	0.030	573	0.002
71	18654	10	0.034	639	0.001
72	18125	2996	0.032	603	0.161
73	17634	240	0.020	374	0.013
74	17467	3514	0.025	469	0.199
75	17329	1035	0.015	285	0.059
76	17489	838	0.025	459	0.048
77	17503	928	0.010	195	0.053
78	17786	1226	0.014	254	0.070
79	17998	2095	0.045	851	0.118
80	17581	3678	0.026	471	0.204
81	17549	3008	0.030	543	0.171
82	17408	1731	0.066	1217	0.099
83	16486	555	0.049	872	0.032
84	15888	499	0.074	1286	0.030
85	14873	728	0.108	1787	0.046
86	13447	913	0.084	1277	0.061
87	12659	1841	0.166	2375	0.137
88	10860	1418	0.138	1692	0.112
89	9681	1480	0.118	1295	0.136
90	8802	375	0.142	1427	0.039
91	7704	755	0.133	1189	0.086
92	6799	1208	0.084	680	0.157
93	6407	1155	0.153	1199	0.170
94	5563	650	0.123	860	0.101
95	5066	3830	0.109	721	0.688
96	4703	1749	0.111	707	0.345
97	4346	370	0.127	797	0.079
98	3910	2677	0.146	890	0.616
99	3417	218	0.055	326	0.056
100	3455	1171	0.038	239	0.343
101	3661	1171	0.020	130	0.339

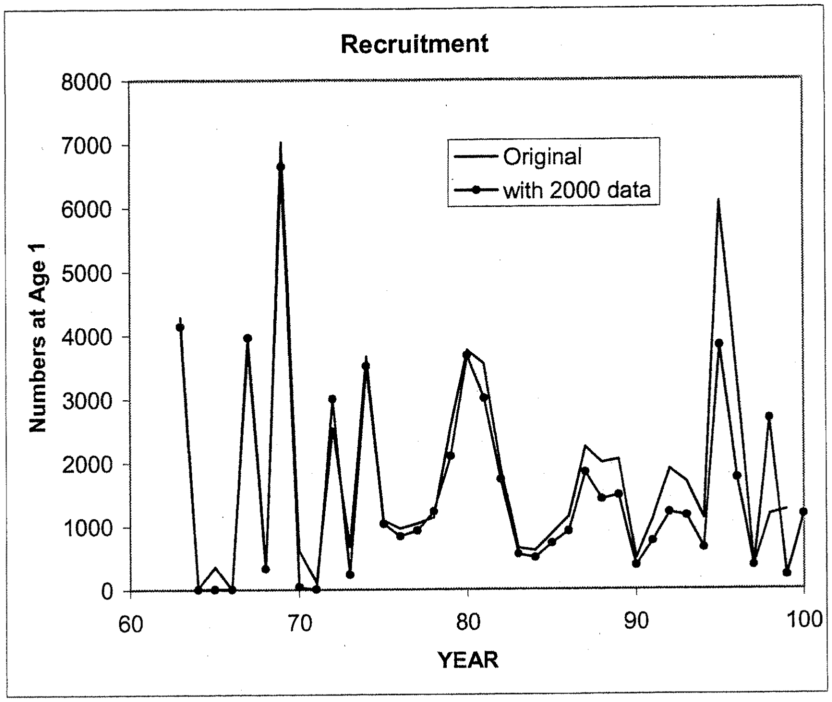

Figure 1. Time series of recruitment in the original (2000) and updated (2001) assessment model for darkblotched rockfish.

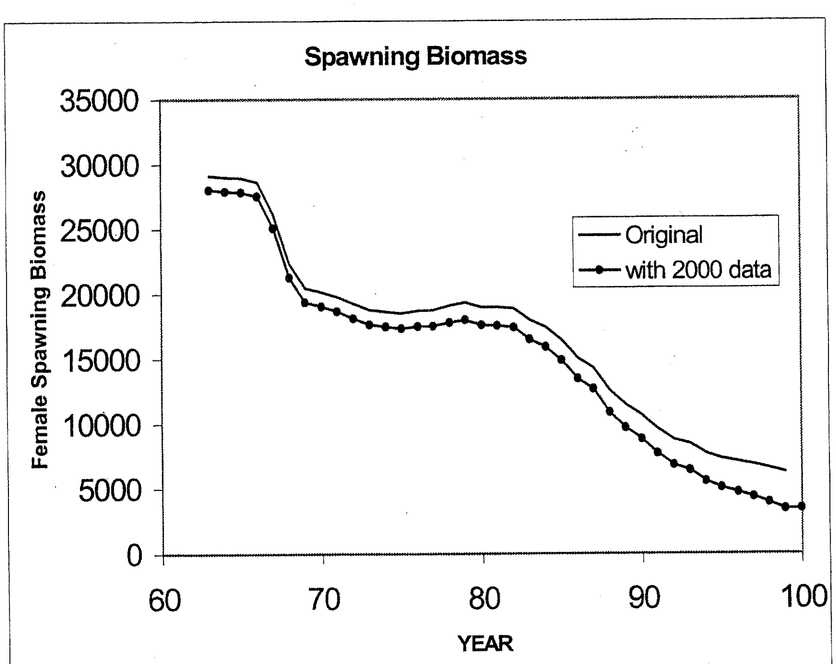

Figure 2. Time series of spawn output and recruitment for original and updated assessment model.

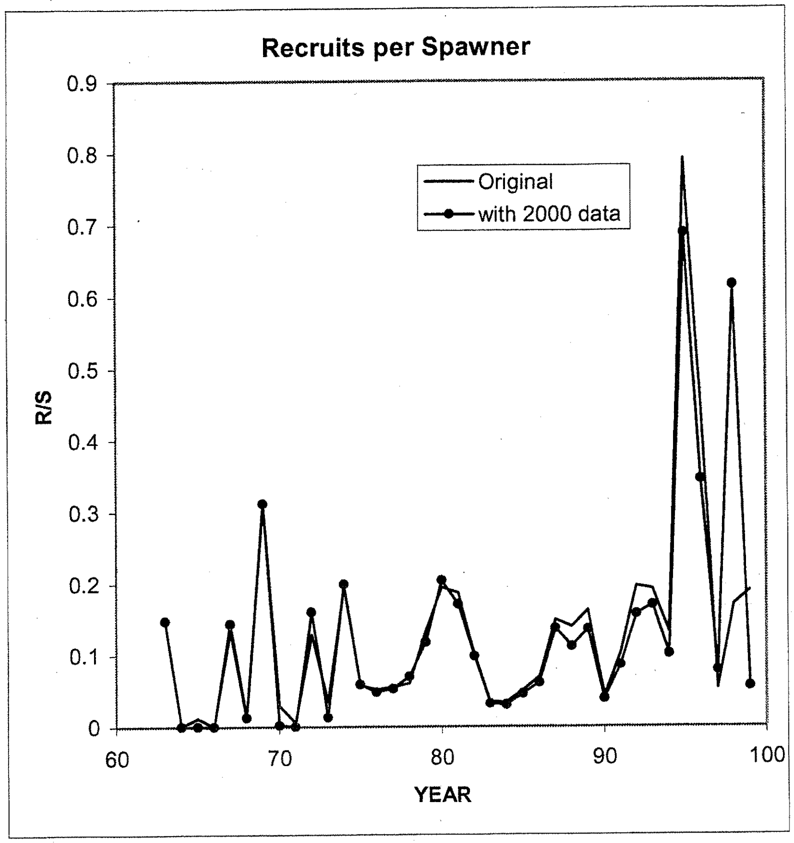

Figure 3. Time series of recruits per spawner for original and updated assessment model.

Table 2. Mean recruitment in early and late eras of the original and updated assessment models.

	Original			with 2000 data	
Year	Recruit	R/S		Recruit	R/S
Initial	1925	–		1865	–
63-82	1972	0.093		1823	0.091
63-96	1903	0.130		1577	0.116
83-96	1806	0.183		1225	0.153

The downward shift in recruitment beginning in the mid 1980s is probably due to an combination of two factors: decreased abundance of spawners and shifts in ocean conditions. It is probable that both have some impact on the decline in recruitment, but the relative magnitude of these two factors cannot be unambiguously determined from available data. In order to examine the potential consequences of these two hypotheses, four rebuilding scenarios were constructed.

A1 - Environment hypothesis: Virgin recruitment determined from the long-term average (1963-1996) which spans good and poor environmental conditions. Recruitments during rebuilding are taken only from the recent (1983-1996) era with poor recruitments in recognition of the uncertain time at which mean recruitment will again shift.

A2 - Virgin recruitment as in A1, but recruitment during rebuilding is taken from the entire time series (1963-1996) in recognition of the possibility that future recruitments will be better represented by the entire historical period. This is an optimistic scenario that is supported only by the moderately strong recruitment in 1995 and 1996.

B1 - Stock-Recruitment hypothesis: Virgin recruitment determined from the model initial conditions in recognition of the historical abundance of the stock. Recruitments during rebuilding are taken from the recent era. This is a pessimistic scenario because it does not account for increased recruitment even as the stock rebuilds.

B2 - Virgin recruitment from initial conditions and rebuilding recruitments from the entire time series.

The results of the rebuilding analyses for the four scenarios is summarized in Table 4 and Figures 4-5. Scenario A1 is considered to be a reasonable basis for forecasting the rebuilding of darkblotched rockfish. It provides for short-term harvest (181 mt in 2002 for a 60% probability of rebuilding) that is similar to the 1999-2001 catch level and to the F50% ABC level, and is intermediate between scenarios A2 and B1. A table of the rebuilding trajectory for scenario A1 is presented in Table 5 and the input parameter file is in the appendix.

Characteristics of some alternatives are worth noting. Faster initial rebuilding (Figure 4) would occur under application of the 40:10 OY adjustment because the 2002 OY would be very low due to the projected spawning biomass in 2002 being at only 14% of the virgin level. Some of the rebuilding scenarios produce short-term catch levels that would exceed the F50% ABC level. Presumably, these would be capped at the F50% ABC level to stay within the overfishing limit.

All four scenarios are based upon the updated assessment model which estimates current stock abundance to be low and implies that the catchability for the shelf and slope trawl surveys is near 1.0. If the actual catchability is less than 1.0, then the current biomass is being underestimated. Improved estimates of catchability and current biomass will be obtained as the survey time series gets longer and as new analyses of survey data are conducted. Meanwhile, the high estimated catchability implies a degree of precaution in these projected levels of catch during rebuilding.

Table 3. Age-specific population characteristics. The mean generation time is 33 years: (age x survival x spawn) summed for all ages/(survival x spawn) summed for all ages.

Both		Females				Males		
AGE	Natural Mortality	spawn (eggs x 100000)	fishery weight (kg)	fishery % selected	Population numbers in 1998	fishery weight (kg)	fishery % selected	Population numbers in 1998
1	0.05	0	0.052	0.001	586	0.043	0.001	586
2	0.05	0	0.136	0.002	179	0.117	0.002	179
3	0.05	0	0.263	0.018	1512	0.227	0.012	1512
4	0.05	0	0.377	0.108	2615	0.333	0.076	2617
5	0.05	0.006	0.472	0.323	451	0.423	0.259	453
6	0.05	0.039	0.56	0.573	627	0.502	0.51	634
7	0.05	0.139	0.645	0.759	630	0.574	0.716	641
8	0.05	0.323	0.729	0.868	323	0.642	0.841	329
9	0.05	0.574	0.809	0.927	126	0.702	0.907	129
10	0.05	0.858	0.885	0.958	449	0.754	0.942	462
11	0.05	1.149	0.955	0.974	375	0.798	0.961	386
12	0.05	1.428	1.018	0.984	359	0.836	0.972	371
13	0.05	1.687	1.075	0.989	154	0.867	0.979	160
14	0.05	1.923	1.125	0.992	100	0.894	0.984	104
15	0.05	2.134	1.169	0.995	58	0.916	0.987	60
16	0.05	2.321	1.207	0.996	51	0.934	0.989	54
17	0.05	2.486	1.24	0.997	126	0.948	0.991	132
18	0.05	2.63	1.269	0.997	198	0.96	0.992	206
19	0.05	2.756	1.293	0.998	180	0.97	0.993	186
20	0.05	2.865	1.315	0.998	106	0.978	0.993	110
21	0.05	2.959	1.333	0.998	41	0.985	0.994	43
22	0.05	3.041	1.349	0.999	34	0.99	0.994	35
23	0.05	3.111	1.362	0.999	28	0.995	0.994	29
24	0.05	3.171	1.374	0.999	29	0.998	0.995	30
25	0.05	3.223	1.383	0.999	91	1.001	0.995	93
26	0.05	3.267	1.392	0.999	15	1.003	0.995	16
27	0.05	3.305	1.399	0.999	54	1.005	0.995	55
28	0.05	3.337	1.405	0.999	2	1.007	0.995	2
29	0.05	3.364	1.41	0.999	11	1.008	0.995	12
30	0.05	3.388	1.414	0.999	121	1.009	0.995	123
31	0.05	3.408	1.418	0.999	4	1.01	0.995	5
32	0.05	3.425	1.421	0.999	56	1.011	0.995	57
33	0.05	3.439	1.424	0.999	0	1.011	0.995	0
34	0.05	3.452	1.426	0.999	4	1.012	0.995	4
35	0.05	3.462	1.428	0.999	0	1.012	0.995	0
36	0.05	3.471	1.43	0.999	41	1.012	0.995	43
37	0.05	3.478	1.431	0.999	16	1.012	0.995	17
38	0.05	3.485	1.432	0.999	14	1.013	0.995	15
39	0.05	3.49	1.433	0.999	13	1.013	0.996	13
40	0.05	3.514	1.438	0.999	203	1.013	0.996	206

Table 4. Summary results for four rebuilding scenarios as described in the text.

Scenario	A1	A2	B1	B2
Virgin Years	63-96	63-96	init	init
Virgin Recr.	1577	1577	1865	1865
Virgin Spawn	29044	29044	34348	34348
Target (40%) Spawn	11618	11618	13739	13739
Spawn 2002/Virgin	0.140	0.140	0.118	0.118
Resample from:	83-96	63-96	83-96	63-96
Rebuild year with F=0	2014	2013	2018	2015
Max allowed rebuild year	2047	2046	2051	2048
Pr(rebuild)	0.5	0.5	0.5	0.5
F	0.033	0.051	0.023	0.039
median rebuild year	2047	2046	2051	2048
OY in 2002	190	295	135	229
Pr(rebuild)	0.6	0.6	0.6	0.6
F	0.031	0.048	0.021	0.036
median rebuild year	2040	2039	2044	2041
OY in 2002	181	277	125	211
Pr(rebuild)	0.7	0.7	0.7	0.7
F	0.029	0.045	0.02	0.034
median rebuild year	2034	2033	2038	2036
OY in 2002	168	260	115	196
Pr(rebuild)	0.8	0.8	0.8	0.8
F	0.027	0.041	0.018	0.031
median rebuild year	2030	2028	2034	2031
OY in 2002	157	238	105	179
2002 ABC at F50%	187	187	187	187

Table 5. Expected time series of rebuilding under scenario A1 and with a 60% probability of rebuilding by 2047.

Year	Median Catch	Median Spawn	Spawn/ Target	Pr(rebuilt)
2002	181	4060	0.350	0.000
2003	198	4506	0.388	0.000
2004	213	5000	0.430	0.000
2005	225	5514	0.475	0.000
2006	235	6023	0.518	0.000
2007	244	6502	0.560	0.000
2008	252	6940	0.597	0.000
2009	260	7327	0.631	0.000
2010	267	7687	0.662	0.000
2011	272	8009	0.689	0.000
2012	279	8307	0.715	0.000
2013	284	8589	0.739	0.000
2014	289	8828	0.760	0.002
2015	293	9052	0.779	0.005
2016	296	9255	0.797	0.018
2017	299	9438	0.812	0.036
2018	303	9595	0.826	0.060
2019	306	9744	0.839	0.076
2020	309	9877	0.850	0.095
2021	313	9995	0.860	0.116
2022	316	10120	0.871	0.153
2023	318	10237	0.881	0.171
2024	319	10355	0.891	0.187
2025	321	10476	0.902	0.211
2026	322	10550	0.908	0.224
2027	324	10636	0.916	0.254
2028	324	10685	0.920	0.280
2029	326	10737	0.924	0.299
2030	327	10789	0.929	0.323
2031	329	10852	0.934	0.343
2032	330	10901	0.938	0.366
2033	330	10963	0.944	0.388
2034	331	11003	0.947	0.401
2035	332	11039	0.950	0.418
2036	332	11084	0.954	0.443
2037	333	11082	0.954	0.458
2038	333	11120	0.957	0.473
2039	334	11156	0.960	0.493
2040	334	11164	0.961	0.502
2041	334	11171	0.962	0.517
2042	335	11194	0.964	0.530
2043	335	11227	0.966	0.545
2044	333	11239	0.967	0.562
2045	335	11232	0.967	0.575
2046	335	11236	0.967	0.585
2047	336	11241	0.968	0.600

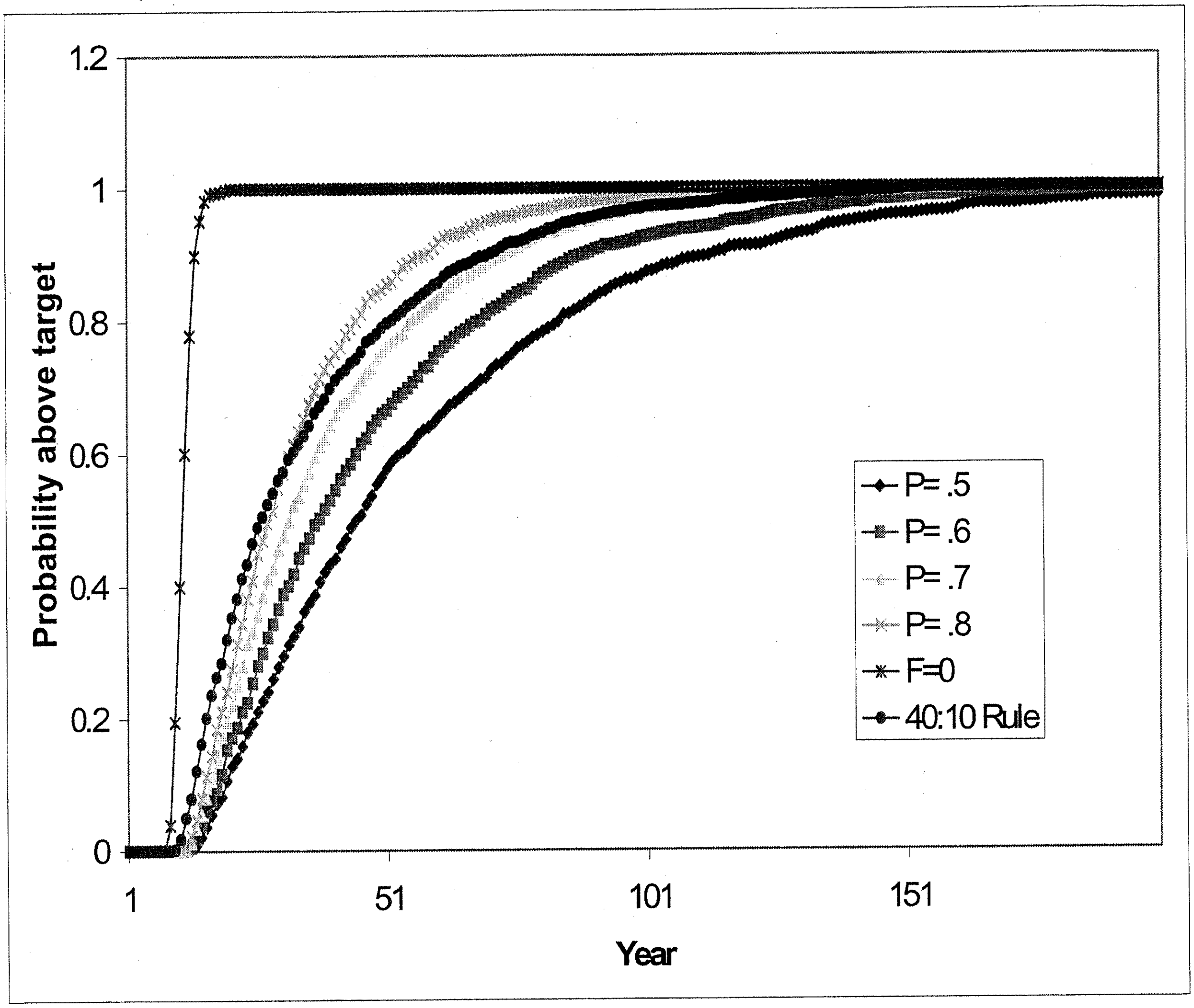

Figure 4. Probability that spawning biomass will be above the target level in each year according to Scenario A1 and six diff harvest schedules. Harvest schedules P=0.5 to P=0.8 refer to probability of being rebuilt by 2047.

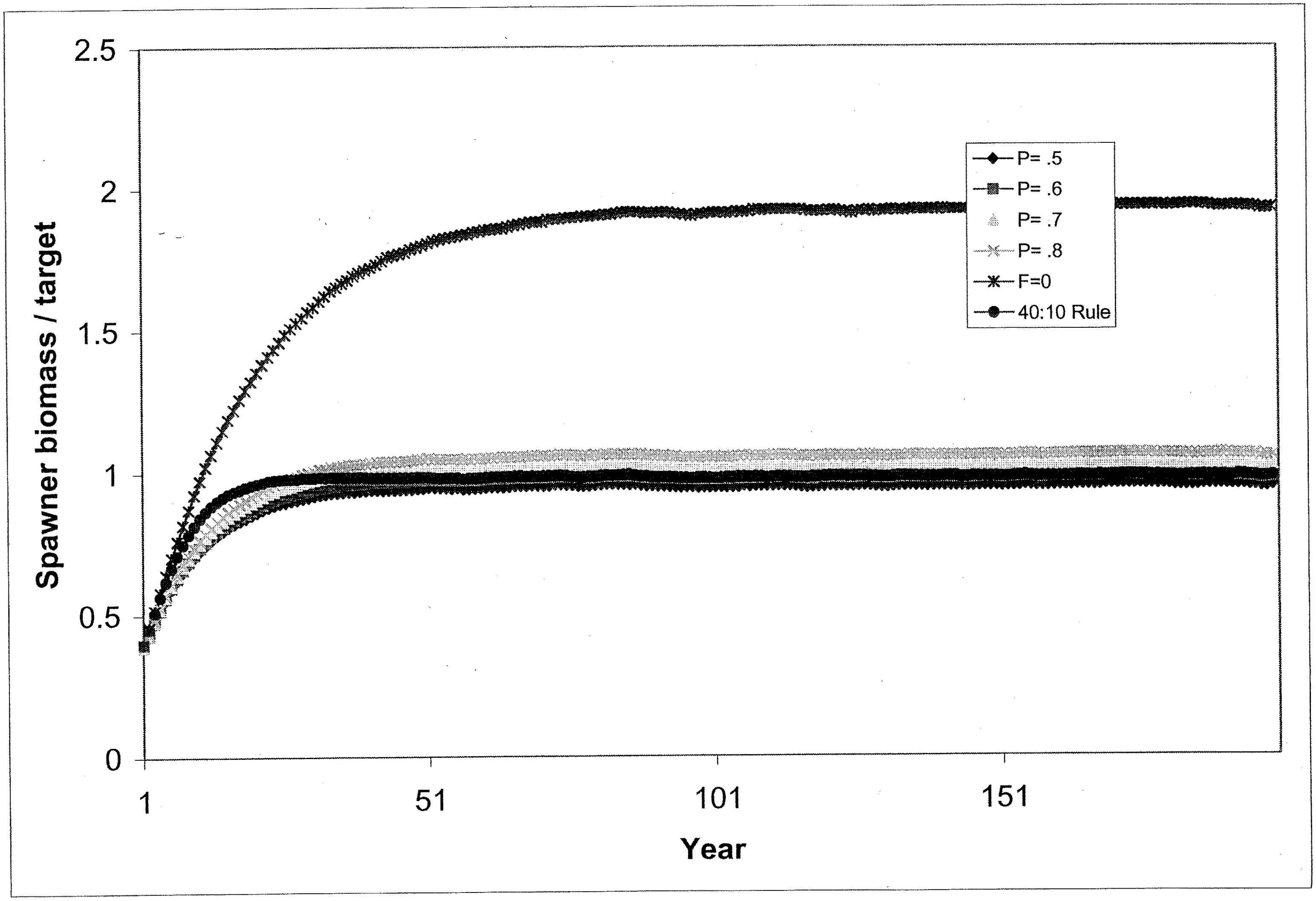

Figure 5. Time series of the ratio of spawner biomass to the target (40%) spawner biomass according to scenario A1 and six harvest schedules.

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Methot, R.D. 2000. Technical description of the stock synthesis assessment program. NOAA Technical Memorandum NMFS-NWFSC-43, 46 p.

Punt, A.E. 2001. SSC default rebuilding analysis. Technical specifications and user manual. version 1.0 12 p.

Rogers, J.B. R.D. Methot, T.L. Builder, K. Piner, and M. Wilkins. 2000. Status of the darkblotched rockfish (*Sebastes crameri*) resource in 2000. Appendix to Status of the Pacific coast groundfish fishery through 2000 and recommended acceptable biological catches for 2001. PFMC, 2130 SW Fifth Avenue Suite 224, Portland, OR 97201.

STAR. 2000. Darkblotched rockfish STAR panel meeting report. In: Status of the Pacific coast groundfish fishery through 2000 and recommended acceptable biological catches for 2001. PFMC, 2130 SW Fifth Avenue Suite 224, Portland, OR 97201.

Appendix. Input file for rebuilding analysis with Scenario A1

```
#Title,,
Darkblotched - with 2000; virgin=63-96; resamp=83-96
# Number of sexes,,
2,,
# Age range to consider (minimum age; maximum age),,
1,40,
# First year of projection,,
1998,,
# Is the maximum age a plus-group (1=Yes;2=No),,
1,,
# Generate future recruitments using historical recruitments (1), historical recruits/spawner (2), or a
stock-recruitment (3)
1,,
# Constant fishing mortality (1) or constant Catch (2) projections,,
1,,
# Pre-specify the year of recovery (or -1) to ignore,,
-1
# Fecundity-at-age,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,
#
1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18,19,20,21,22,23,24,25,26,27,28,29,30,31,32,33,34,35,36,37,3
8,39,40
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857,2.63,2.7557,2.8648,2.9591,3.0406,3.111,3.1712,3.2228,3.2669,3.3047,3.3369,3.3644,3.3878,3.4078,
3.4248,3.4393,3.4516,3.462,3.4709,3.4785,3.4849,3.4904,3.5136
# Age specific information (Females then males) M; body wt; selex; Numbers,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,
# Females,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,
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945,0.9959,0.9968,0.9974,0.9978,0.9981,0.9984,0.9986,0.9987,0.9988,0.9989,0.9989,0.999,0.999,0.999
1,0.9991,0.9991,0.9992,0.9992,0.9992,0.9992,0.9992,0.9992,0.9992,0.9992,0.9993
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115.1,56.4,28.9,19.4,15.8,17.7,55.1,3.5,40.2,0.1,0.5,71.3,3.3,36.2,0.1,0.1,0.1,24.6,9.6,8.4,7.6,119
# Male,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,
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# Number of simulations,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,
1000,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,
#  recruitment and biomass,,,,,
# Number of historical assessment years ,,,,,
37,,,,,
# Historical data,,,,,
# year,recruitment,spawner,in B0,in R project,in R/S project
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1991,755,7704,0,1,1
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1994,650,5563,0,1,1
1995,3830,5066,0,1,1
1996,1749,4703,0,1,1
1997,370,4346,0,0,0
1998,2677,3910,0,0,0
Number of years with pre-specified catches,,,,,
4
catches for years with pre-specified catches,,,,,
1998,889
1999,326
2000,236
2001,130
Number of future recruitments to override,,
0,,
Process for overiding (-1 for average otherwise index in data list),,
Which probability to product detailed results for (1=0.5; 2=0.6; etc.),,
1,,
Steepness,sigma-R,
0.5,0.5,
Target SPR information: Use (1=Yes), target SPR rate,power
0,0.5,1
Discount rate (for cumulative catch),,
0.1,,
Truncate the series when 0.4B0 is reached (1=Yes),,
0,,
Set F to FMSY once 0.4B0 is reached (1=Yes),,

0,,
Percentage of FMSY which defines Ftarget
0.9
Conduct MacCall transition policy (1=Yes)
0
Definition of recovery (1=now only;2=now or before)
2
Produce the risk-reward plots (1=Yes)
0

Appendix B. Rebuilding Analysis for Pacific Ocean Perch

Revised Rebuilding Analysis for Pacific Ocean Perch

Andre E. Punt[1] and James, N. Ianelli[2]
(July 2001)

1.School of Aquatic and Fishery Sciences
Box 355020
University of Washington
Seattle, WA 98195-5020
Email: aepunt@u.washington.edu

2. NMFS Sand Point Laboratory
7600 Sand Point Way NE
Seattle, WA 98115

Email: Jim.Ianelli@noaa.gov

Introduction

The Pacific Fishery Management Council (PFMC) adopted Amendment 11 to its Groundfish Management Plan in 1998. This amendment established an overfishing definition of 25% of the unfished biomass ($0.25B_0$). NMFS determined that a rebuilding plan was required for Pacific Ocean perch (*Sebastes alutus*) in March 1999 based on the most recent stock assessment at that time (Ianelli and Zimmerman, 1997). The PFMC began developing a rebuilding plan for Pacific Ocean perch (based upon a rebuilding analysis; August 1999; A. MacCall, pers. comm.) and submitted this plan to NMFS in February 2000. However, NMFS deferred adoption of the plan until the assessment was updated and reviewed, which was later that year (Ianelli *et al.*, 2000). This rebuilding analysis is based upon the updated assessment and is consistent with the Terms of Reference for rebuilding analyses developed by the SSC.

Ianelli *et al.*'s (2000) assessment involved fitting an age-structured population dynamics model to catch, catch-rate, length-frequency, age-composition, and survey data. Results were presented based on maximum likelihood and Bayesian estimation frameworks. The STAR panel that reviewed this assessment selected the posterior modal estimate from Model 1d as the "best assessment" (PFMC, 2000), and this result is carried forward into this rebuilding analysis. Appendix 1 lists the values for the biological and technological parameters used for the rebuilding analyses and the age-structure at the start of 2000 while Appendix 2 lists the time-series of recruitment and spawning output. The catches for 2000 and 2001 are assumed to be 270 and 303*t* respectively (J. Hastie, NWFSC, pers. commn).

The calculations of this document were performed using the rebuilding software developed by Punt (2001) and the results are based on 1000 Monte Carlo replicates. The definition of "recovery by year *y*" in this analysis is that the spawning output reaches $0.4B_0$ by year *y* (even if it subsequently drops below this level due to recruitment variability). The input to the rebuilding program for the base-case rebuilding analysis is given as Appendix 3.

Selection of the rebuilding period

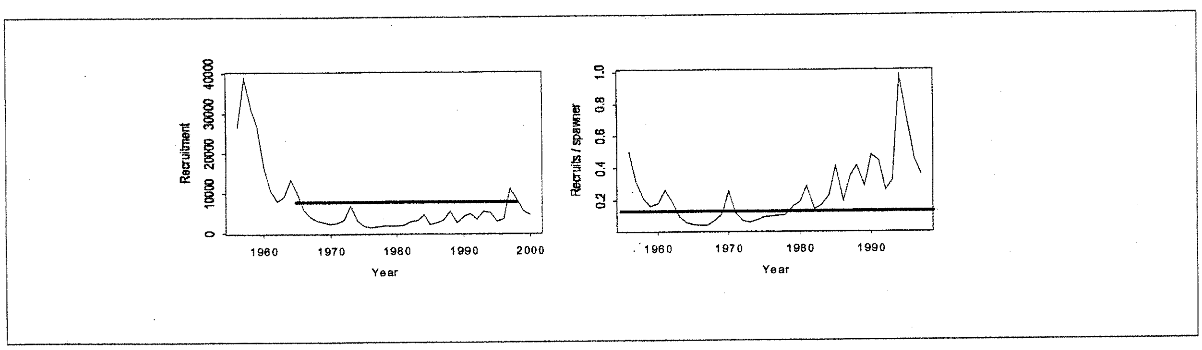
The maximum allowable rebuild period is defined as ten years if the resource can be rebuilt to $0.4B_0$ in fewer than ten years or the minimum possible rebuild period plus one generation if the resource cannot be rebuilt to $0.4B_0$ in ten years. In order to determine the maximum allowable rebuild period, it is therefore necessary to define B_0, how future recruitments are to be generated, and the generation time.

Selection of B_0

It is common (and indeed recommended by the SSC) to define B_0 in terms of the recruitment in the first years of the assessment period. This approach is not considered appropriate in this case because these recruitments were substantially larger than earlier or later recruitments (Figure 1)[1/]. Instead, virgin recruitment (7.8 million age 3 fish - see the horizontal line in the left panel of Figure 1) is based on the estimate of B_0 obtained from the assessment (60,212 units of spawning output). The spawning output at the start of 1998 (the year on which the designation of overfished status was based) is 21.7% of B_0, i.e. below the overfished threshold of $0.25B_0$.

Generation of future recruitment

The assessments on which Appendices 1 and 2 are based included a Beverton-Holt stock-recruitment relationship. However, consistent with SSC guidelines, the base-case projections on which the rebuilding analyses are based ignore this relationship. Figure 1 indicates that both recruitment and recruits per spawner exhibit increasing trends over recent years. However, the trend in recruitment is less marked than that in recruits per spawner so the analyses in this document are based on generating future recruitment by selecting randomly from the historical estimates of recruitment. The years used when generating future (age 3) recruitment are restricted to 1965-98 (see the horizontal line in the left panel of Figure 1). This period encompasses a time of relative stability in recruitment. The mean recruitment during this period is 3839, which is 49% of the virgin level. Furthermore, only three recruitments during 1965-98 exceed the virgin recruitment; rebuilding depends on achieving more of these larger recruitments in the future. Recruitments for 1999 and 2000 are produced by the assessment but are ignored



when generating future recruitment because there are few data on which to base recruitment estimates for these years.

Figure 1 : Recruitment and recruits per spawner. The horizontal line in the left panel indicates the recruitment corresponding to B_0 (the range of this line indicates the years used when generating future recruitment) and that in the right panel indicates the virgin recruits per spawner ratio.

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[1] The earlier recruitments are calculated as part of the assessment but are not reported in Figure 1.

Generation time
The generation time (30 years) is defined as the mean age weighted by net spawning output (Figure 2).

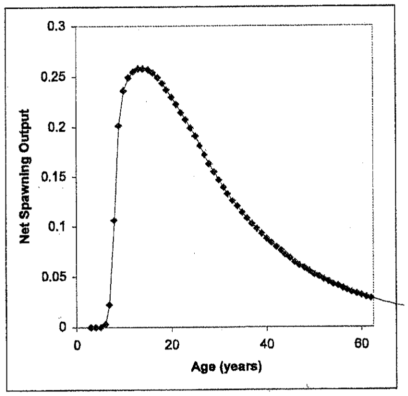

Figure 2 : Net spawning output versus age for Pacific Ocean perch.

The maximum allowable rebuild period
The minimum possible rebuild period (the median time to rebuild to $0.4B_0$ with 0.5 probability in the absence of catches from 2002) based on the above specifications is 10 years (i.e. 2012) (Figure 3). This year is later than 2010 (ten years beyond the year in which Pacific Ocean perch was declared overfished). Therefore the maximum allowable rebuild period is defined as the minimum possible rebuild period plus 30 years (i.e. 2042).

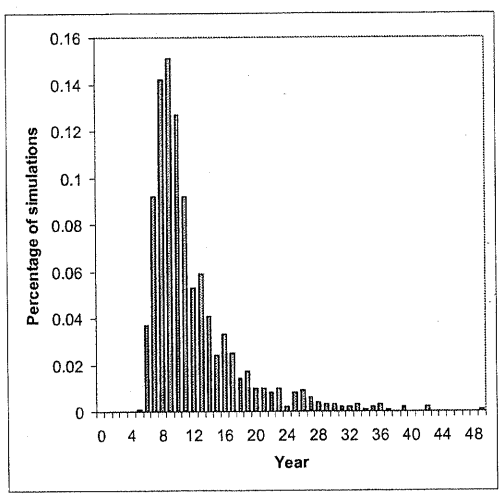

Figure 3 : Time to recover to $0.4B_0$.

Alternative rebuilding strategies
Figure 4 illustrates the trade-off between the time to rebuild with 0.5 probability, the probability of recovery within the maximum allowable rebuild period, and the OY for 2002. The points in Figure 4 are based on a range of equally spaced constant fishing mortalities between 0 and that which achieves a 0.5 probability of recovery within the maximum allowable rebuild period. The

relationship between the probability of recovery within the maximum allowable rebuild period and the number of years to achieve a 0.5 probability of recovery is close to linear. However, the other two relationships are not.

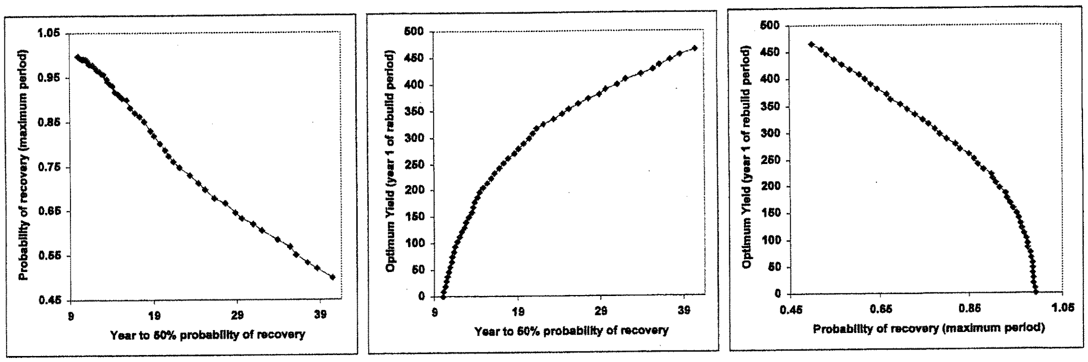

Figure 4: Plots illustrating the trade-off between the probability of rebuilding within the maximum allowable rebuild period, the time to rebuild with 0.5 probability, and the 2002 OY (in mt).

Table 1 lists some key output statistics for five rebuild strategies (probabilities of recovery in the maximum allowable rebuild period of 0.5, 0.6, 0.7 and 0.8 and the strategy of setting future fishing mortality to zero). The probabilities of recovery are not exactly 0.5, 0.6, etc. because of the limited number of recruitments on which the projections are based and the accuracy of the numerical search procedure employed. Figure 5 contrasts the time-trajectory of the probability of recovery for each of the five rebuild strategies in Table 1 along with the envelopes (5%, 25%, 50%, 75% and 95%) of the time-trajectories for catch and the ratio of spawning output to $0.4B_0$ for a 0.6 rebuild probability. Appendix 4 lists the envelopes for the annual catch and the ratio of the spawning output to the target level for a 0.6 probability of rebuild. Note that this ratio is calculated each point in time – the probability of having reached $0.4B_0$ sometime before a given year is at least as great as that listed in Appendix 4 and shown in the right panel of Figure 5 for that year. The choice of 0.6 is based on a suggestion by the SSC (Punt, 2001).

Table 1: Four management-related quantities for five rebuild strategies.

Fishing mortality rate	0.0109	0.0096	0.0082	0.0068	0
OY_{2002} (mt)	464.5	409.7	352.5	290.5	0
Probability of recovery in 40 years	49.9	60.1	69.9	80.1	99.7
Median years to rebuild from year 2000	42.1	33.8	26.8	21.5	11.6

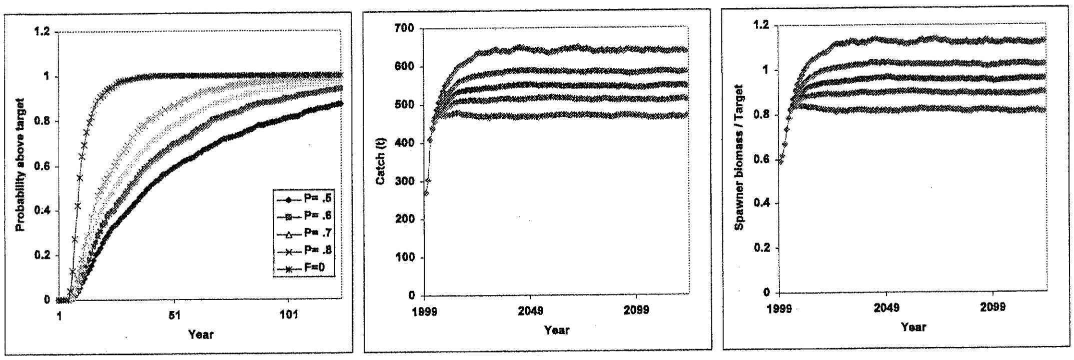

Figure 5 : Time trajectories of the probability of recovery for five rebuild strategies, of the catch for a 0.6 probability of recovery, and of the spawning output expressed relative to $0.4B_0$ for a 0.6 probability of recovery.

Sensitivity tests

Stock-recruitment relationship

The assessments on which the results in the Appendices are based placed constraints on the recruitments in the form of a stock-recruitment relationship. This relationship was ignored for the calculations reported above for consistency with past SSC practice. Table 2, however, reports the values of the four key output statistics when the rebuilding analysis includes the estimated stock-recruitment relationship rather than when future recruitment is generated by sampling from past recruitments (note that including the stock-recruitment relationship changes the maximum allowable rebuild period). The inclusion of a stock-recruitment relationship makes the results more optimistic. These results should, however, be interpreted with some caution because the fits of the stock-recruitment relationship (Figure 6) are relatively poor.

Table 2: Four management-related quantities for five rebuild strategies. Results are shown for the rebuilding analyses that include a Beverton-Holt stock-recruitment relationship and that ignore the three highest recruitments when generating future recruitment.

With stock-recruitment relationship					
Fishing mortality rate	0.0311	0.0287	0.0266	0.0233	0
OY_{2002} (mt)	1313.2	1214.6	1125.6	990.9	0
Probability of recovery in 38 years	50.1	60.1	70	80.1	100
Median years to rebuild from year 2000	39.9	32.8	28.1	23.4	9.9
Ignoring 1965, 1997 and 1998 recruitments when generating future recruitment					
Fishing mortality rate	0.0038	0.0031	0.0023	0.0014	0
OY_{2002} (mt)	162.4	133.3	100.8	58.6	0
Probability of recovery in 44 years	49.9	60.1	70	80.1	90.2
Median years to rebuild from year 2000	46.1	36.8	28.0	20.5	15.8

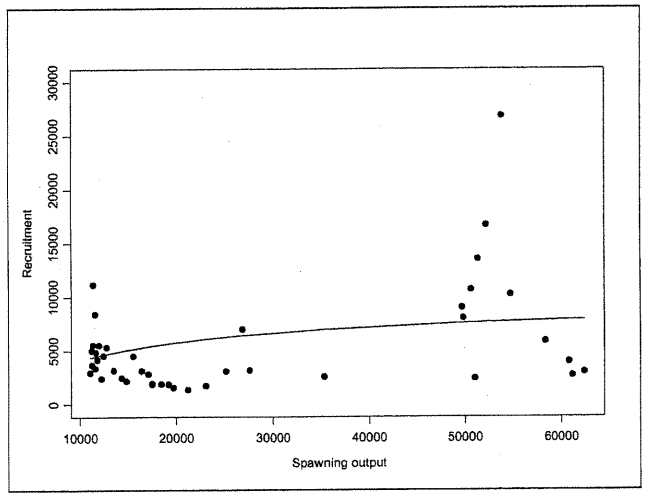

Figure 6: Fit of the Beverton-Holt stock recruitment relationship to the data for Pacific Ocean perch.

Removal of selected recruitment estimates

Table 3 also reports results when the three largest recruitments (1965, 1997 and 1998) are ignored when generating future recruitment. The rationale for omitting these years for sensitivity analyses is to provide a scenario where the future recruitments are much lower and less variable. Also, there is a large degree of uncertainty in the recruitments for 1997 and 1998. The approximate 95% confidence bounds for these years range from nearly one third to three times the point estimate. As expected, removal of these estimates from the projection calculations led to a major reduction in rebuild potential. Consequences of this include a longer time to rebuild in the absence of exploitation (14 compared to 10 years) and lower 2002 OYs.

Revisions to the catch series

Several refinements to the assessment of Pacific Ocean perch and other species are being considered at present. The development since the 2000 assessment that will probably have the greatest impact on the rebuilding analysis is the re-analysis of the foreign catches by Rogers (In prep). Although the revisions to the catch series for Pacific Ocean perch are yet to be finalized, preliminary results indicate that the OYs for 2002 based on assessments using the revised catches will be lower than those reported in Table 1.

References

Ianelli, J.N., Wilkins, M. and S. Harley. 2000. Status and future prospects for the Pacific Ocean Perch resource in waters off Washington and Oregon as assessed in 2000. In: Appendix to "Status of the Pacific coast groundfish fishery through 2000 and recommended Acceptable Biological Catches for 2001". Stock Assessment and Fishery Evaluation. Pacific Fishery Management Council. 2130 SW Fifth Avenue, Suite 224, Portland OR, 97201.

Ianelli, J.N. and M. Zimmerman. 1997. Status and future prospects for the Pacific Ocean perch resource in waters off Washington and Oregon as assessed in 1998. In: "Status of the Pacific coast groundfish fishery through 1998 and recommended Acceptable Biological Catches for 1999". Stock Assessment and Fishery Evaluation. Pacific Fishery Management Council. 2130 SW Fifth Avenue, Suite 224, Portland OR, 97201.

Pacific Fishery Management Council. 2000. Pacific Ocean Perch STAR Panel Report. In "Status of the Pacific Coast Groundfish Fishery Through 2000 and Recommended Biological Catches for 2001: Stock Assessment and Fishery Evaluation". (Document prepared for the Council and its advisory entities) Pacific Fishery Management Council. 7700 NE Ambassador Place, Suite 200. Portland, OR 97220.

Punt, A.E. SSC default rebuilding analysis. Technical specifications and user manual. Ver. 1.00003. (Draft document, available from author).

Rogers, J.B. In prep. Species allocation of 1965-1977 United States west coast foreign rockfish (*Sebastes* and *Sebastolobus* sp.) catch

Appendix 1 : Biological and technological parameters used for the rebuilding analyses

Age	Fecundity	Weight (kg)	Selectivity	N
3	0.000	0.169	0.015	4519
4	0.000	0.241	0.046	5228
5	0.000	0.317	0.138	7574
6	0.004	0.396	0.349	9525
7	0.028	0.474	0.697	2945
8	0.137	0.550	1.047	2229
9	0.274	0.622	1.239	3554
10	0.339	0.690	1.251	3638
11	0.375	0.752	1.223	2053
12	0.404	0.809	1.197	2748
13	0.431	0.861	1.178	2169
14	0.454	0.908	1.170	1151
15	0.475	0.950	1.168	2331
16	0.494	0.987	1.166	1260
17	0.510	1.021	1.174	887
18	0.525	1.050	1.201	719
19	0.538	1.076	1.239	1364
20	0.550	1.099	1.265	860
21	0.560	1.119	1.262	706
22	0.569	1.137	1.244	440
23	0.576	1.153	1.244	381
24	0.583	1.166	1.244	350
25+	0.589	1.178	1.244	5847

Appendix 2 : Historical series of spawning output and recruitment.

Year	Recruitment (age 3)	Spawning output
1956	26452	53787
1957	38763	52201
1958	31233	50654
1959	26822	49841
1960	16651	49702
1961	10648	51349
1962	8005	54705
1963	8979	58321
1964	13485	60822
1965	10198	62421
1966	5828	61190
1967	3904	51035
1968	2965	35385
1969	2629	27577
1970	2357	26841
1971	2522	25157
1972	3141	23073
1973	6969	21230
1974	3047	19746
1975	1703	19236
1976	1345	18493
1977	1537	17546
1978	1860	17533
1979	1867	17131
1980	1847	16464
1981	1931	15572
1982	2812	14873
1983	3111	14388
1984	4499	13528
1985	2166	12801
1986	2440	12243
1987	3157	11814
1988	5317	11669
1989	2395	11598
1990	4139	11371
1991	4841	11250
1992	3351	11095
1993	5512	11273
1994	5011	11395
1995	2936	11594
1996	3646	11998
1997	11142	12457
1998	8399	13039
1999	5504	13725
2000	4519	14250

Appendix 3 : The input file for the base-case rebuilding analysis

```
#Title,
POP - STAR panel model (Original foreign catches),
# Number of sexes,
1,
# Age range to consider (minimum age; maximum age),
3,25,
# First year of projection,
2000,
# Is the maximum age a plus-group (1=Yes;2=No),
1,
# Generate future recruitments using historical recruitments (1), historical recruits/spawner (2), or a stock-recruitment (3)
1,
# Constant fishing mortality (1) or constant Catch (2) projections,
1,
# Pre-specify the year of recovery (or -1) to ignore,
-1,
# Fecundity-at-age
# 3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18,19,20,21,22,23,24,25
3.84E-06,4.03E-
05,0.000392248,0.003560962,0.028260766,0.1374925,0.273954602,0.338584679,0.375081501,0.404469053,0.430553194,0.453991276,0.47
49965,0.493739,0.510395,0.52515,0.53818,0.549655,0.559745,0.568595,0.576345,0.58313,0.589055
# Age specific information (Females then males) M; body wt; selex; Numbers
# Females
0.051268,0.051268,0.051268,0.051268,0.051268,0.051268,0.051268,0.051268,0.051268,0.051268,0.051268,0.051268,0.051268,0.051268,0.0
51268,0.051268,0.051268,0.051268,0.051268,0.051268,0.051268,0.051268,0.051268
0.169105,0.240603,0.317273,0.395966,0.474162,0.54997,0.62206,0.689572,0.752022,0.80921,0.861146,0.907988,0.949993,0.987478,1.0207
9,1.0503,1.07636,1.09931,1.11949,1.13719,1.15269,1.16626,1.17811
0.0150383,0.0460987,0.137995,0.349401,0.696964,1.04722,1.23902,1.25075,1.22328,1.1965,1.17838,1.17032,1.16768,1.16629,1.17384,1.20
124,1.23873,1.26485,1.26166,1.24369,1.24369,1.24369,1.24369
4518.68,5228.16,7573.91,9524.67,2945.37,2228.92,3554.34,3637.52,2052.94,2748.15,2168.62,1151.47,2330.93,1259.57,886.926,718.926,13
64.47,860.091,706.002,439.578,381.17,349.572,5847.27
# Number of simulations
1000
#  recruitment and biomass
# Number of historical assessment years
46
# Historical data
# year,recruitment,spawner,in B0,in R project,in R/S project
1955,7822.9,60212,1,0,0
1956,26451.8,53787.1,0,0,0
1957,38762.7,52200.5,0,0,0
1958,31232.9,50653.7,0,0,0
1959,26821.6,49841.3,0,0,1
1960,16650.9,49701.9,0,0,1
1961,10648.3,51349.2,0,0,1
1962,8005.34,54704.5,0,0,1
1963,8978.75,58320.8,0,0,1
1964,13485,60821.6,0,0,1
1965,10198.2,62420.6,0,1,1
1966,5828.14,61190.2,0,1,1
1967,3904.45,51034.5,0,1,1
1968,2965.33,35385.3,0,1,1
1969,2629.07,27577.3,0,1,1
1970,2356.87,26840.8,0,1,1
1971,2521.91,25157.4,0,1,1
1972,3141.36,23073.4,0,1,1
1973,6969.44,21229.5,0,1,1
1974,3046.8,19745.7,0,1,1
1975,1703.11,19235.9,0,1,1
1976,1344.54,18493.2,0,1,1
1977,1536.94,17545.6,0,1,1
1978,1859.93,17533.3,0,1,1
1979,1866.67,17131.1,0,1,1
1980,1846.92,16464,0,1,1
1981,1931.13,15572.2,0,1,1
1982,2812.19,14873.4,0,1,1
```

1983,3110.87,14387.5,0,1,1
1984,4498.81,13528,0,1,1
1985,2165.78,12801.2,0,1,1
1986,2440.4,12242.8,0,1,1
1987,3157.47,11814.4,0,1,1
1988,5316.72,11668.7,0,1,1
1989,2394.87,11597.9,0,1,1
1990,4138.59,11371.2,0,1,1
1991,4841.48,11250.2,0,1,1
1992,3350.57,11095.4,0,1,1
1993,5512.09,11272.9,0,1,1
1994,5011.27,11394.6,0,1,1
1995,2936.13,11594.2,0,1,1
1996,3646.31,11997.5,0,1,1
1997,11141.9,12457.3,0,1,1
1998,8399.49,13039.4,0,1,1
1999,5504.47,13725.2,0,0,0
2000,4518.68,14249.6,0,0,0
Number of years with pre-specified catches
2
catches for years with pre-specified catches,
2000,270,
2001,303,
Number of future recruitments to override,
0
Process for overiding (-1 for average otherwise index in data list)
Which probability to product detailed results for (1=0.5; 2=0.6; etc.)
2
Steepness,sigma-R,
0.5,0.5,
Target SPR information: Use (1=Yes), target SPR rate,power
0,0.7,20
Discount rate (for cumulative catch),
0.1,
Truncate the series when 0.4B0 is reached (1=Yes),
0,
Set F to FMSY once 0.4B0 is reached (1=Yes)
0
Percentage of FMSY which defines Ftarget
0.9
Conduct MacCall transition policy (1=Yes)
0
Defintion of recovery (1=now only;2=now or before)
2
Produce the risk-reward plots (1=Yes)
1

Appendix 4 : The envelopes (5%, 25%, 50%, 75% and 95% distribution points) for the annual catch and the annual ratio of the spawner output to $0.4B_0$.

Year	Spawner output / $0.4B_0$					Annual catch (t)				
	5%	25%	50%	75%	95%	5%	25%	50%	75%	95%
2000	0.592	0.592	0.592	0.592	0.592	270	270	270	270	270
2001	0.619	0.619	0.619	0.619	0.619	303	303	303	303	303
2002	0.669	0.669	0.669	0.669	0.669	410	410	410	410	410
2003	0.733	0.733	0.733	0.733	0.733	437	438	438	438	440
2004	0.785	0.785	0.785	0.785	0.786	456	457	458	460	465
2005	0.818	0.819	0.820	0.821	0.826	466	469	472	476	487
2006	0.834	0.838	0.842	0.849	0.870	470	475	481	488	506
2007	0.839	0.848	0.858	0.872	0.910	471	480	489	500	522
2008	0.840	0.856	0.873	0.893	0.936	471	485	496	511	536
2009	0.840	0.863	0.884	0.913	0.960	472	489	503	520	548
2010	0.839	0.870	0.896	0.928	0.979	473	493	509	528	559
2011	0.840	0.877	0.905	0.940	0.997	474	497	515	534	569
2012	0.839	0.880	0.913	0.949	1.014	475	500	520	539	577
2013	0.836	0.882	0.922	0.956	1.026	477	503	525	547	584
2014	0.835	0.884	0.926	0.966	1.036	479	507	530	553	591
2015	0.836	0.887	0.929	0.971	1.045	479	508	532	557	596
2016	0.834	0.887	0.932	0.977	1.051	479	509	534	559	600
2017	0.833	0.889	0.936	0.982	1.055	476	510	535	563	604
2018	0.829	0.890	0.936	0.988	1.065	475	510	536	565	606
2019	0.827	0.891	0.939	0.992	1.069	474	510	537	567	610
2020	0.825	0.892	0.940	0.996	1.073	473	512	539	570	614
2021	0.825	0.894	0.942	0.999	1.078	473	512	538	572	617
2022	0.823	0.895	0.942	1.003	1.085	472	511	539	573	621
2023	0.821	0.893	0.944	1.004	1.089	471	510	539	575	625
2024	0.821	0.893	0.944	1.006	1.099	470	510	539	576	632
2025	0.820	0.891	0.945	1.010	1.108	469	511	539	577	636
2026	0.813	0.892	0.945	1.009	1.116	469	510	540	575	635
2027	0.818	0.891	0.944	1.008	1.116	469	509	541	578	634
2028	0.817	0.891	0.946	1.013	1.115	469	510	543	578	635
2029	0.817	0.891	0.949	1.014	1.117	467	510	543	578	636
2030	0.815	0.892	0.950	1.015	1.115	467	511	543	580	636
2031	0.814	0.894	0.950	1.016	1.121	469	512	544	581	639
2032	0.817	0.894	0.950	1.017	1.119	469	512	543	580	641
2033	0.818	0.894	0.950	1.019	1.129	469	511	543	581	643
2034	0.818	0.893	0.951	1.019	1.127	470	513	545	582	641
2035	0.821	0.895	0.955	1.021	1.125	471	515	547	582	638
2036	0.821	0.897	0.956	1.021	1.120	470	515	547	581	639
2037	0.820	0.900	0.957	1.021	1.121	471	515	547	584	641
2038	0.821	0.900	0.957	1.023	1.126	471	514	548	586	639
2039	0.821	0.898	0.958	1.025	1.123	470	515	548	587	639
2040	0.818	0.899	0.959	1.025	1.120	470	514	548	587	639
2041	0.818	0.897	0.958	1.029	1.125	468	514	551	588	643
2042	0.817	0.898	0.960	1.032	1.129	469	514	550	589	645

Year	Spawner output / $0.4B_0$					Annual catch (t)				
	5%	25%	50%	75%	95%	5%	25%	50%	75%	95%
2043	0.817	0.897	0.961	1.031	1.136	468	514	551	588	648
2044	0.815	0.897	0.964	1.031	1.137	468	514	552	589	648
2045	0.819	0.897	0.963	1.031	1.139	468	513	552	588	648
2046	0.816	0.897	0.965	1.028	1.136	469	514	550	589	649
2047	0.819	0.899	0.964	1.032	1.132	469	514	552	589	646
2048	0.817	0.897	0.964	1.031	1.134	469	515	552	589	645
2049	0.817	0.898	0.966	1.029	1.129	468	514	553	589	642
2050	0.814	0.898	0.966	1.034	1.126	468	515	553	589	642
2051	0.817	0.899	0.968	1.033	1.125	468	515	552	589	641
2052	0.814	0.899	0.965	1.033	1.127	469	515	550	590	642
2053	0.816	0.900	0.963	1.032	1.126	466	517	550	587	643
2054	0.814	0.902	0.960	1.029	1.126	467	517	549	587	640
2055	0.813	0.903	0.959	1.029	1.122	468	517	550	586	641
2056	0.815	0.904	0.960	1.025	1.120	469	517	550	586	639
2057	0.819	0.902	0.962	1.025	1.121	470	517	550	587	637
2058	0.820	0.903	0.962	1.026	1.115	470	517	549	586	634
2059	0.817	0.903	0.960	1.028	1.113	471	519	550	587	634
2060	0.822	0.905	0.962	1.029	1.117	470	519	550	586	637
2061	0.820	0.906	0.963	1.024	1.119	470	518	550	585	638
2062	0.821	0.905	0.962	1.026	1.120	472	518	550	586	638
2063	0.823	0.905	0.962	1.025	1.119	471	516	549	585	640
2064	0.822	0.902	0.960	1.025	1.123	473	516	548	586	642
2065	0.827	0.901	0.958	1.026	1.129	474	517	547	586	644
2066	0.827	0.902	0.958	1.026	1.135	473	517	547	586	646
2067	0.825	0.903	0.958	1.027	1.130	472	517	547	585	642
2068	0.825	0.903	0.956	1.025	1.129	471	516	548	585	644
2069	0.823	0.900	0.957	1.025	1.132	473	514	548	585	645
2070	0.825	0.899	0.959	1.025	1.135	473	513	548	586	647
2071	0.824	0.896	0.958	1.026	1.136	471	514	548	584	646
2072	0.824	0.896	0.959	1.023	1.139	471	514	548	585	650
2073	0.821	0.899	0.958	1.023	1.137	472	514	547	583	645
2074	0.822	0.898	0.956	1.022	1.133	473	513	547	584	644
2075	0.825	0.896	0.955	1.021	1.130	472	513	546	584	643
2076	0.823	0.895	0.957	1.023	1.130	474	513	547	585	646
2077	0.824	0.897	0.955	1.026	1.135	474	513	547	585	643
2078	0.824	0.894	0.957	1.024	1.129	472	512	547	586	641
2079	0.825	0.893	0.958	1.023	1.126	472	511	547	587	638
2080	0.822	0.892	0.956	1.024	1.120	471	514	547	587	638

Rebuilding Analysis for Canary Rockfish: Update to Incorporate Results of Coastwide Assessment in 2002

June 2002

Richard Methot and Kevin Piner
National Marine Fisheries Service

Summary

The rebuilding analysis for canary rockfish was first conducted in 2000 based on the 1999 stock assessment. This document updates the analysis based upon the 2002 assessment.

The target spawning stock biomass is 40% of the unfished spawning stock biomass (Bzero). The method to calculate Bzero is improved to incorporate more historical information and results in a higher level than estimated in 2000. Spawning stock abundance reached a low of 6.6% of the unfished level in 2000, the year of the overfished declaration. By 2002 it had increased to 7.9%.

The mean generation time is 19 years. The time to rebuild with no fishingis year 2057. This is longer than the previous estimate of 2041 primarily because of the higher Bzero level.

The rate of rebuilding is based on the estimated spawner-recruitment relationship with steepness of 0.33. Based on this relationship, Fmsy = F73%; MSY = 622 mt; Bmsy = 45% of Bzero; and ABC in 2003 is 116 mt at the estimated Fmsy and 256 mt at the default F50% proxy for Fmsy.

The table below shows the initial OY associated with a range of rebuilding targets.

Pr(rebuild by 2076)	Year to 50% Pr(rebuild)	OY in 2003
50%	2076	45 mt
60%	2074	41 mt
70%	2071	36 mt
80%	2068	30 mt

Rate of rebuilding is most sensitive to the steepness of the spawner-recruitment relationship. Improved ocean conditions could cause higher steepness, but no evidence yet. The level of allowable catch during rebuilding is sensitive to the recreational:commercial allocation because of their difference in selectivity for young versus old fish.

Introduction

The stock assessment for canary rockfish in 1999 documented that the stock had declined below the overfished level (25% of Bzero) in the northern area (Columbia and U.S. Vancouver INPFC areas; Crone et al., 1999) and in the southern area (Williams et al., 1999). Canary rockfish was determined to be in an "overfished" state on Jan. 1, 2000 which initiated development of a rebuilding plan. The first rebuilding analysis (Methot, 2000) used results from the northern area assessment to project rates of potential stock recovery. The stock was found to have extremely low productivity, defined as production of recruits in excess of the level necessary to maintain the stock at its current, low level. Rates of recovery were highly dependent upon the level of recent recruitment, which could not be estimated with high certainty. The initial rebuilding OY for 2001 and 2002 was set at 93 mt based upon: a 50% probability of rebuilding by the year 2057, a medium level for these recent recruitments, and maintaining a constant catch (93 mt) throughout the rebuilding period.

The purpose of this document is to use results of the updated canary rockfish stock assessment (Methot and Piner, 2002) to update estimates of the potential rate of rebuilding of canary rockfish. The basic results of this assessment are summarized in the Assessment Summary below. In addition to using results from the updated assessment, the following changes were made at the request of the Council's Groundfish Management Team:

a. Use a constant exploitation rate, as in most other rebuilding plans, rather than a constant catch;
b. Evaluate sensitivity to the allocation between recreational and commercial fishing sectors.

The rebuilding analysis was conducted using software developed by A. Punt (version 2.0). The analysis involves six steps:

(1) examine the recruitment-spawner information to determine levels of historical and current recruitment;
(2) determine unfished level of spawning biomass (Bzero) in order to calculate target levels for rebuilding (Btarget);
(3) calculate the generation time (Gentim), which affects the maximum allowable duration of rebuilding;
(4) determine expected levels of recruitment during the rebuilding period;
(5) calculate the time to 50% probability of rebuilding with no fishing mortality (Tmin);
(6) finally, calculate the year to 50% probability of rebuilding (Ttarget) associated with various levels of fishing mortality. This is subject to the constraint that Ttarget must be no more than Tmax. Tmax is 10 years if Tmin is less than 10 years, and is Tmin plus Gentim otherwise. The selection of Ttarget between Tmin and Tmax is a management decision and is beyond the scope of the rebuilding analysis.

Assessment Summary

The updated assessment for canary rockfish (Methot and Piner, 2002) has several features that influence the rebuilding analysis:

1. The assessment is now coastwide (California to Washington) so the ad hoc adjustment for the southern area is not needed as it was in Methot (2000). The previous assessments (Crone et al., 1999; Williams et al., 1999) did not have a strong biological rationale for the north-south split, and the present assessment's review of patterns in growth and distribution does not support a split at the Eureka-Columbia border. However, uncertainty regarding the contribution of canary rockfish in Canada to the U.S. assessment area remains unresolved.

2. The previous dichotomy between natural mortality and dome-shaped selectivity to explain the low occurrence of old females is blended into one assessment scenario that links female natural mortality to maturation and allows for dome-shaped selectivity. This does not fully resolve the issue, but does eliminate the need for a rebuilding analysis for each mortality/selectivity scenario.

3. The assessment start year was moved from 1967 back to 1941 because the previous assessment had found that historical catch levels were relatively large and that the model was estimating a historical recruitment level that was greater than the recruitment level of the 1967-1977 period. The recruitment level from 1967-1977 had been used to estimate the unfished recruitment in the previous rebuilding analysis, but this level is now seen to be a better estimate of the recruitment level at MSY, which is substantially less than the unfished recruitment level.

4. The strong pattern of declining recruitment at low spawning stock levels was noted in the previous assessment and is now quantified by fitting a spawner-recruitment curve. This curve allows calculation of maximum long-term average yield (MSY), the fishing mortality rate that would produce MSY (Fmsy), and the equilibrium level of spawning stock biomass associated with MSY (Bmsy). The curve also provides a basis for calculation of the level of unfished recruitment (Rzero) and projection of recruitment levels into the future.

5. A large focus of the uncertainty in the previous rebuilding analysis was with regard to the magnitude of recruitment from the 1995 to 1997 year classes as they appeared among the smallest size groups occurring in the 1998 trawl survey. The new assessment does not find these recruitments to be large in subsequent fishery and survey data, and the new method of projecting future recruitments from the spawner-recruitment curve diminishes the influence of any one year's estimate of recruitment.

Rebuilding Calculations

Spawner-Recruit Relationship

The level of recruitment has declined from a level of 3907 thousand fish in the unfished state, to 2549 thousand in 1967-1977, 1918 thousand during 1978-1993, and only 713 thousand during 1994-1999 (Table 1, Figure 1). As long as this lowest level of recruitment persists, the stock cannot rebuild to the 40% biomass level, even without fishing. However, the decline is considered to be primarily a result of the declining level of spawner abundance, so recruitment should increase as the spawning stock is rebuilt.

The critical factor influencing the rate of rebuilding is the degree to which recruitments will be above the replacement level, thus able to rebuild the stock and potentially support a small harvest during rebuilding. Since the level of recruitment is not much above the replacement level (Figure 2), rebuilding will be extremely slow. The expected level of recruitment is determined by the steepness parameter of the Beverton-Holt formula. The canary rockfish assessment in 2002 provides results for three levels of steepness: the steepness level initially estimated within the model (0.289, lower dashed line in Figure 2), the best-estimate of steepness obtained from a focused examination of the recruitment-spawner information (0.33, solid line), and a higher steepness level (0.36, upper dashed line) which provides a contrast to the 0.289 level. The steepness of 0.33 is the best estimate of the level of recruitment to be expected as the stock begins to rebuild.

This low level of steepness is conditional upon all the downward trend in recruitment being caused by the decline in spawner abundance. Other fish species often have steepness levels near 0.7 (Myers, 1999) and Dorn's (2000) meta-analysis of rockfish found a level of approximately 0.67. If some of this recruitment downtrend for canary rockfish has been because of long-term shifts in the ocean climate, then it is possible that a future shift in the ocean climate will cause an upward shift in recruitment and future estimates of the spawner-recruitment steepness will be higher and representative of a longer-term environmental average. As an illustration of such a shift, a spawner-recruitment curve with steepness of 0.5 is shown on Figure 2. Although there are signs of a shift in the ocean climate towards a more productive regime in 1999 and evidence of stronger sablefish, whiting, and salmon survival in 1999, there is yet no evidence of such a shift for canary rockfish. Only time will tell.

The year-to-year variability of recruitment is also important for the rebuilding analysis. The log-normal variability of recruitment about the curve is approximately 0.4, and this level will be used in the forecasts of future recruitment. This lognormal variability is used in lieu of resampling the from the individual year estimates of recruitment deviations.

ABC, Overfishing and Fmsy

The current Council policy for the calculation of ABC is to apply an exploitation rate based on F50%. This would be 256 mt in 2003. However, the calculation of the spawner-recruitment relationship demonstrates that F50% is not a sustainable harvest policy for canary rockfish because of the low spawner-recruitment steepness. The estimate of Fmsy is 0.0601 year^{-1} and corresponds to F73% [1/]. This rate would result in an ABC of 116 mt in 2003. Once rebuilt, fishing at F73% would be expected to produce an average catch of 622 mt from a biomass that would average 45% of the unfished level.

Unfished Abundance Level

The previous rebuilding analysis considered three possible methods for calculating the level of recruitment expected under unfished conditions. The selected method was based upon the estimated recruitments

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1/ This instantaneous fishing mortality rate is for the age(s) with selectivity equal to 1.0. Because of the dome-shaped selectivity pattern (Table 2), the rate for other ages is less.

from the early (1967-1977) portion of the assessment time series, but an alternative based upon the model's higher estimate of initial recruitment levels was also considered. The new assessment starts in 1940 and provides stronger evidence that recruitment had already begun to decline by 1967. It shows that recruitment during 1967-1977 is at about the reduced level expected at MSY, rather than the higher level expected from an unfished stock. This higher, unfished level of recruitment is used as the basis for Bzero in this updated rebuilding analysis, although a comparative run will be made using the updated estimates of the 1967-1977 recruitments. Bzero is calculated as the product of the initial, unfished level of recruitment in the assessment model (3907 thousand fish) and the level of female spawning biomass per recruit that occurs in the absence of fishing (8.135).

Expected Recruitment Level
Three methods of calculating recruitment during rebuilding were considered. These are random resampling of observed recruitment levels, random resampling of observed levels of recruits/spawner (R/S) and random generation of lognormal deviations from the estimated spawner-recruitment relationship. The first method is not reasonable because of the large change in recruitment level observed during the time series. The second method has been used in some other rebuilding analyses and the previous canary rockfish analysis, but there are aspects of this approach that may not be the best that can be done with available information. In particular, it is difficult to objectively select the time frame of the recent period from which to re-sample. If it is short enough to accurately represent recent recruitment, it will not have enough observations to fully represent the frequency distribution of future possible recruitments. Also, this method incorporates no population compensation. . It is effectively a linear spawner-recruitment relationship, so leads to exponential population growth as the stock increases above its current low level.

The third method incorporates compensation in the form of the spawner-recruitment curve and was used in this rebuilding analysis. This third method has several desirable features:
1. Reproduces current low recruitment levels while spawning biomass remains low;
2. Smoothly increases mean recruitment (and decreases recruits per spawner) towards the unfished level as spawning biomass increases;
3. Parametric sampling from the lognormal distribution generates a smoother frequency distribution of future recruitments (in comparison to resampling from the model's time series of annual recruitment deviations) thus provides rebuilding calculations that are less sensitive to individual historical recruitment estimates.

Rebuilding in the Absence of Fishing - Tmin
The best estimate of the unfished time to 50% probability of rebuilding is the year 2057 (Tmin in Table 4 for the BASELINE MODEL column). The level of steepness greatly affects the time to rebuild: year 2049 with a steepness of 0.36, 2057 with the best steepness estimate of 0.33, and 2077 with a steepness of 0.289.

With the previous method for calculating the unfished biomass level, the target biomass level is lower and would be achieved more quickly. There is a 50% probability of achieving this lower level by 2044 (Table 3), which is only 3 years greater than the Tmin (2041) calculated in the initial canary rockfish rebuilding analysis (Methot, 2000). However, this lower target biomass level is not the best estimate of Bzero. In fact, the recruitment level that generates the previous Bzero level is close to the expected recruitment at MSY (Methot and Piner, 2002).

Generation Time
Generation time is calculated as the mean age of female spawners, weighted by age-specific spawn production (Table 2), in an unfished population. It is calculated to be 19 years in the new assessment in which female natural mortality increases at older ages in proportion to maturation. This is intermediate between the 16.8 and 24.7 years calculated for the two natural mortality scenarios in the 1999 assessment (Crone et al., 1999) and used in the 2000 rebuilding analysis. Note that the generation time was erroneously reported as 16 years in the June 2002 version of the 2002 assessment document.

Maximum Allowable Rebuilding Time - Tmax
With Tmin at 2057, the Tmax would be 19 years greater, or 2076. However, two years have elapsed since the stock was declared overfished. The low level of catch during these two years has a small, but unquantified, delay on Tmin. Consequently, the Ttarget (year with 50% expectation of achieving the rebuilt level) should be set less than Tmax.

Rebuilding with Fishing
If the exploitation rate is set to Fmsy, then the stock will not have a 50% probability of rebuilding until 2094, even with the 40:10 adjustment which would set the OY to zero until the stock rebuilt to the 10% biomass level. The year 2094 exceeds Tmax and does not meet the requirement to have a 50% probability of rebuilding before 2076.

At a reduced fishing mortality rate of 0.0242 $year^{-1}$ there is a 50% probability of rebuilding by 2076 (Table 4), and the OY in 2003 would be 45 mt. This harvest level corresponds to the maximum permissible Ttarget.

Lower harvest rates will result in an earlier Ttarget year, a higher probability of being rebuilt by Tmax, and a lower OY in 2003 (Figure 4). Results shown in Figure 4 and Figure 5 are calculated for 50, 60, 70 and 80% probabilities of being rebuilt by Tmax. For these probabilities, the OY in 2003 ranges from 30 to 45 mt. By 2023, the range of expected OY would be 57 to 81 mt (Figure 5). These calculations at 50, 60, 70 and 80% are particular points along a continuum (Figure 4). If socio-economic considerations lead to the need to consider other levels, then interpolation form the results presented here is technically reasonable.

Because future recruitment will vary around the spawner-recruitment relationship (Figure 2), there is variability in the estimate of time to rebuild. Figure 6 shows this variability for a 60% probability of rebuilding

Other Factors Affecting Rebuilding
One factor affecting the level of allowable harvest during rebuilding is the age selectivity of the combined fisheries. Because recreational fisheries take younger fish, their per-ton impact on rebuilding is greater than that of the commercial fisheries which take a broad age range of older fish. Table 4 shows the trade-off for 80:20, 50:50, and 20:80 splits of catch between recreational and commercial fisheries.

The most significant factor affecting the rate of rebuilding, and the level of sustainable fishery post-rebuilding, is the steepness of the spawner-recruitment relationship. If steepness is 0.289, rather than 0.33, then the Tmin is extended by 20 years!. Steepness levels near 0.7 are normal and Dorn's (2000) review of steepness for rockfish found an average value near 0.6 when he included rockfishes off Alaska and off the west coast. If future steepness for canary rockfish increases to 0.5 rebuilding will accelerate, but will still have a Tmin that is 30 years away (Table 3).

The assessment area extends northward to the US-Canada border, but the trawl survey which extends northward to about 49° N shows that canary rockfish abundance is often high near the border. Canadian catch has been near 200 mt in recent years, so the combined impact of the US and Canadian fisheries could be greater than the levels forecast here as necessary for rebuilding. A combined US and Canadian stock assessment is advised to improve the estimate of total fishery impact.

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Table 1. Time series of canary rockfish abundance, recruitment and total catch as estimated in Methot and Piner (2002).

Year	Total Biomass	Female Spawning Biomass	Age 1 Recruitment	Exploitation Rate	Total Catch
Unfished	94062	31782	3907	0	0
Initial Equilibrium	85325	29848	3907	0.006	500
1941	85326	29848	3948	0.006	500
1942	85331	29847	3948	0.040	3363
1943	82235	28852	3948	0.043	3491
1944	79153	27860	3867	0.049	3842
1945	75842	26792	3783	0.060	4500
1946	71975	25538	3691	0.060	4296
1947	68496	24417	3579	0.059	4041
1948	65438	23449	3476	0.016	1069
1949	65720	23626	3384	0.016	1017
1950	66016	23829	3401	0.019	1223
1951	66029	23941	3420	0.023	1500
1952	65686	23919	3431	0.023	1474
1953	65325	23871	3429	0.025	1618
1954	64769	23725	3424	0.026	1657
1955	64147	23525	3410	0.026	1662
1956	63505	23294	3391	0.030	1878
1957	62625	22960	3369	0.032	1989
1958	61731	22577	5788	0.035	2156
1959	60790	22134	3750	0.032	1910
1960	60237	21803	3058	0.029	1760
1961	60040	21561	6281	0.025	1483
1962	60276	21481	2871	0.023	1388
1963	60670	21521	2703	0.026	1571
1964	60937	21582	5547	0.019	1129
1965	61668	21895	2116	0.018	1122
1966	62263	22268	1275	0.043	2690
1967	60889	22060	1271	0.032	1950
1968	60066	22142	2007	0.039	2331
1969	58585	22015	3467	0.027	1578
1970	57769	22078	3530	0.027	1542
1971	56881	21982	2795	0.028	1585
1972	55841	21662	1653	0.030	1682
1973	54592	21124	1973	0.046	2516
1974	52392	20159	3035	0.037	1918
1975	50859	19455	2182	0.038	1921
1976	49347	18792	2618	0.032	1561
1977	48302	18314	3513	0.046	2181
1978	46650	17622	1833	0.066	3060
1979	44149	16596	3158	0.091	3995
1980	40822	15246	3701	0.103	4138
1981	37514	13968	1288	0.086	3174
1982	35365	13106	2443	0.158	5538
1983	30699	11340	2134	0.160	4853
1984	26897	9883	1962	0.089	2361

Year	Total Biomass	Female Spawning Biomass	Age 1 Recruitment	Exploitation Rate	Total Catch
1985	25885	9543	2091	0.107	2748
1986	24436	9083	2341	0.095	2299
1987	23415	8788	1344	0.136	3148
1988	21395	8088	1275	0.143	3038
1989	19404	7355	1986	0.171	3283
1990	17090	6438	1488	0.175	2932
1991	15118	5667	1227	0.219	3255
1992	12739	4683	1255	0.236	2960
1993	10644	3831	1169	0.212	2212
1994	9286	3254	830	0.134	1220
1995	8969	3130	1342	0.132	1168
1996	8657	3037	766	0.178	1508
1997	7899	2762	449	0.180	1399
1998	7160	2512	374	0.204	1444
1999	6266	2195	516	0.142	883
2000	5887	2102	454	0.030	177
2001	6197	2312	435	0.015	90
2002	6540	2524	477	0.014	89

Table 2. Life history parameters, fishery selectivity (with 50:50 commercial:recreational allocation) and population numbers at age in 2002.

	Females					Males			
Age	Fecundity	M	Weight	Selectivity	InitN	M	Weight	Selectivity	Init N
1	0.000	0.060	0.047	0.000	238.4	0.06	0.032	0.000	238.4
2	0.000	0.060	0.133	0.008	205.0	0.06	0.119	0.007	205.0
3	0.004	0.060	0.265	0.193	201.1	0.06	0.260	0.193	201.1
4	0.022	0.060	0.435	0.980	213.0	0.06	0.441	0.980	213.0
5	0.081	0.060	0.635	0.997	136.8	0.06	0.645	1.000	136.8
6	0.216	0.061	0.855	0.576	140.3	0.06	0.858	0.587	140.3
7	0.441	0.064	1.085	0.354	208.9	0.06	1.069	0.373	209.1
8	0.735	0.070	1.319	0.278	318.7	0.06	1.269	0.297	319.3
9	1.057	0.079	1.550	0.253	167.6	0.06	1.455	0.266	168.1
10	1.377	0.088	1.775	0.241	199.9	0.06	1.623	0.248	198.3
11	1.676	0.096	1.988	0.233	173.4	0.06	1.774	0.236	166.5
12	1.945	0.102	2.190	0.226	126.2	0.06	1.907	0.227	117.8
13	2.188	0.107	2.378	0.220	104.8	0.06	2.023	0.220	99.2
14	2.401	0.110	2.552	0.214	95.4	0.06	2.124	0.214	95.0
15	2.594	0.113	2.711	0.210	43.4	0.06	2.210	0.210	46.4
16	2.762	0.114	2.856	0.204	32.7	0.06	2.285	0.206	37.0
17	2.913	0.116	2.988	0.199	39.5	0.06	2.348	0.203	44.6
18	3.048	0.117	3.107	0.194	22.9	0.06	2.402	0.201	25.2
19	3.166	0.117	3.214	0.182	13.5	0.06	2.448	0.199	15.1
20	3.270	0.118	3.310	0.172	9.4	0.06	2.486	0.197	11.4
21	3.362	0.118	3.396	0.164	7.2	0.06	2.519	0.196	9.5
22	3.445	0.119	3.473	0.157	2.7	0.06	2.546	0.195	3.8
23	3.520	0.119	3.541	0.139	5.6	0.06	2.569	0.194	8.4
24	3.584	0.119	3.602	0.127	3.7	0.06	2.589	0.193	5.7
25	3.884	0.119	3.900	0.118	45.3	0.06	2.700	0.192	23.5

Table 3. Rebuilding results with alternative levels of Bzero or spawner-recruitment steepness. Baseline model with best steepness estimate is in Table 3.

	Rzero from 67-77 (old method)	Low Steepness	High Steepness	Recruitment Upshift **speculative**
Spawn-recruit steepness	0.33	0.289	0.36	0.50
comm:recr allocation	50:50	50:50	50:50	50:50
F(msy)	F73%	F79%	F69%	F55%
Bmsy/Bzero	45%	45%	43%	40%
MSY (mt)	622	461	728	1395
2003 ABC (mt)				
@ F50%	256	256	256	256
@ Fmsy	116	87	137	222
Btarget (fem. spawn biomass)	8296	12713	12713	12713
Tmin	2044	2077	2049	2032
Tmax	2063	2096	2068	2051
% reb. by Tmax	50%	50%	50%	50%
F	0.0272	0.0136	0.0322	0.0695
OY in 2003 (mt)	51	26	61	129
Yr to 50% reb.	2063	2096	2068	2051
% reb. by Tmax	60%	60%	60%	60%
F	0.0249	0.0116	0.0297	0.0665
OY in 2003 (mt)	47	22	56	124
Yr to 50% reb.	2061	2092	2066	2050
% reb. by Tmax	70%	70%	70%	70%
F	0.0226	0.0096	0.0265	0.0634
OY in 2003 (mt)	43	18	50	118
Yr to 50% reb.	2058	2089	2064	2048
% reb. by Tmax	80%	80%	80%	80%
F	0.0194	0.0071	0.0234	0.0592
OY in 2003 (mt)	36	13	44	110
Yr to 50% reb.	2055	2085	2062	2046
Fmsy with 40:10				
% reb. by Tmax	19%	13%	22%	35%
OY in 2003 (mt)	11	0	0	0
Yr to 50% reb.	2079	2127	2082	2058

Table 4. Rebuilding results with alternative selectivities based upon different commercial:recreational allocation.

	Recreational	BASELINE MODEL Even	Commercial
Spawn-recruit steepness	0.33	0.33	0.33
comm:recr allocation	20:80	50:50	80:20
F(msy)	F73%	F73%	F73%
Bmsy/Bzero	44%	45%	45%
MSY (mt)	525	622	749
2003 ABC (mt)			
@ F50%	218	256	309
@ Fmsy	99	116	140
Btarget (fem. spawn biomass)	12713	12713	12713
Tmin	2057	2057	2057
Tmax	2076	2076	2076
% reb. by Tmax	50%	50%	50%
F	0.0317	0.0242	0.0161
OY in 2003 (mt)	37	45	57
Yr to 50% reb.	2076	2076	2076
% reb. by Tmax	60%	60%	60%
F	0.0289	0.0220	0.0147
OY in 2003 (mt)	34	41	52
Yr to 50% reb.	2074	2074	2074
% reb. by Tmax	70%	70%	70%
F	0.0253	0.0193	0.0129
OY in 2003 (mt)	29	36	45
Yr to 50% reb.	2071	2071	2071
% reb. by Tmax	80%	80%	80%
F	0.0212	0.0161	0.0108
OY in 2003 (mt)	25	30	38
Yr to 50% reb.	2068	2068	2068
Fmsy with 40:10			
% reb. by Tmax	20%	19%	19%
OY in 2003 (mt)	0	0	0
Yr to 50% reb.	2093	2094	2094

Table 5. Time series of median catch, probability of rebuilding (with P=0.6 by 2076 and with F=0.0), anf the median spawning biomass relative to the unfished level.

Year	Median Catch P=0.6	Pr(rebuilt) P=0.6	Pr(rebuilt) F=0	Median(SPB)/Bzero P=0.6	Median(SPB)/Bzero F=0
2003	41	0.000	0.000	0.085	0.085
2004	42	0.000	0.000	0.090	0.091
2005	43	0.000	0.000	0.094	0.095
2006	45	0.000	0.000	0.097	0.099
2007	47	0.000	0.000	0.099	0.102
2008	48	0.000	0.000	0.101	0.104
2009	50	0.000	0.000	0.103	0.107
2010	52	0.000	0.000	0.105	0.110
2011	54	0.000	0.000	0.107	0.112
2012	55	0.000	0.000	0.109	0.116
2013	57	0.000	0.000	0.112	0.119
2014	59	0.000	0.000	0.115	0.123
2015	60	0.000	0.000	0.118	0.128
2016	62	0.000	0.000	0.122	0.132
2017	64	0.000	0.000	0.125	0.137
2018	65	0.000	0.000	0.128	0.141
2019	67	0.000	0.000	0.132	0.146
2020	69	0.000	0.000	0.136	0.151
2021	71	0.000	0.000	0.139	0.156
2022	73	0.000	0.000	0.142	0.161
2023	75	0.000	0.000	0.146	0.166
2024	77	0.000	0.000	0.150	0.171
2025	79	0.000	0.000	0.154	0.176
2026	81	0.000	0.000	0.157	0.182
2027	83	0.000	0.000	0.161	0.187
2028	85	0.000	0.000	0.165	0.192
2029	87	0.000	0.000	0.169	0.198
2030	89	0.000	0.000	0.173	0.204
2031	91	0.000	0.000	0.176	0.209
2032	93	0.000	0.000	0.181	0.216
2033	95	0.000	0.000	0.186	0.222
2034	98	0.000	0.000	0.190	0.229
2035	100	0.000	0.000	0.194	0.235
2036	103	0.000	0.000	0.198	0.241
2037	104	0.000	0.000	0.203	0.248
2038	106	0.000	0.000	0.208	0.255
2039	109	0.000	0.000	0.212	0.262
2040	111	0.000	0.000	0.217	0.269
2041	114	0.000	0.002	0.221	0.275
2042	117	0.000	0.005	0.226	0.283
2043	120	0.000	0.010	0.230	0.290
2044	122	0.000	0.018	0.235	0.297
2045	124	0.000	0.024	0.240	0.305
2046	127	0.000	0.033	0.245	0.312
2047	129	0.001	0.047	0.251	0.321
2048	131	0.001	0.072	0.256	0.329
2049	135	0.001	0.105	0.262	0.338
2050	137	0.002	0.143	0.267	0.346
2051	139	0.002	0.189	0.272	0.354

Year	Median Catch P=0.6	Pr(rebuilt) P=0.6	Pr(rebuilt) F=0	Median(SPB)/Bzero P=0.6	Median(SPB)/Bzero F=0
2052	141	0.004	0.229	0.278	0.362
2053	143	0.007	0.281	0.284	0.371
2054	145	0.009	0.331	0.289	0.378
2055	149	0.015	0.404	0.294	0.386
2056	152	0.020	0.457	0.298	0.393
2057	155	0.023	0.514	0.304	0.403
2058	157	0.032	0.558	0.310	0.411
2059	160	0.042	0.624	0.314	0.419
2060	163	0.057	0.696	0.319	0.427
2061	166	0.078	0.754	0.325	0.435
2062	169	0.093	0.797	0.330	0.443
2063	172	0.116	0.832	0.335	0.451
2064	174	0.140	0.856	0.341	0.460
2065	177	0.170	0.887	0.349	0.472
2066	180	0.207	0.905	0.356	0.482
2067	182	0.235	0.922	0.361	0.491
2068	185	0.278	0.940	0.367	0.498
2069	187	0.314	0.953	0.372	0.508
2070	191	0.359	0.963	0.378	0.516
2071	194	0.391	0.973	0.384	0.525
2072	197	0.432	0.980	0.390	0.534
2073	200	0.472	0.984	0.396	0.542
2074	202	0.508	0.989	0.401	0.550
2075	205	0.556	0.993	0.407	0.559
2076	207	0.601	0.994	0.413	0.568

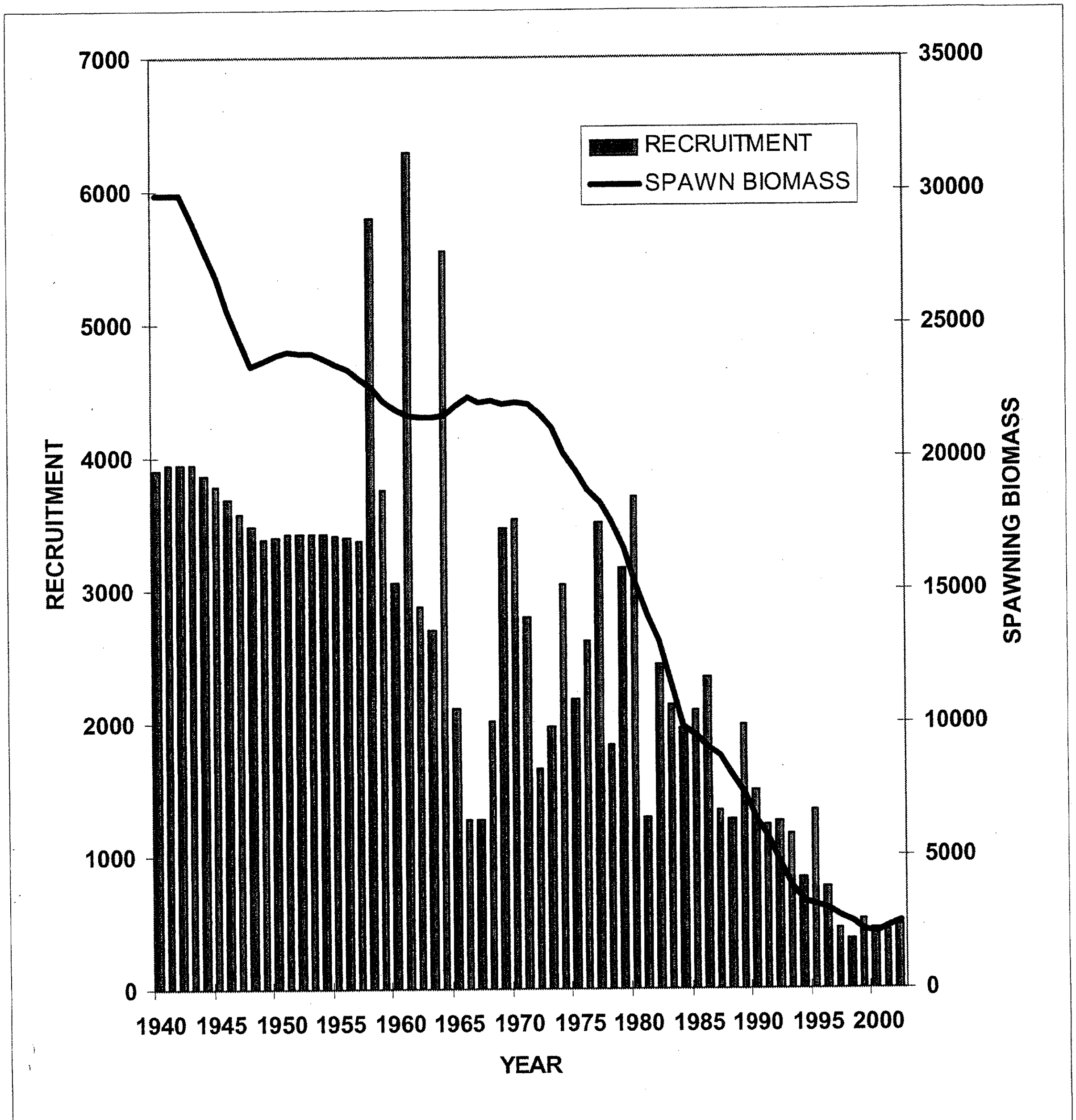


Figure 1 Time series of age 1 recruitment and female spawning biomass.

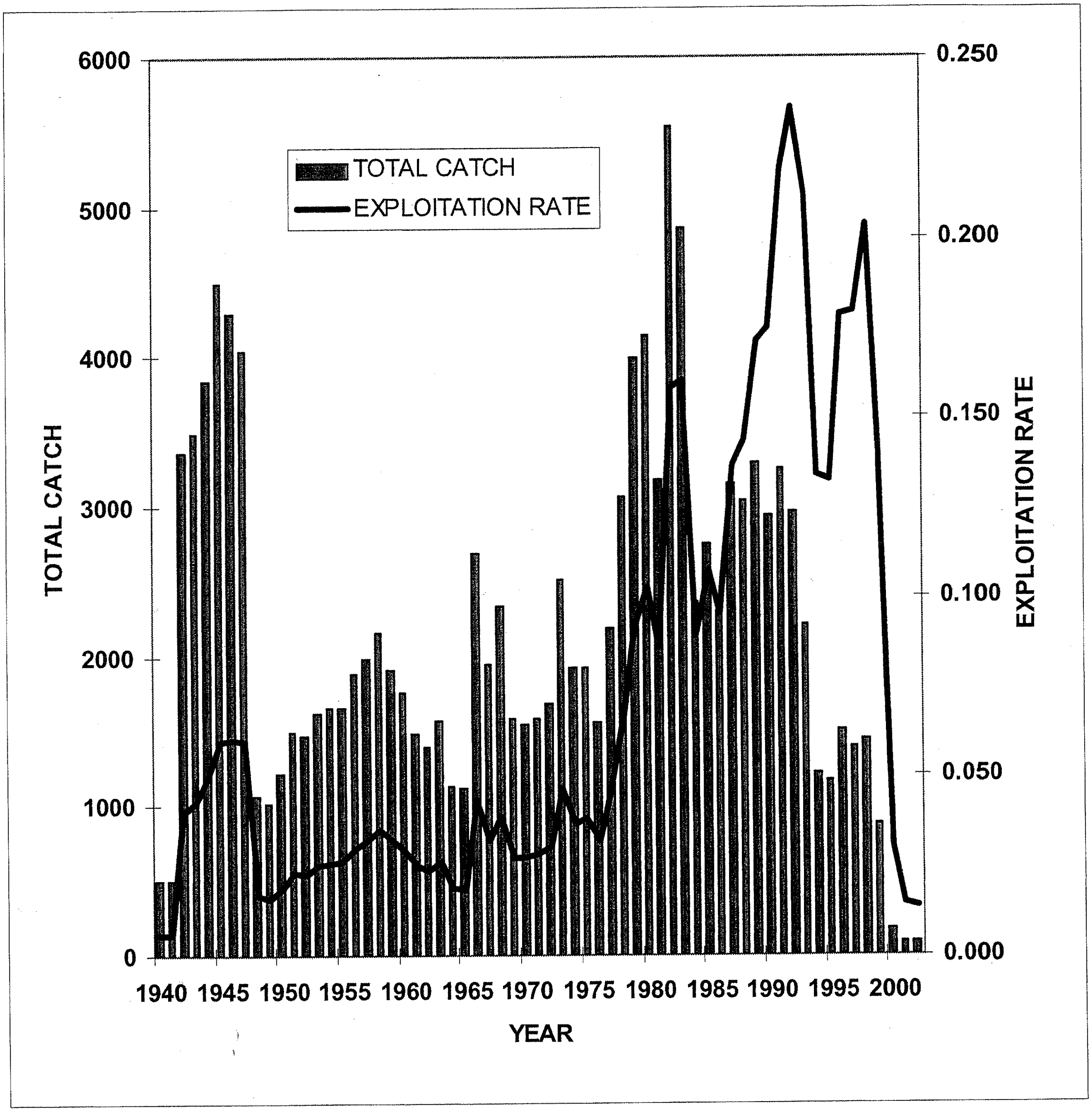


Figure 2 Time series of total catch and exploitation rate.

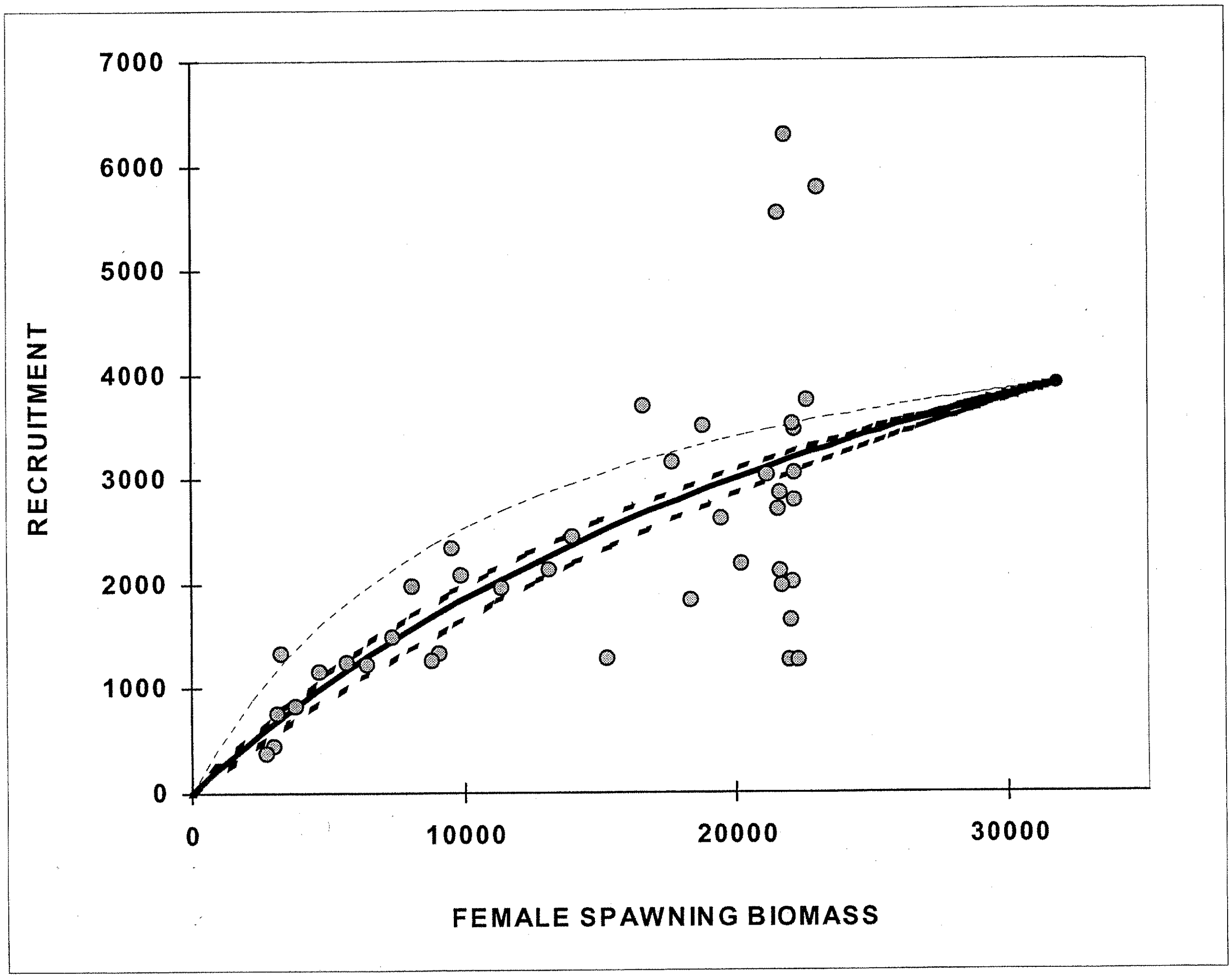


Figure 3 Recruitment-spawner relationship. Bold line is the best estimate of steepness (0.33). Bracketing dashed lines are steepness of 0.289 and 0.36. The light upper line has a steepness of 0.50 which is clips the upper edge of recent recruitments and is closer to the general rockfish steepness level estimated by Dorn (2000).

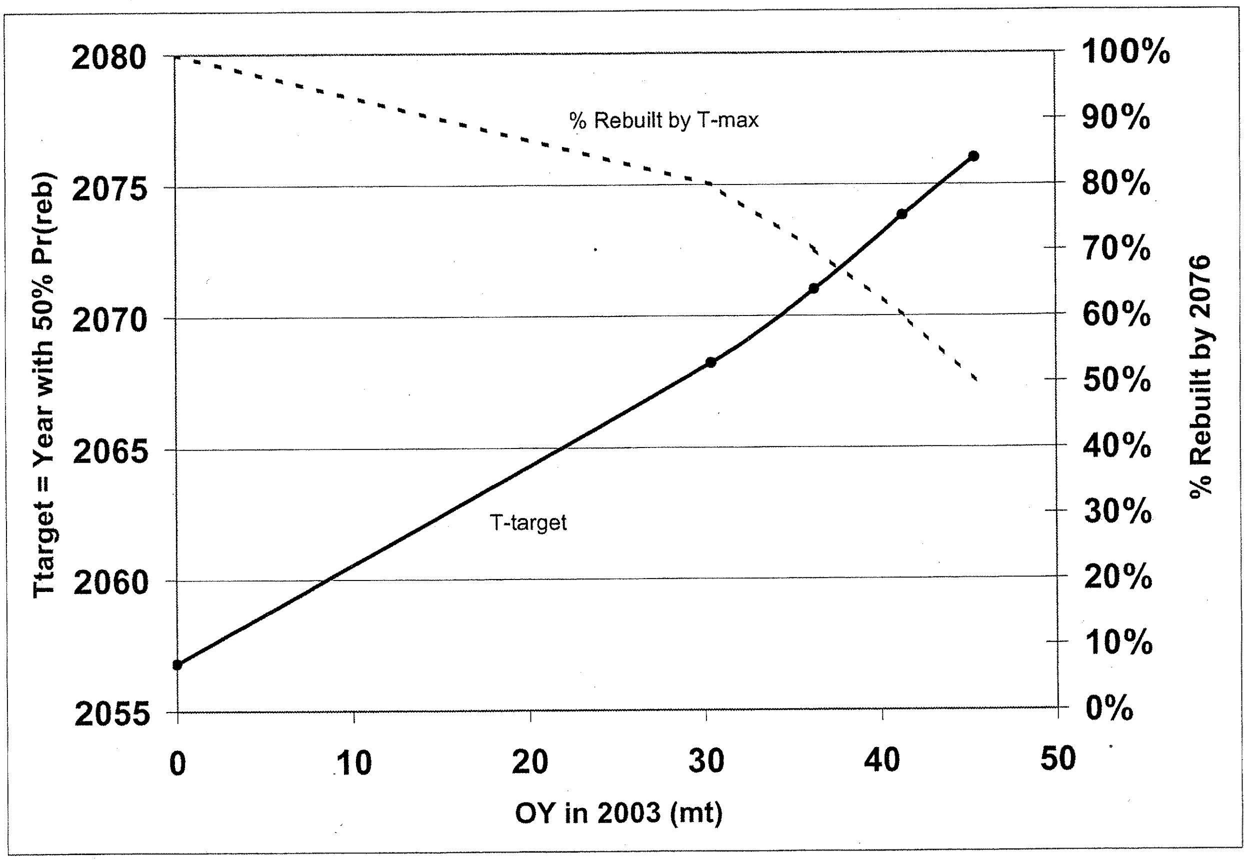


Figure 4 Trade-off between OY in 2003, the year (Ttarget) with 50% probability of achieving the rebuilt level, and the probability of achieving the rebuilt level before Tmax (2076). Each calculation is based upon a constant exploitation rate being applied throughout the rebuilding period.

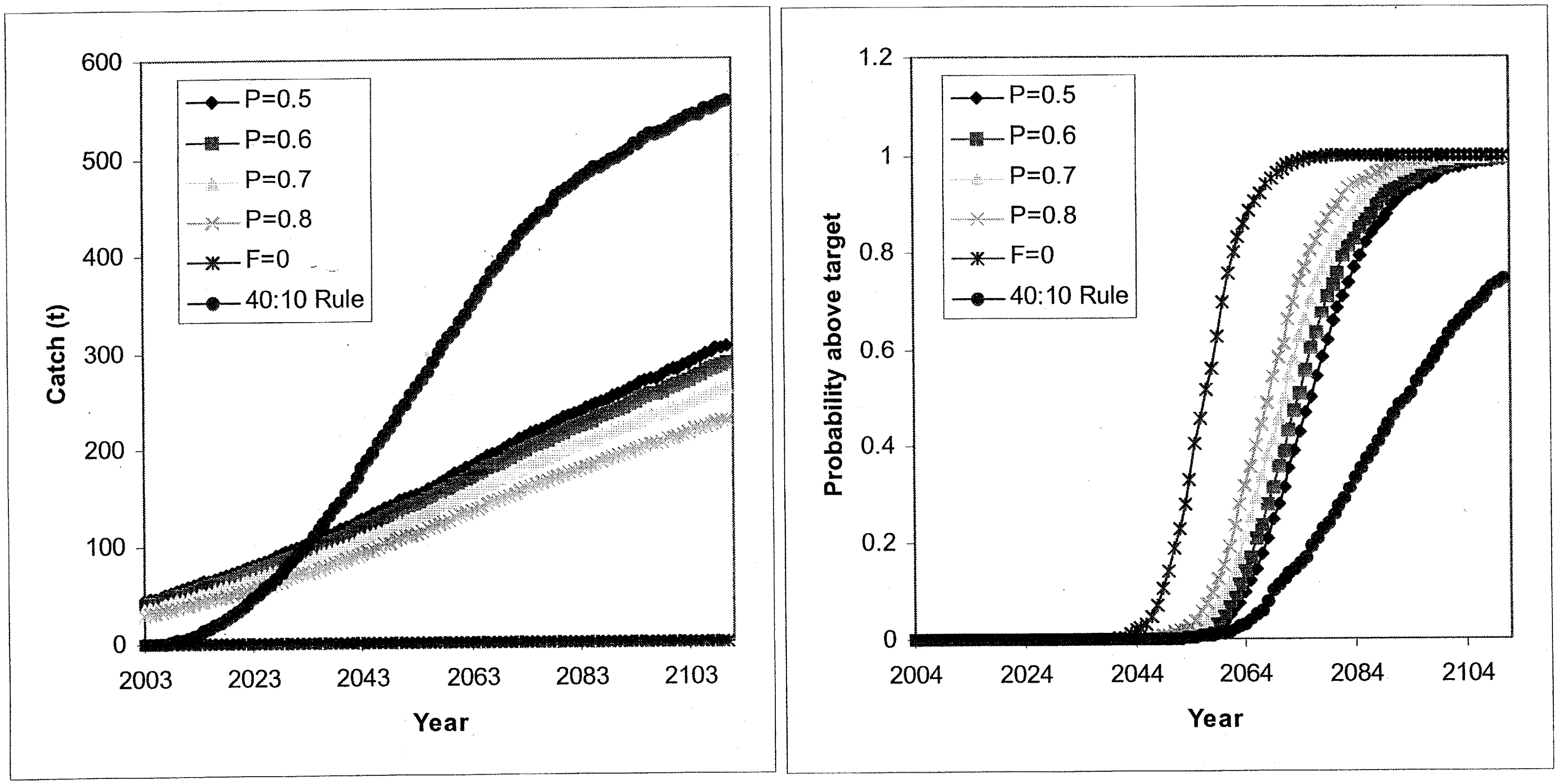
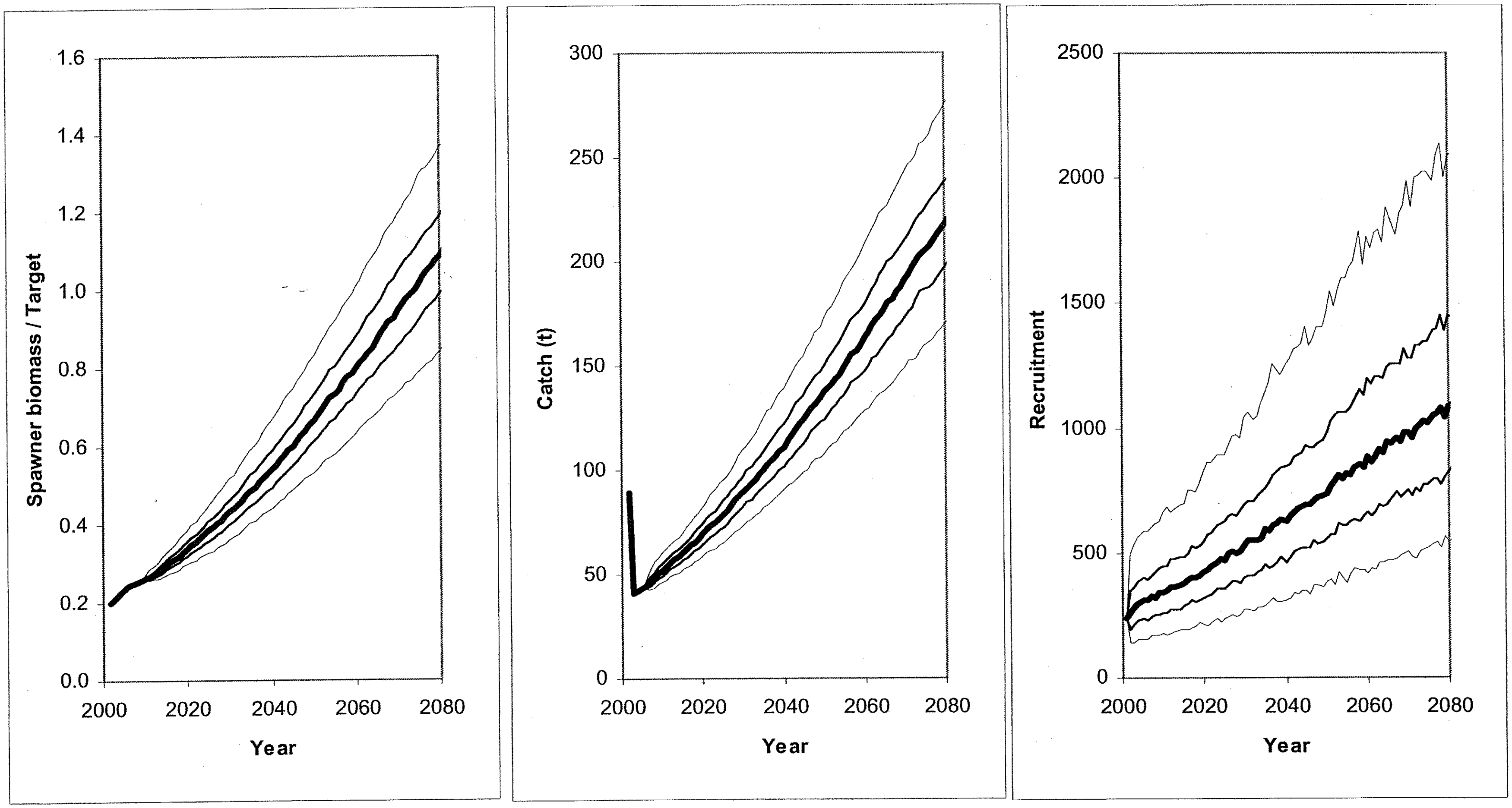


Figure 5. Time series of expected catch level and expected probability of achieving the rebuilt biomass level (40% of Bzero).

Figure 6. Time series of spawning biomass, catch and recruitment with probability of rebuilding by 2076 at 60%. The 5%, 25%, 50%, 75% and 95% percentiles are shown.



Appendix. Input file for rebuilding analysis.

```
#Title,
Canary rockfish - 50:50 comm:recr
# Number of sexes,
2,
# Age range to consider (minimum age; maximum age),
1,25
# First year of projection,
2002,
# Year declared overfished,
2000,
# Is the maximum age a plus-group (1=Yes;2=No),
1,
# Generate future recruit using: hist. recr (1); hist recr/spawn (2); or a stock-recruit (3),
3,
# Constant fishing mortality (1) or constant Catch (2) projections,
1,
# Pre-specify the year of recovery (or -1) to ignore,,,,,,,,,,,,,,,,,,,,,,,
-1,,,,,,,,,,,,,,,,,,,,,,,
# FECUNDITY @ AGE,,,,,,,,,,,,,,,,,,,,,,,
# AGES   1   25,,,,,,,,,,,,,,,,,,,,,,,
0,0.00027,0.00371,0.02219,0.08128,0.21632,0.44051,0.73468,1.0571,1.3774,1.67588,1.94472,
2.18776,2.40143,2.59443,2.76175,2.9133,3.04797,3.16579,3.27028,3.36204,3.44522,3.51975,
3.58399,3.8844,
# AGE INFO: M,WT,SELEX,NUMBERS,,,,,,,,,,,,,,,,,,,,
# FEMALE,,,,,,,,,,,,,,,,,,,,,,,
   .06000,   .06000,   .06000,   .06001,   .06013,   .06097,   .06402,   .07037,   .07903,
.08804,   .09594,   .10201,   .10672,   .10999,   .11259,   .11425,   .11561,   .11664,   .11734,
 .11787,   .11822,   .11857,   .11893,   .11910,   .11928,
   .04700,   .13300,   .26500,   .43500,   .63500,   .85500,   1.08500,   1.31900,   1.55000,
1.77500,   1.98800,   2.19000,   2.37800,   2.55200,   2.71100,   2.85600,   2.98800,   3.10700,
3.21400,   3.31000,   3.39600,   3.47300,   3.54100,   3.60200,   3.90000,
   .00026,   .00760,   .19323,   .97956,   .99727,   .57631,   .35398,   .27796,   .25278,
.24120,   .23283,   .22566,   .21951,   .21429,   .20992,   .20391,   .19868,   .19413,   .18210,
 .17184,   .16358,   .15690,   .13934,   .12706,   .11833,
  238.35288,   204.98610,   201.08574,   212.96610,   136.79802,   140.27095,   208.92664,   318.68570,
167.58476,   199.88103,   173.39323,   126.20521,   104.82539,   95.38803,   43.40654,   32.73907,
39.54165,   22.86064,   13.47217,   9.44046,   7.20839,   2.67660,   5.62894,   3.65099,   45.27893,


# MALE
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.06000,   .06000,   .06000,   .06000,   .06000,   .06000,   .06000,   .06000,   .06000,   .06000,
 .06000,   .06000,   .06000,   .06000,   .06000,   .06000,
   .03200,   .11900,   .26000,   .44100,   .64500,   .85800,   1.06900,   1.26900,   1.45500,
1.62300,   1.77400,   1.90700,   2.02300,   2.12400,   2.21000,   2.28500,   2.34800,   2.40200,
2.44800,   2.48600,   2.51900,   2.54600,   2.56900,   2.58900,   2.70000,
   .00020,   .00748,   .19307,   .97977,   1.00000,   .58666,   .37252,   .29673,   .26567,
.24776,   .23562,   .22675,   .21991,   .21443,   .20996,   .20628,   .20326,   .20077,   .19874,
 .19708,   .19572,   .19463,   .19374,   .19302,   .19245,
  238.35288,   204.98708,   201.08975,   212.98472,   136.82954,   140.32663,   209.07910,   319.30972,
168.05285,   198.30151,   166.49020,   117.81606,   99.15396,   95.03106,   46.41686,   36.97260,
44.57084,   25.18530,   15.14766,   11.36878,   9.50305,   3.80037,   8.44462,   5.72975,   23.50413,
# NUMBER OF SIMULATIONS,,,,,
```

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1000,,,,
# TIME SERIES,,,,,
# NUMBER OF HISTORICAL YEARS + 2,,,,,
64,,,,,
# YR, RECR, SPBIO,USE_IN_Bzero,USE_IN_R, USE_IN_R/S
#,,,,,
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1901,3907,29848,0,0,0
1941,3948,29848,0,0,0
1942,3948,29847,0,0,0
1943,3948,28852,0,0,0
1944,3867,27860,0,0,0
1945,3783,26792,0,0,0
1946,3691,25538,0,0,0
1947,3579,24417,0,0,0
1948,3476,23449,0,0,0
1949,3384,23626,0,0,0
1950,3401,23829,0,0,0
1951,3420,23941,0,0,0
1952,3431,23919,0,0,0
1953,3429,23871,0,0,0
1954,3424,23725,0,0,0
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1957,3369,22960,0,0,0
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1960,3058,21803,0,0,0
1961,6281,21561,0,0,0
1962,2871,21481,0,0,0
1963,2703,21521,0,0,0
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1966,1275,22268,0,0,0
1967,1271,22060,0,0,0
1968,2007,22142,0,0,0
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1971,2795,21982,0,0,0
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1973,1973,21124,0,0,0
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1976,2618,18792,0,0,0
1977,3513,18314,0,0,0
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1979,3158,16596,0,0,0
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1981,1288,13968,0,0,0
1982,2443,13106,0,0,0
1983,2134,11340,0,0,0
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1987,1344,8788,0,0,0
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1992,1255,4683,0,0,0
1993,1169,3831,0,0,0
1994,830,3254,0,0,0
1995,1342,3130,0,0,0
1996,766,3037,0,0,0
1997,449,2762,0,0,0
1998,374,2512,0,0,0
1999,516,2195,0,0,0
2000,454,2102,0,0,0
2001,435,2312,0,0,0
2002,477,2524,0,0,0

Number of years with pre-specified catches,,,,,
1,,,,,
catches for years with pre-specified catches,,,,,
2002,89,,,,
Number of future recruitments to override,,,,,
0,,,,,
Process for overiding (-1 for average otherwise index in data list),,,,,
Which probability to product detailed results for (1=0.5;2=0.6;etc.),,,,,
2,,,,,
Steepness and sigma-R,
0.330, 0.4
Target SPR rate (FMSY Proxy),
0.73
Target SPR information: Use (1=Yes) and power,
0 20
Discount rate (for cumulative catch),
0.1
Truncate the series when 0.4B0 is reached (1=Yes),
0
Set F to FMSY once 0.4B0 is reached (1=Yes),
0
Percentage of FMSY which defines Ftarget,
0.9
Conduct MacCall transition policy (1=Yes),
0,
Defintion of recovery (1=now only;2=now or before)
2
Produce the risk-reward plots (1=Yes)
0
Calculate coefficients of variation (1=Yes)
0
Number of replicates to use
1
First Random number seed
-89102

Updated Rebuilding Analysis for Lingcod

August 8, 2001

Tom Jagielo[1] and Jim Hastie[2]

1. Washington Department of Fish and Wildlife
600 Capitol Way N
Olympia, WA 98501

2. National Marine Fisheries Service
2725 Montlake Blvd. E.
Seattle, WA 98112

Introduction

In 1997, an assessment of lingcod prepared for the PFMC found that female spawning biomass estimates were below 25% of the unfished biomass level for the northern portion of the stock (Jagielo et al 1997). An analysis was subsequently prepared which indicated that rebuilding to the $B_{40\%}$ level was possible within 10 years at F=0 (Jagielo 1999). Based on the analysis for the northern area, a 10 year rebuilding plan was implemented by PFMC for the entire West Coast (Washington-Oregon-California). The rebuilding plan began in 1999 and set the target date of the start of 2009 for achieving the $B_{40\%}$ spawning stock size.

More recently, a new coastwide assessment for lingcod was conducted in 2000 (Jagielo et al 2000). The new assessment provides separate estimates of spawning stock biomass for the northern (LCN: US-Vancouver and Columbia) and southern (LCS: Monterey, Eureka, Conception) areas. Spawning stock size estimates have increased since 1997 in both areas, indicating progress toward the rebuilding target since the implementation of coastwide catch reductions (Figure 1). Recruitments are plotted by brood year in Figure 1a.

The present rebuilding analysis utilizes information from the most recent stock assessment and conforms to the SSC Terms of Reference for Groundfish Rebuilding Plans. This analysis provides new rebuilding trajectories for both the northern and southern areas that provide for lingcod rebuilding within the time frame originally established by PFMC in 1999.

Data and Parameters

This analysis uses the SSC Default Rebuilding Analysis software developed by Punt (2001). For each area, data inputs included: 1) spawning output by age (the product of the weight-at-age and % maturity-at-age vectors); 2) sex-specific natural mortality; 3) age specific weight (kg), selectivity, and numbers of fish for the year 2000; and 4) vectors of annual recruitment (age 2 fish) and spawning biomass estimates (1973-2000). Age specific data were input for ages 2-20+, with 20+ serving as an accumulator age. The population projection was configured to begin in

2001 with rebuilding occurring by the start of 2009 (year 10 from the original rebuilding start year of 1999). Catches were pre-specified for 2001, and were derived from the projections for the years 2002-2008.

Management Reference Points

Separate estimates of B_0 were computed using random draws from 1) the full time series of recruitment estimates (1973-1995), and 2) the time series of early recruitments (1973-1982) (Table 1). Distributions of the simulated B_0 estimates under these alternative recruitment scenarios indicated a marked difference for the northern area, but little difference for the southern area (Figure 2). For both areas, the full recruitment time series B_0 scenario was selected for the rebuilding projection analysis (Table 1 values shown in bold). Comparison of the spawning stock estimates for 2000 (Table 1) with the full recruitment time series estimates of B_0 indicate that the recent coastwide spawning population size is approximately 15% of the unfished population size.

The median time to rebuild at F=0 was determined by the previous lingcod rebuilding analysis to be 5 years, and the maximum time allowed to rebuild (T_{max}) was established by PFMC to be 10 years (by the start of 2009) (Jagielo 1999). The present analysis confirmed that rebuilding could occur within 10 years with no fishing; the median time to rebuild at F=0 was estimated to be 3.6 years for the northern area, and 4.8 years for the southern area.

Rebuilding Projections

Population projections were conducted using the "recruits" in lieu of the "recruits-per-spawner" option provided by Punt (2001). The basis for this choice was the lack of a credible spawner-recruit relationship for lingcod (Figures 3 and 4). This is evidenced particularly for the northern area (Figure 3), where the ratio of recruit/spawning output increased substantially from 1987-1993 -- a period where the trend in spawning stock size was decreasing (Figure 1). Recruitments for the LCN and LCS projections were randomly drawn from the values estimated from the most recent years (1986-1995) in the assessment (Jagielo et al 2000).

Performance of alternative rebuilding policies

Estimates of fishing mortality, median years to rebuild, and OY (mt) for 2002-2009 were computed for alternative probabilities of achieving the rebuilding target by start of 2009--50%, 60%, 70% and 80%--as well as the 40-10 and F=0 policies (Table 2). The bottom panel of Table 2 shows the coastwide rebuilding OYs for each policy, which represent the combination of northern and southern yields. These trajectories are also portrayed in Figure 7. For comparative purposes, Figure 7 also depicts the 2000 harvest and the 2001 OY. The 2002 OY associated with a 60% likelihood of rebuilding is slightly lower than the OY adopted for 2001. Plots of the probability ogives for each of the alternative policies, including F=0 and the 40:10 rule, are shown in Figures 5 and 6. Also shown in these figures are the median projected OYs through 2009, for each policy, and the trajectories of median ratios of spawner biomass to target biomass. For the alternative with 60% likelihood of rebuilding, Figure 8 portrays the variability in the ratio of spawner-to-target biomasses in the northern and southern areas. The median ratio is portrayed, along with the 5th, 25th, 75th, and 95th percentiles for the years 2001-2009. For figures relating to biomass, the year indices reflect the status at the beginning of the year.

References

Jagielo, T., P. Adams, M. Peoples, S. Rosenfield, K. Silberberg, and T. Laidig. 1997. Assessment of lingcod (*Ophiodon elongatus*) for the Pacific Fishery Management Council in 1997. In: Status of the Pacific Coast groundfish fishery through 1997 and recommended biological catches for 1998. Stock assessment and fishery evaluation. Pacific Fishery Management Council, Portland, Oregon.

Jagielo, T.H. 1999. Lingcod Rebuilding. Analysis submitted to Pacific Fishery Management Council, May 5, 1999. Attachment G.9.c June 1999, PFMC Briefing Book.

Jagielo, T.H., D. Wilson-Vandenberg, J. Sneva, S. Rosenfield, and F. Wallace. 2000. Assessment of Lingcod (*Ophiodon elongatus*) for the Pacific Fishery Management Council in 2000. In Appendix to Status of the Pacific Coast Groundfish Fishery Through 2000 and Recommended Acceptable Biological Catches for 2001, Stock Assessment and Fishery Evaluation. 142 p. Pacific Fishery Management Council, 2130 SW Fifth Avenue, Suite 224, Portland, Oregon 97201, October 2000.

Punt, A.E. 2001. SSC Default Rebuilding Analysis. Technical specifications and user manual. Ver. 1.000003 (July 2001).

Tables and Figures

Table 1. Estimates of unfished spawning stock biomass (B_0), Bmsy proxy ($B_{40\%}$), and spawning stock size in 2000 (B2000) for the northern (LCN) southern (LCS) areas. Values in bold were used for rebuilding projections.

	Spawning Output (mt)				
	All Recruitments (1973-1995)		Early Recruitments (1973-1982)		Recent Estimate
	Unfished (B_0)	Target ($B_{40\%}$)	Unfished (B_0)	Target ($B_{40\%}$)	(B_{2000})
LCN	**22,882**	**9,153**	31,033	12,413	3,527
LCS	**20,971**	**8,389**	22,799	9,120	3,220

Table 2. Rebuilding projection results; Top: northern area (LCN), Middle; southern area (LCS), Bottom: LCN and LCS Combined.

LCN						
Fishing rate	0.0607	0.0531	0.051	0.0474	40:10 Rule	F=0
Prob to rebuild by Tmax	**50%**	**60%**	**70%**	**80%**	**55%**	**100%**
Median years to rebuild	7.0	6.6	6.1	5.9	6.7	3.6
OY (mt)						
2002	384	337	324	302	189	0
2003	429	379	365	341	284	0
2004	470	417	402	376	384	0
2005	502	447	432	405	473	0
2006	531	475	460	432	553	0
2007	561	504	487	459	621	0
2008	581	523	506	477	665	0

LCS						
Fishing rate	0.0667	0.061	0.0533	0.0472	40:10 Rule	F=0
Prob to rebuild by Tmax	50%	60%	70%	80%	68%	100%
Median years to rebuild	7.0	6.7	6.3	6.0	6.5	4.8
OY (mt)						
2002	262	240	211	187	91	0
2003	296	273	241	214	150	0
2004	345	319	283	253	232	0
2005	399	370	329	295	332	0
2006	448	416	371	334	434	0
2007	494	460	412	371	534	0
2008	536	500	448	405	644	0

Coastwide OY (mt)	**Prob to rebuild by Tmax:**					
Year	**50%**	**60%**	**70%**	**80%**	**40:10 Rule**	**F=0**
2002	646	577	535	489	280	0
2003	725	651	606	555	434	0
2004	815	735	685	629	616	0
2005	901	817	761	701	805	0
2006	979	891	831	766	987	0
2007	1,055	963	899	830	1,155	0
2008	1,117	1,022	954	882	1,309	0

Figure 1. Time series of female spawning stock biomass estimates (mt).
Source: Jagielo et al. 2000.

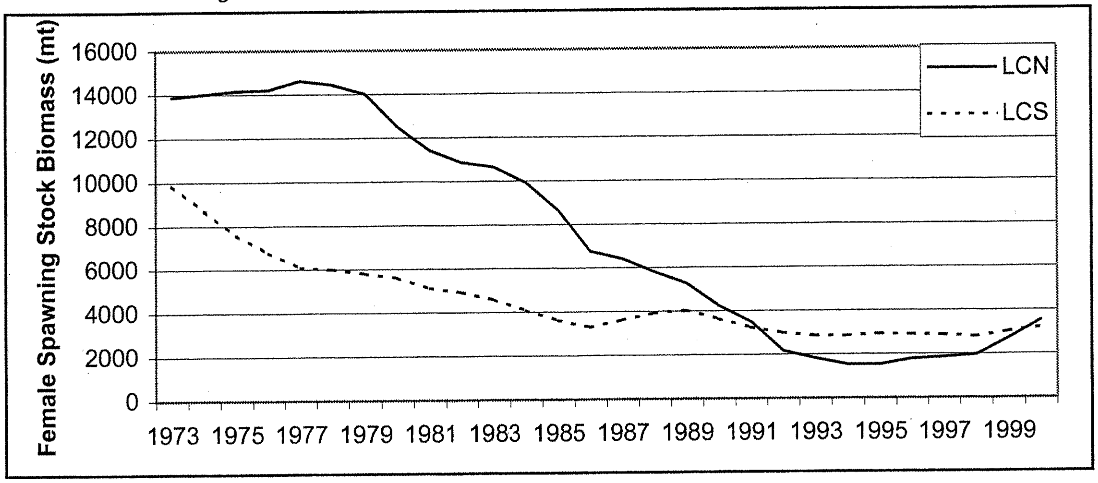


Figure 1a. Full recruitment time series by brood year (1971-1993) for LCN and LCS.

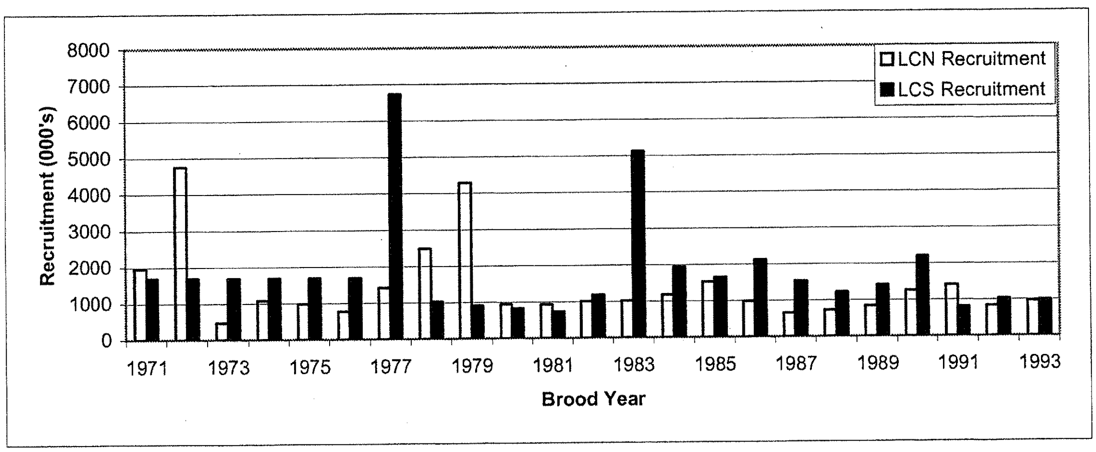
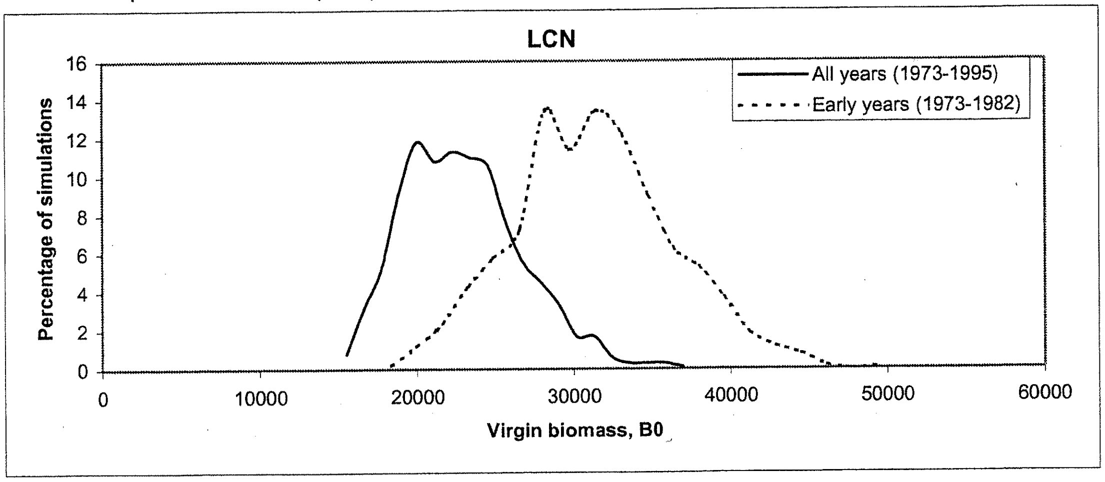


Figure 2. Distribution of Virgin Spawning Biomass (B_0) estimates for 1000 simulation runs.
Top: Northern area (LCN), Bottom: Southern area (LCS).



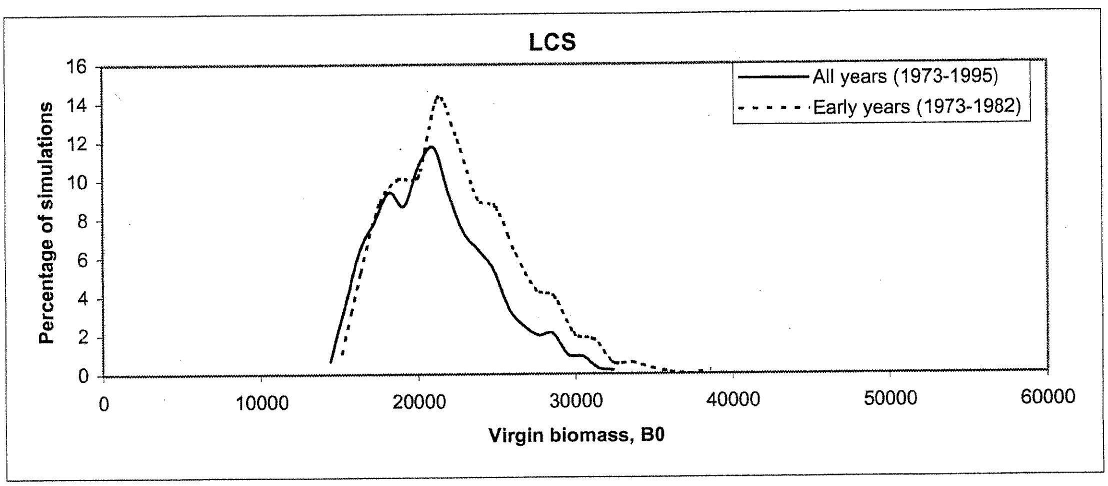


Figure 3. Recent northern area (LCN) recruitment and recruits/spawning output (R/S).

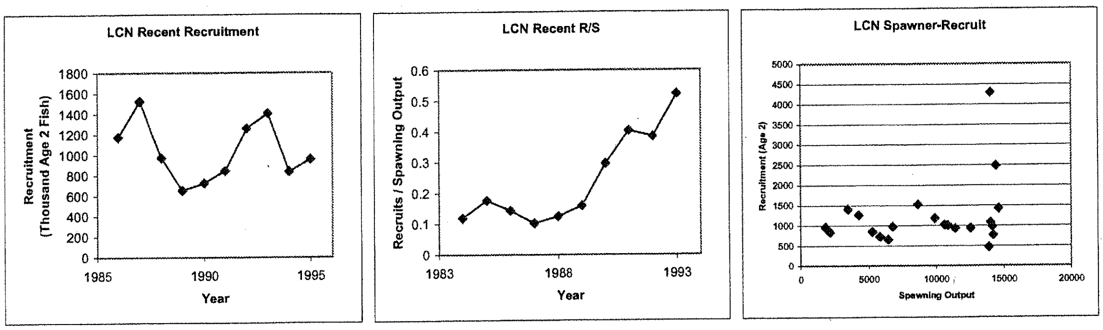


Figure 4. Recent southern area (LCS) recruitment and recruits/spawning output (R/S).

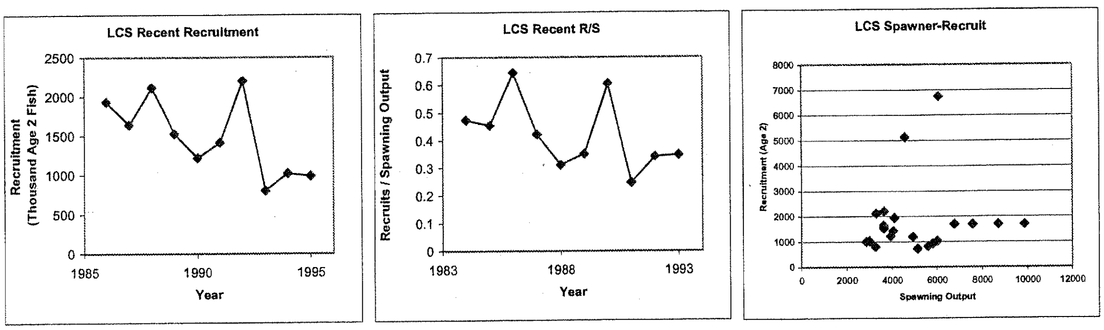


Figure 5.--Probability of limit attainment, median OY trajectories, and ratios of spawner biomass to target biomass, under six alternative harvest policies in the northern area (LCN).

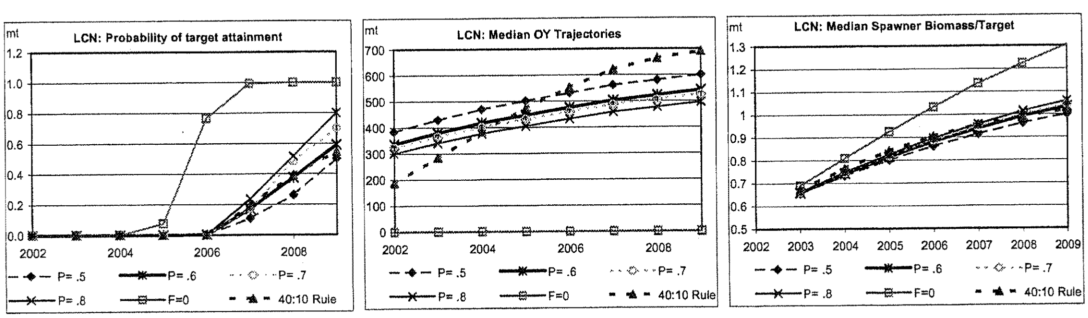


Figure 7.--Coastwide rebuilding OYs for lingcod, 2002-2008, based on the median projections, for six alternative harvest policies, and the 2000 harvest and 2001 OY.

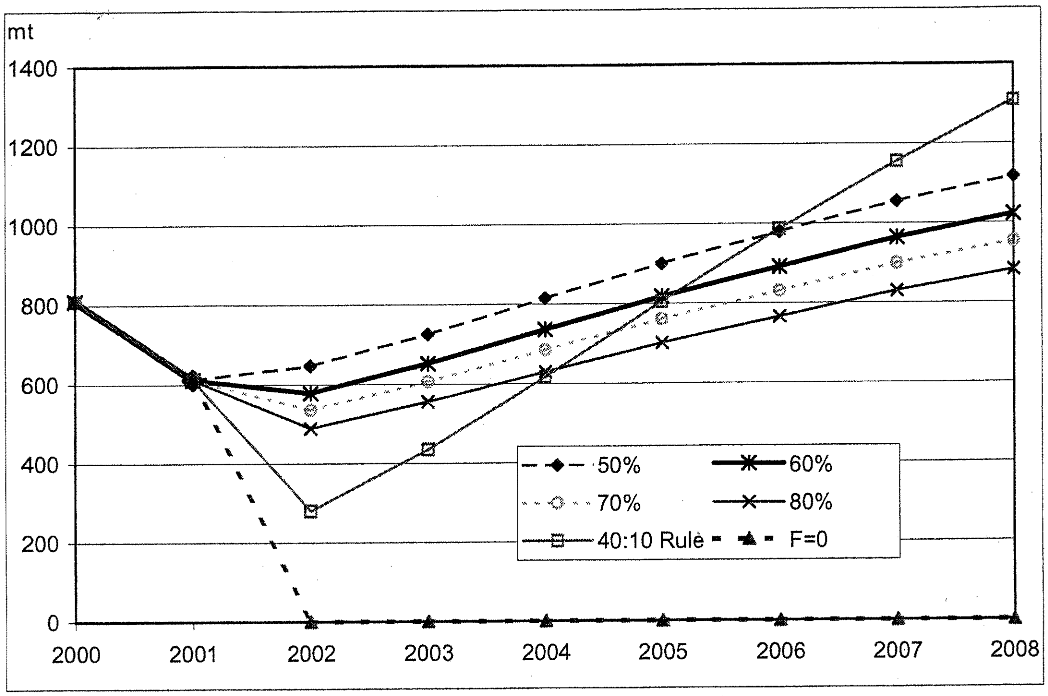
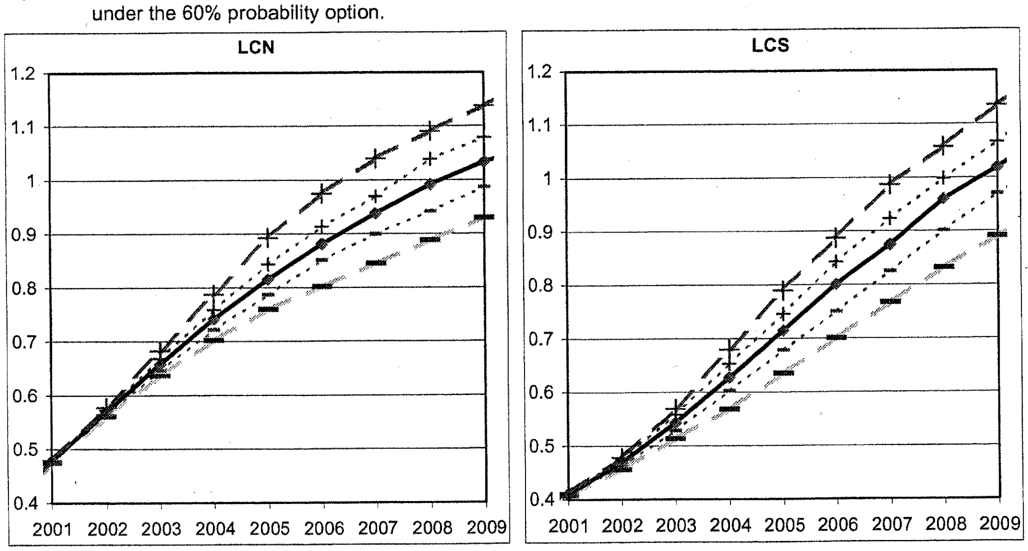


Figure 8.--Projected ratios of spawner biomasses to the targets, for the northern (LCN) and southern (LCS) areas under the 60% probability option.



Note: The central thick line represents the median ratio in each year. Other lines, from bottom to top represent the 5th, 25th, 75th, and 95th percentiles.

Appendix E. FMP Amendment Language

Not available.

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 10
1200 Sixth Avenue
Seattle, WA 98101

Reply To
Attn Of: ECO-088

MAY -7 2003

02-025 ~~NOA~~

John DeVore
Pacific Fishery Management Council
7700 NE Ambassador Pl., Suite 200
Portland, OR 97220

Dear Mr. DeVore:

The U.S. Environmental Protection Agency (EPA) has reviewed the 16 April 2002 Notice of Intent (NOI) to prepare an Environmental Impact Statement (EIS) for *Amendment 16 to the Pacific Coast Groundfish Fishery Management Plan* in accordance with our responsibilities under the National Environmental Policy Act (NEPA) and Section 309 of the Clean Air Act. The NOI states that Amendment 16 will incorporate rebuilding plans for groundfish species that have been declared overfished by the Secretary of Commerce and procedures for periodic review and revision of rebuilding plans. The NOI also states that the EIS under development will address the injunction that emerged from NRDC v. Evans ordering that the National Marine Fisheries Service (NMFS) include rebuilding overfished groundfish species as part of its fishery management plan and that it specifically address the overfished species of lingcod, cowcod, Pacific ocean perch, widow rockfish, and darkblotched rockfish.

The current overfished condition of multiple groundfish species belies the importance of managing groundfish as long-lived species unable to recover from overexploitation in a short period of time. We understand that is difficult to gather data on, understand the complexities of, and model marine systems. Gaps in knowledge and understanding about the effect of the changing ocean environment on groundfish is one of the reasons that the several groundfish species have been overexploited. We are pleased that Congress has allocated $750,000 to research the causes of the overexploitation of groundfish species and that NMFS is partnering with the fishing fleet to get the most out of this limited funding. However, we know that significant data gaps will continue to exist because of the vastness and complexities of the marine environment, and continue to believe that the lack of comprehensive data on the marine environment and species sustainability demands an ecologically protective approach to rebuilding.

An ecologically protective approach would use all reasonably available technologies to avoid non-target species and age classes, avoid impairing the habitats of target and non-target species, and reduce exploitation rates to compensate for missing or uncertain ecological information. Avoiding impacts to non-target species and age classes is important ecologically and economically because the impacts on marine resources from bycatch are often not well understood in an ecological sense and are often not monitored as intensively as target species. In addition, bycatch can result in impaired future marine resources when these species are later targeted to replace overexploited stocks or increase harvested biomass. We recommend that the

EIS evaluate a range of alternatives for rebuilding the Pacific groundfish stocks, and utilize an ecologically conservative approach to allowable fishing given the severe overexploitation of many species subject to harvest.

Similarly, we recommend that NMFS evaluate and consider the advantages of avoiding impacts to marine habitats as a component of rebuilding, including the possible inclusion of marine reserves into alternatives. Habitat destruction from various gear types and fishing methods used in the groundfish fishery have also contributed to the lack of sustainability of many of these species. We are pleased that many participants in the Pacific groundfish fleet have volunteered to change fishing methods to avoid habitat destruction, and encourage NMFS to address how these efforts might be furthered through the rebuilding plan. The EIS should specifically address the options for, and effectiveness of habitat protection as an integral component of the rebuilding plan.

Thank you for the opportunity to provide scoping comments. Please feel free to contact me at (206) 553-0253 to discuss these comments.

Sincerely,

Christian F. Gebhardt
NEPA Reviewer

Gebhardt.Chris@epamail.epa.gov wrote:

These are some preliminary comments from the EPA on the draft Amendments 16-1 and 16-2. Due to the very short timeframe for reviewing these documents, our review was cursory. We offer NMFS and the Council some brief comments on the following points for clarification or further information in their preparation of the EIS. Our review of the EIS, when it is released to the public, will be much more substantive, and EPA will submit formal comments under our Clean Air Act Section 309 responsibilities at that time.

Page 1-1 briefly states the relationship between documents describing amendments 16-1 and 16-2. The draft EIS should identify the relationship between amdendments 16-1 and 16-2 in greater detail. The draft EIS should also describe the timing of preparing NEPA analyses and making decisions for each of the planning elements for rebuilding overfished species.

Page 1-1 states that federal agencies requires agencies to prepare and circulate draft EISs which must fulfill and satisfy to the fullest extent possible the requirements established for final statemenets in section 102(2)(c) of the Act. Although other entities may prepare EISs (e.g., state departments of transportation), the leading federal agency is ultimately responsible for the content of the EIS and its support of the decision made. The EIS should clearly identify that NMFS is the party responsible for the NEPA process.

Page 1-1 discusses the Council's preferred alternative. NEPA regulations discuss the "agency" preferred alternative. Activities initially proposed by the agency and outside parties are usually referred to as proposals. We recommend that the Council's preferred alternative be renamed "the proposal" and NMFS' preferred alternative be called the preferred alternative.

Pages 1-1 and 1-2 state that information would be arranged in 11 chapters. It appears that only five chapters (plus appendices exist in the preliminary EIS).

Page 1-2 states that rebuilding plans are mandated when the size of a stock or stock complex falls below a level described in the FMP as the Minimum Stock Size Threshold of MSST, which is 25% of unfished biomass for stocks managed under the Groundfish FMP. This description is difficult to understand for those unfamiliar with fisheries management. We recommend that you explain this concept in greater detail and give an example.

Page 1-3 states that the proposed action is needed because National Standard 1 in the Magnuson-Stevens Act requires conservation and management measures that prevent overfishing. The EIS should explain if proposed actions conserve overfished species by limiting impacts to habitat, harvest as target species, or harvest as bycatch species.

Page 1-3. An example would be invaluable to a reader in understanding the requirements for rebuilding plans and how overfishing should be distinguished from an overfished stock.

Page 1-3 describes the mixed stock exception. We are pleased that the document explicityly states that different fish assemblages-some with healthy stocks and some with overfished stocks-can co-occur in a mixed-stock complex, and thus be caught simultaneously and that an optimum yield harvest for the healthy stock can result in overfishing the depleted stock. On the face of things, however, it appears that the criteria for mixed stock exception are oriented largely toward not worsening the overfished condition of depleted stocks rather than recovering them. The EIS should state if and if so, why this is the case.

Page 1-4 states that the actual discard rate of fish species that are overfished is a critical uncertainty that must be addressed if effective measures to control total mortality and thus achieve rebuilding objectives are to be adopted. The EIS continues to state that assumptions are contentious and that an observer program has existed since August 2001to monitor bycatch and discard. The EIS should 1) describe the sufficiency of the observer program to represent activities of the fishing community, 2) state if recently collected observer data has been used to indicate the validity of models and assumptions used now and in the past, and 3) state why observer data is not being relied upon to a greater extent to describe bycatch and discard.

Page 1-6 states that scientific and industry advisory bodies commented on the high degree of uncertainty associated with predicting stock rebuilding. If possible, the draft EIS should quantify this level of uncertainty and state if prediction of recovering overfished stocks take this high level of certainty into consideration.

Page 1-6 states that rebuilding analyses showed that even at high levels of risk (low probability of stock recovery) annual catch levels would have to be substantially reduced. It appears that higher levels of risk would make it more imperative to substantially reduce annual catch levels. Please explain.

Page 1-7 states that in September 2000, choosing a rebuilding strategy was made difficult due to uncertainty about the maximum age and survival of femail fish. The draft EIS should state if this information is now available.

Page 1-9 discusses the purpose of scoping in the context of identifying relevant issues. We recommend that the beginning of the EIS contain a section which succinctly raises issues in a question format and those questions with references to pages in the EIS to provide the reader with additional information.

Page 1-10. Renaming "mean generation time" with "difference between Tmin and Tmax" might be clearer to readers.

Page 2-1 discusses the no-action alternative. The draft EIS does not clearly state if the No Action alternative is the situation prior to or after interim measures were adopted to address overfishing. Instead, the discussion on the bottom of 2-1 nebulously addresses 40-10 adjustments and what could be interpretted as the no-action. We recommend that the EIS clearly state what the no-action alternative is and why NMFS and the Council selected that particular scenario.

Page 2-4 identifies the probability of rebuilding stocks within Tmax. The draft EIS should also explain the probability of rebuilding stocks within Tmin or explain why this parameter is not included.

Page 2-4 lists the criteria for the mixed stock exception alternative. Criteria (a) states that the Council demonstrates by analysis that such action will result in long-term benefits to the Nation. The draft EIS should should explain this criteria in more detail. For example, what is the timeframe used to analyze long-term benefits? What resources are valued and which are not? Are values placed on ecological resources?

Page 2-5 indicates that the mixed stock exception might be used for canary rockfish. The description indicates that it is assumed that the stock would be static for the next 100 years. The EIS shouls explain why the NMFS and the Council are entertaining maintaining the depleted condition of overfished canary rockfish instead of planning to rebuild this stock.

Page 4-1 describes various human caused effects. The draft EIS should attempt to quantify different human-caused effects and their significance for different alternatives. This information and analysis should indicate the extent by which habitat degradation, targetted harvest, or bycatch harvest are causing decreased numbers or preventing recovery and the effectiveness of mitigation measures in limiting these effects.

Page 4-3, second paragraph of Section 4.2.1.4 is missing text.

DRAFT SUMMARY MINUTES
Ad Hoc Allocation Committee

Pacific Fishery Management Council
Embassy Suites Hotel
The Firs I-II Room
7900 N.E. 82nd Ave.
Portland, OR 97220
(503) 460-3000

June 10 - 11, 2003

Note: In these draft minutes the Ad Hoc Allocation Committee will be referred to as the Committee. Supporting materials are often referenced by their June, 2003 Council meeting exhibit number.

TUESDAY, JUNE 10, 2003 - 8 A.M.

Members Present:
Dr. Hans Radtke, Chairman, Pacific Fishery Management Council
Ms. Marija Vojkovich, California Department of Fish and Game
Mr. Neal Coenen, Oregon Department of Fish and Wildlife
Mr. Phil Anderson, Washington Department of Fish and Wildlife
Mr. Bill Robinson, Northwest Region National Marine Fisheries Service

Others Present:
Ms. Eileen Cooney, General Counsel, National Oceanic and Atmospheric Administration
Dr. Jim Hastie, Northwest Fisheries Science Center, National Marine Fisheries Service, GMT
Mr. Rod Moore, West Coast Seafood Processors Association, GAP
Ms. Jamie Goen, Northwest Region National Marine Fisheries Service
Mr. Tom Barnes, California Department of Fish and Game, GMT
Dr. Patty Burke, Oregon Department of Fish and Wildlife
Mr. Peter Huhtala, Pacific Marine Conservation Council
Mr. Chris Dorsett, The Ocean Conservancy
Mr. John Holloway, Oregon Anglers
Mr. Mark Saelens, Oregon Department of Fish and Wildlife, GMT
Mr. Don Bodenmiller, Oregon Department of Fish and Wildlife
Mr. Brian Culver, Washington Department of Fish and Wildlife, GMT
Ms. Michele Robinson, Washington Department of Fish and Wildlife, GMT
Ms. Janice Green, Non-charter Recreational Representative, GAP
Ms. Karen Garrison, Natural Resources Defense Council
Mr. Bob Strickland, United Anglers of California, Inc
Mr. Dale Myer, Arctic Storm, Inc., GAP
Mr. Steve Bodnar, Coos Bay Trawlers Association
Mr. Jim Glock, National Marine Fisheries Service
Mr. Mark Cedergreen, Pacific Fishery Management Council
Mr. Steve Joner, Makah Indian Tribe
Mr. Rob Jones, Northwest Indian Fisheries Commission, GMT
Dr. Vidar Wespestad, Pacific Whiting Conservation Cooperative
Dr. Donald McIsaac, Executive Director, Pacific Fishery Management Council
Mr. Ed Waters, Pacific Fishery Management Council staff
Dr. Kit Dahl, Pacific Fishery Management Council staff
Mr. Dan Waldeck, Pacific Fishery Management Council staff
Mr. Jim Seger, Pacific Fishery Management Council staff
Mr. Mike Burner, Pacific Fishery Management Council staff
Mr. John DeVore, Pacific Fishery Management Council staff

A. *Call to Order*

1. Roll Call, Introductions, Announcements, Approve Agenda, etc.
2. Opening Remarks

Dr. McIsaac welcomed the Committee and attendees and noted that the meeting is being recorded. Mr. DeVore reviewed the supporting documents. Dr McIsaac characterized the objective of the meeting as an initial consideration of options covering a wide range of management alternatives for 2004. Adopting a complete suite of alternatives at the June meeting is a critical step towards detailed analyses in an Environmental Impact Statement (EIS) to be prepared by the Council staff before the September Council meeting.

3. Agenda Overview

Mr. Anderson noted the substantial amount of time set aside for review of new assessments and rebuilding analysis and a relatively short period for development of 2004 management options. He would prefer a brief summary of new assessments saving more time for 2004 management options. Additionally, he suggested allocation issues come before development of 2004 management options and the agenda was modified accordingly. Ms. Vojkovich asked about the alternative management strategies agenda item that originally appeared on the draft agenda. Dr. McIsaac stated this agenda item had been removed from previous drafts because the schedule for developing alternative management approaches will be discussed at the June meeting and discussing actual alternatives at this meeting seems premature. It was also clarified that inseason adjustments was scheduled at the end of the agenda for brief discussion as it is not the focus of Committee objectives and has the potential to occupy the bulk of this two day meeting.

B. *Review of New Assessments and Rebuilding Analyses*

1. Pacific Ocean Perch Assessment, Rebuilding Analysis, and STAR Panel Report

Mr. DeVore suggested that the Committee focus on rebuilding analyses for newly assessed overfished species as a first step towards developing a range of Optimum Yields (OYs). The recruitment profile for POP has changed from the previous assessment. The critical difference, as displayed on page three of the document, is the lack of the recruits per spawner trend exhibited in the previous assessment. A trend in recruits per spawner implies density dependence and, under these conditions, the SSC Terms of Reference recommends forecasting future recruitment by sampling historic recruits rather than recruits per spawner. The new recruitment profile shows no trend in recruits per spawner suggesting a need to change the way future recruitment is forecast by sampling historic recruits per spawner rather than only recruits. Additionally, there is a decision to be made on whether or not to fix T_{MAX}. The report presents various OYs under differing model results with the range in OY roughly 200 mt to 700 mt. The SSC will advise on these issues at the June Council meeting. Mr. Culver reported that at the STAR-Lite Panel there were some comments relative to using recruits rather that recruits per spawner for POP modeling. Dr. McIsaac asked that for each of these stocks there be a summary of improving or declining trends, the status of rebuilding, and whether there is scientific controversy or uncertainty. The primary uncertainty surrounding POP is the issue of using recruits or recruits per spawner with a corresponding large effect on the resulting OYs for 2004. The issue of fixing or re-estimating the maximum rebuilding time (T_{MAX}) will also need to be addressed by the SSC and will affect the resulting OY. Under Amendment 16-1 there is a discussion suggesting such biologically-determined rebuilding parameters would automatically change with new assessments. OYs for POP will have to decline if the original T_{MAX} is fixed. Ms. Robinson referred to Tables 2 and 3 of the rebuilding analysis to help the Committee put POP status and resulting OYs into perspective.

2. Widow Rockfish Assessment, Rebuilding Analysis, and STAR Panel Report

The current assessment suffered from a lack of informative indices with only one indicator approved for use by the STAR Panel, a juvenile midwater trawl survey out of Santa Cruz, California. Preliminary estimates prior to this full assessment suggested a slight improvement in stock health; however, changes in model assumptions substantially decreased estimated stock productivity while concurring with a slightly improved estimate of relative biomass. The SSC has several technical analyses to review and comment on. Table 4 of the rebuilding analysis displays several different modeling approaches taken by Dr. Xi He. The STAR Panel took a conservative approach in its modeling recommendations and the GMT was unable to settle all of the technical issues. The range of OYs is huge ranging from 0 to over 500 mt. The GMT-projected bycatch in the 2003 whiting fisheries is around 250 mt with an additional 20 mt required to account for bycatch in other groundfish fisheries. This assessment and rebuilding analysis will be the subject of intense discussions at the June Council meeting. There is considerable scientific uncertainty surrounding the estimates. There is some indication that data available for future assessments may illustrate improved recruitment but those indices are not yet available. Using the limited midwater survey information available for this year's assessment suggests poor recruitment and therefore the rebuilding analysis has several scenarios with reductions in OY relative to 2003. Landed catch from 2002 was 275 mt with an additional 16% in bycatch. The majority of the mortality of widow rockfish in 2002 occurred in the directed fishery. The Committee reviewed estimated widow rockfish bycatch of 272 mt in the most recent version of the GMT scorecard for total mortality in 2003 fisheries. Ms. Robinson added that for 2004 the situation for widow rockfish is considerably worse. The high end of the ranges from the current rebuilding analyses are around 500 mt, less than recent years. There is so much uncertainty in the science behind the assessment there will need to be difficult decisions on data treatment to determine if the stock's productivity is higher or lower than previously estimated. There are considerable concerns with model runs that utilize a weak stock-recruit relationship. The resulting estimates of OY from these model runs tended to be very low. The stock-recruit relationship will certainly be a focus of SSC review.

Dr. McIsaac reminded the Committee the technical issues and their resolution is not the charge of this meeting. The Committee needs only an update on the status of these assessments and the general management implications required for developing a broad range of management options for 2004.

Referring to page 8 or the rebuilding analyses, Mr. Anderson asked if the recommendation presented could be characterized as the Stock Assessment Team (STAT) recommendations. Disagreements between the STAR and the STAT exist; however, the recommendation of the STAT team was model number 8 with an OY of 284 mt.

3. Bocaccio Assessment, Rebuilding Analysis, and STAR Panel Report

The current assessment of bocaccio is much improved from the 2002 assessment largely due to the strength of the 1999 year class. The 1999 year class had not recruited into the indices used in the 2002 assessment. This strong year class did show up in indices used for the 2003 assessment. This had dramatic effects on rebuilding projections. This is due to improved estimates of current biomass and productivity of the stock. There are three separate models presented in the rebuilding analysis. Two were approved by the STAR Panel: one omits a new recreational data source developed by Dr. Alec MacCall and the other rejects the results from recent NMFS trawl surveys. Dr. MacCall proposed a third approach that can be thought of as a hybrid that utilizes all data sources. All three models show an improvement of stock status. The SSC will likely need to comment on which of these three models, if any, should be used. There is a policy decision to be made on how to treat this new information. Bocaccio assessments have varied greatly in recent years and the Council will need to determine what level of caution to use when determining the reaction to this improved status. There are indications that the 2002 year-class is also strong, but like the past, these individuals have not recruited to the indices. This stock appears to be very susceptible to variations in the marine environment.

Dr. McIsaac summed up the situation as improved with significant uncertainty. The stock is still severely depressed but improving at a faster rate than previously expected.

Mr. Barnes referred the Committee to Table 4 of the rebuilding analysis where Dr. MacCall presents the paradox that as bocaccio recover, the interception of bocaccio in fisheries also increases thereby increasing bycatch.

4. Black Rockfish Assessment and STAR Panel Report

This is a new assessment for the black rockfish population south of Cape Falcon, Oregon with a slight overlap with previous northern assessments between Cape Falcon and the Columbia River. The stock is above $B_{40\%}$ and deemed healthy. This assessment had the benefit of a wealth of data as black rockfish is taken in many nearshore fisheries. It appears that there may be more black rockfish than are anticipated under the current nearshore management strategies in Oregon and California.

Dr. McIsaac summed the situation as follows. This new assessment is optimistic and replaces a precautionary harvest approach required due to the stock's uncertain status in the absence of an assessment. The status of black rockfish in this area is healthy and may allow some consideration of new nearshore management approaches. This stock is not overfished and therefore is not subject to rebuilding measures. Mr. Barnes reported that the 50% reduction in nearshore fisheries in California is consistent with a recommendation by Restrepo *et al.* relative to fisheries on data poor species and assumes that black rockfish is between $B_{25\%}$ and $B_{40\%}$. Mr. Bodenmiller reminded the Committee that the uncertainty surrounding historic catch data still exists. Dr. Dahl asked how the range of OYs for black rockfish would be structured. The GMT has not developed a range of OYs, rather a range of allocation strategies between Oregon and California. The OY proposed by the GMT for 2004 is 775 mt taken from base model runs in the current assessment. Mr. Coenen asked about the uncertainty in historic data. In Oregon, the data was collected only in Garibaldi where individuals tend to be larger and there are questions about the accuracy of landings prior to the mid 1970's.

5. Cowcod Rebuilding Review

Mr. Barnes reviewed the assessment update on cowcod completed by himself and Dr. John Butler. This updated assessment brought in new data from the GMT scorecard estimates of total mortality, CPUE from California Partyboat Fishing Vessels (CPFVs), Orange County sanitation district surveys, and California Cooperative Ocean Fisheries Investigations (CALCOFI). The new data are in general agreement that management measures adopted for cowcod have effectively kept harvest within prescribed limits. Under the more liberal regulations of 2000, the OY for cowcod was being met which is unlikely under current more restrictive regulations. Mr. Barnes reported that attempts to recreate previous GLM analyses were difficult due to their complexity and lack of documentation. In summary, the Cowcod Conservation Area (CCA) and non-retention regulations have been effective in keeping cowcod mortality within acceptable levels under the rebuilding analysis. Regarding biomass status, there is no evidence of large improvements, the productivity of the stock is unchanged and the current harvest rates are appropriate, and there is no new scientific uncertainty.

6. Darkblotched Rockfish Assessment and Rebuilding Analysis

In summary, darkblotched rockfish status is stable or slightly improved. There have been discussions of scheduling a full assessment for darkblotched rockfish as many of the issues that were raised during this expedited assessment would require a departure from some of the modeling assumptions made in the previous assessment. The lead author is unavailable this summer, so a new full assessment in time for 2005-06 management is unlikely. It is unlikely that there will be a substantial change in OY for 2004. The estimated mortality in 2003 was 122 mt with an OY of 172 mt due to the conservative management strategy adopted by the Council.

7. Yellowtail Rockfish Assessment

This expedited assessment showed the biomass estimate is slightly improved and above $B_{40\%}$. Given the constraints to fisheries from overfished stocks, it will be difficult to take the yellowtail rockfish OY in 2004; therefore, yellowtail rockfish will not be a constraining stock.

Dr. McIsaac summarized the discussions under this agenda item by displaying the worksheet on page 6. Shaded values represent those with considerable scientific uncertainty.

Mr. Anderson noted the SSC will be called upon for resolving disagreements. Species with substantial issues to be resolved include bocaccio, widow rockfish, and POP.

Informational Worksheet

Pacific Fishery Management Council
Ad Hoc Allocation Committee Meeting

June 10, 2003

Stock Assessment and Rebuilding Analyses Summary

Consideration (changes from 2003)	POP	Widow	Bocaccio	Black RF	Cowcod	DB RF	YT RF
	Species						
Biomass Status?	Status Quo	Sl. Greater	Much Larger	Sl. Greater (first assmnt)	Status Quo	Sl. Less	Sl. Greater
Rebuilding Status?	Sl. Slower T-max +4yrs	Slower	Much Faster	N/A	Status Quo	Sl. Faster	N/A
High Scientific Uncertainty? (need SSC input next week)	Yes	Yes	Yes	No	No	No *	No
Impact on OY/HL?	Less	Less	Higher	Sl. Higher	Status Quo	Sl. Higher	Sl. Higher

* Needs new, full assessment?

High Scientific Uncertainty Category

Species	2003 OY	2003 Projected Impacts	Possible 2004 OY Range	Initial GMT Range	Initial Alloc. Cm. Range
POP	377	120	51 - 737	51 - 555	
Widow	832	272	0 - 582	0 - 501	72 - 284
Bocaccio	<20	<20	199 - 784	199 - 710	
DB	172	122	125 - 345		

this portion of the Allocation Committee Report was referenced under Agenda Item B.4.d

C. *Observer Data Implementation Status*

Working from Exhibit B.2, Attachment 1 in the briefing book, Dr. Hastie updated the Committee on implementation of observer data and new versions of the trawl bycatch model. Observer data has been matched successfully with fish tickets and is planned to be matched with logbooks by July. The logbook data would be a preferable source of landed catch. Projections of effort by depth have been updated with logbook data as it became available, thus improving the trawl bycatch model which relied on 1999 data that is not representative of current fleet behavior under the existing regulations. Issues surrounding sample sizes and resulting variance will be improved with the addition of the second year of observer data. Historic logbook and fish ticket data, which informs baseline participation and species depth distribution, has been weighted as presented with greater emphasis placed on the most recent information.

A more formal routine for modeling the effects of differential landing limits by gear type has been developed since the April Council meeting. Projections of vessel participation in deeper and shallower areas are being estimated, in part, by looking at the vessels that participated in periods 3 through 6 in these depths in past years. Under the current regime of depth-based restrictions there are situations where limits are currently higher than those in the base period and a more formal weighted average from the baseline period for assessing participation has been implemented. The model uses the most basic stratification of the observer data (north and south, deep and shallow).

At the May GMT meeting there was preliminary modeling of 2004 fisheries based on the assumptions presented in Exhibit B.2, Attachment 1. There are issues surrounding the ability of the model to change from a non-retention to a near target or a retention fishery for bocaccio. This may not be an issue due to continued canary restrictions and the limited trawl activity south of 36° N. latitude. The total mortality framework used in the past will be more difficult to assess as we move from a situation where mortality is entirely discard to a combination of landed and discard mortality due to changing fishing strategies. Existing constraints from other overfished species may prevent this from becoming an issue in the near future.

Mr. Anderson asked for clarification on updated bycatch rates. Dr. Hastie reported there will be a more detailed description of discard rates by depth at the June Council meeting. Additionally, the information available this summer will still be exclusive to the trawl fleet.

Public Comment

Mr. Moore asked how trip limits listed under Table 3 could be lower than existing limits when the management lines appear to be as restrictive? Dr. Hastie reported that this is a preliminary report and these types of discrepancies will be worked out with the GMT and the GAP at the June meeting.

D. *Preliminary Range of Harvest Levels for 2004*

Mr. DeVore reviewed Exhibit B.4, Attachment 1, Preliminary ABCs/OYs prepared by the GMT at their May meeting. The Committee and GMT representatives present at the meeting updated the values with either new information from analyses completed since the GMT last met or recommendations by the Committee during the course of discussions. GMT members in attendance reported the Team will be reviewing their work from May and will provide an updated table of preliminary ABCs and OYs at the June Council meeting. The following table reflects recommendations that differed from those prepared by the GMT. The Committee also discussed the preliminary range of OYs under agenda item J.

Committee Recommendations for Preliminary OYs (mt) for 2004 (proposed for initial consideration).

	2003		2004		
STOCK	ABC	OY	LOW OY	MED. OY	HIGH OY
WIDOW ROCKFISH	3,871	832	72	178	284
CANARY ROCKFISH					
50% Comm. - 50% Rec.	256	44	31	42	46
61% Comm. - 39% Rec. [a/]				~45	
BLACK ROCKFISH			600	775	861

[a/] The Committee recommended that the preliminary range of OYs for canary represent the same allocation (61% commercial : 39% recreational) as in 2003. Specific OY values will be provided by the GMT at a later date.

1. Whiting OY has been deferred until 2004 following a new joint assessment. Mr. Robinson requested that the GMT present a range of possible OYs for whiting this year to facilitate incorporation of the final OY next year.
2. POP has been revised since the GMT met and the numbers will be updated based on the new rebuilding analysis. The GMT presented two ranges: one where P_{MAX} is fixed and one where T_{MAX} is fixed at the old value of 2042. Within these approaches there are a range of data treatments with a P_{MAX} of no less that 60%. The GMT will likely revise this range in response to SSC input next week.
3. The widow rockfish range is tentative awaiting SSC review. The current range is 0 - 501 mt. As with most of the overfished species, the GMT is not recommending any OY with a P_{MAX} less than 60%.
4. Canary OYs were updated by the team according to criteria from 2003 as there has not been a new assessment. The OY for canary does change with allocation between recreational and commercial fisheries due to the differential sizes of fish taken. Given the severely constraining nature of this stock the GMT does show an OY option with a P_{MAX} of 50%.
5. Yellowtail OYs were not addressed at the GMT meeting as the STAR-Lite Panel had not yet met but the expedited assessment presents some slightly improved status and a three year mean (3,897 mt on page 53 of the assessment document) reflecting this improvement. The GMT will present a range at the June Council meeting but there will not be an expectation of achieving this level of harvest due to other constraints.
6. Darkblotched rockfish values are unchanged and will need updating according to the new rebuilding analysis.
7. Yelloweye rockfish has been updated according to the rebuilding analysis from last year which added 2 mt.
8. Black rockfish total OYs were not ranged by the GMT but this exercise may need to be taken up for NEPA analyses. The team did present a range of allocations between California and Oregon by catch histories from a variety of time periods, and a gross calculation of nearshore habitat in each state. This Committee is asked to weigh in on this issue. It may be wise to capture the uncertainty in the assessment by developing a wide range of OYs. Mr. Coenen requested that the low OY for black rockfish be 600 mt to reflect a cap being considered by the Oregon Fish and Wildlife Commission.
9. Cabezon has not been assessed for 2004 management but is scheduled to be assessed along with lingcod for 2005-06 management with a STAR Panel tentatively scheduled the week after the September Council meeting. The Council is scheduled to adopt the new assessment for use in 2005-06 at the November meeting and at that time may represent the best available science for 2004. The team thought it would be wise to anticipate a wide range of OYs that could capture all the possibilities from the assessment so that those measures could be analyzed in the EIS for 2004 management measures. This will be particularly important if the cabezon assessment results in a declaration that the species is overfished. The EIS should have a low OY option that addresses this possibility. The results of the cabezon assessment are expected between the DEIS and the FEIS; therefore, it is important to try to anticipate the cabezon assessment results prior to November. The GMT is hoping to get preliminary information on potential outcomes in time to present a reasonable range of alternatives that is broad enough to cover likely assessment outcomes. Ms. Vojkovich is concerned about keeping the public informed of these possibilities prior to September, particularly if the results of the assessment are greatly different from what we now understand about the stock. This scheduling difficulty is partly due to the transitional phase the management regime in 2004. Ms. Vojkovich added this will be the first

assessment on cabezon making the outcome less predictable. Cabezon are a nearshore species with relatively low release mortality rates and therefore should not have the difficulties of rockfish in non-retention fisheries. Therefore, non-retention fisheries could be entertained as part of the management package under the low alternative. Mr. Strickland reiterated the importance of keeping the public informed as this could severely impact nearshore management. The intent of the GMT is to make the transition as smooth as possible.

The Committee was reminded that the values in the GMT OY table are preliminary and are likely to change.

E. Exempted Fishing Permits (EFPs) and Research Set-Asides/Caps

EFP proposals presented at the June meeting will be conceptual in nature. However, it would be useful if the Committee could get a sense from the states of changes to required EFP set-asides.

Washington

Washington has or is conducting three EFPS in 2003 with some conceptual modifications to the Arrowtooth EFP considered for 2004. In 2003 the gear modifications in the Arrowtooth EFP were largely left up to the experimentation choices of the participant. Proposed for 2004, are the addition of gear requirements based on results of the 2003 EFPS. Specifically, one individual in 2003 had success with a 7 inch mesh in the codend. The longline dogfish EFP is contemplated for 2004 with the possibility of restricting the participants to specific areas in an effort to further limit bycatch. The third is a pollock EFP and it is not certain at this time whether it will be proposed for 2004.

Preliminary Bycatch Caps (mt) for Washington EFPS in 2004.

EFP	Canary	Yelloweye	Darkblotched	Widow	POP	Lingcod
Arrowtooth	3.0	0.5	3.0	3.0	10	NA
Longline Spiny Dogfish	0.5	1.0	0.4	0.4	0.4	2.0

Oregon

Oregon is currently conducting a selective flatfish EFP. There are new vessels interested in the program as a result of the new 50 fathom lines. Oregon does not have plans to extend this EFP from the eight Oregon vessels to more vessels in a coastwide program. However, expansion of the concept could be a logical next step before requiring the tested gear modifications in regulation. Under a Letter of Authorization, Oregon is testing a similar net in deeper water with some disappointing preliminary results on darkblotched rockfish interception. This EFP targets the DTS complex in waters deeper than 150 fathoms. The third possible application would be for the shoreside whiting EFP and will be dependent on whether NMFS completes the rulemaking to implement Amendment 10. Preliminary results from 2003 EFPs suggests that caps will not be exceeded in 2003.

California

California has one EFP in 2003 that is similar to the Oregon selective flatfish EFP. There are two additional EFPs being considered for 2004. The first of these involves the ridgeback prawn fishery for which there is currently no requirement for Bycatch Reduction Devices (BRDs). Participants in this fishery are interested in an EFP to explore the effectiveness of BRDs in the ridgeback prawn trawl fishery. The second concept for 2004 is intended to explore modified fishing techniques from Commercial Passenger Fishing Vessels (CPFVs) looking at ways to reduce bycatch while fishing on the shelf.

Mr. DeVore asked if NMFS has any estimates of research set asides. Dr. Hastie reported that there is not at this time as there are entirely new surveys being conducted. Mr. Anderson also recommended that the International Pacific Halibut Commission longline survey will continue in 2004 and will need to be included.

F. 2004 Nearshore Management Alternatives

Dr. McIsaac stated that the objective of this agenda item was to get general outlooks from the respective states on nearshore management.

1. California Nearshore Management Update

Ms. Vojkovich briefed the Committee on California nearshore management actions and proposals. The focus in California is to find ways to allow more time on the water. Tools being considered included adding management lines including lines at the Oregon/California border, Año Nuevo (between San Francisco and Half Moon Bay), and Lopez Point (between Monterey Bay and Point Conception). These proposals are in keeping with a 'four area model' previously considered by California in an effort to create regional management flexibility. Bag limits and season modifications are being considered including times when fishing is restricted to only shallow waters and times of year when nest guarding lingcod should be avoided. There have been proposals for slot limits for some species. Modifications to the Cowcod Conservation Area are being considered. Bag limit modifications are likely to be omitted from proposed 2004 management options as they don't seem to be effective.

California has also adopted a nearshore capacity reduction program. Shallow nearshore species permitted vessels have been reduced in number from 550 vessels to 200 vessels. There is a permit moratorium for the deeper nearshore species preventing further expansions. The California Fish and Game Commission (CFGC) is currently developing OYs for cabezon and greenling for adoption in late August.

2. Oregon Nearshore Management Update

Dr. Patty Burke reviewed the restrictions to participation in nearshore fisheries as adopted by the Oregon Fish and Wildlife Commission (OFWC). The number of commercial nearshore vessels has been reduced to 70 with a goal of reducing to 50. The majority of the remaining boats (64) are on the south coast. Catch caps for greenling, cabezon, black and blue rockfish, and other nearshore rockfish are capped at the catches observed in 2000. There was a derby that began prior to implementation of the4 nearshore management plan that was stopped by emergency action by the OFWC. The fleet now in place is generally considered to be of manageable size. The 70 boat figure is based on landing permits issued for greenling and cabezon with endorsements for black and blue rockfish pending the results of the black rockfish assessment. Vessels will be issued a nearshore rockfish permit that may or may not include an endorsement for black and blue rockfish. It is uncertain whether the required legislation for implementation of the nearshore plan will be signed into law by 2004.

3. Washington Nearshore Management Update

Mr. Anderson gave the Washington nearshore management update. Commercial fishing is closed within three miles along the entire Washington coast with no allowance for a live-fish fishery. There were modifications to recreational bag limits in 2003. The total bag is 15 groundfish, 10 of which can be rockfish of which only one can be canary rockfish. Additionally, the fishery is closed to yelloweye rockfish retention. The lingcod bag limit is 2 with a 24 inch minimum size limit with the season open March 16 through October 15 as a means of protecting nest guarding males and limiting harvest. There is an ongoing tagging project for black rockfish and it is estimated that the catch of black rockfish is well below the OY. Washington reserves black rockfish as a recreational fishery that is currently enjoying a healthy population. There are about 50 open access vessels that deliver groundfish (mostly sablefish) in Washington. Most of these vessels land <2 mt of groundfish species.

4. Low OY Nearshore Management Options
(How to React To A Potentially Pessimistic Cabezon Assessment)

Mr. DeVore and Dr. Hastie requested that the states begin to consider what a zero retention option for cabezon would mean in terms of total mortality. This could function as the low end of the range allowing consideration of less restrictive regulations if warranted by the assessment this fall. Mr. Barnes reported that hook and release mortality for cabezon would be limited to estimates of hook injury and unknown causes only as they do not exhibit barotrauma. Studies of rockfish mortality could be used as a conservative estimate. However, being very hardy and similar to lingcod, studies of lingcod mortality could be applied to cabezon. Estimates of release mortality will be made available at the June Council meeting.

Ms. Vojkovich reported that California may also consider seasonal approaches to avoid nest guarding male cabezon and a slot limit of 15 inches minimum size to 21 inches maximum to protect larger individuals and their value to cabezon reproduction.

J. Allocation Issues

Black Rockfish

Mr. DeVore opened the discussion with the catch sharing scenarios proposed by the GMT at the May meeting. There are three alternatives presented in the GMT ABC/OY table. He asked the Committee to add to or adjust these alternatives. Ms. Vojkovich asked about the criteria for developing the area calculations and whether it is based on habitat or simply area. The GMT members present reported it was based on the relative areas within 50 fathoms between northern California (San Francisco north) and Oregon. The estimate was quick and used as an approximation. Area comparisons were generally received by the Committee with caution due to their arbitrary nature.

Mr. Coenen stated several concerns about allocation. There is a larger issue that goes beyond black rockfish and decisions can set precedence. Area calculations are arbitrary and determining a range of years for estimating historic catches is time consuming and potentially contentious. There will likely need to be more time spent on this allocation issue. Mr. DeVore stated that June is not when final adoption of management measures occurs and this allocation sharing doesn't have to be settled until September. There does need to be a range of possibilities that covers what is finally adopted. Oregon and California will need to start discussions on this issue. At the June meeting there will need to be a range of OYs for black rockfish as well as a range of sharing options for Oregon and California. Council staff will also need analyses, data, and rationale that support the management measures proposed to keep fisheries within these OYs and allocations.

Mr. Bodenmiller stated that Dr. David Sampson, a member of the black rockfish STAR Panel, reported the possibility of providing assessments in the future that are specific to California and Oregon.

Canary Rockfish

The range of OYs for canary rockfish is dependent upon the allocation of canary rockfish between sport and commercial fisheries. It would be helpful to get an early sense of canary allocation to those analyzing management measures. Ms. Vojkovich stated that it is difficult to answer this question before knowing if the new assessment information for bocaccio will allow some access to the shelf. If this is the case there will be increased need for canary bycatch allowances. Mr. Anderson does not see opportunity for changing the current commercial:recreational sharing of 61%:39% based on the constraining nature of canary rockfish. Ms. Vojkovich asked about inseason tracking of canary bycatch to see how well the values in the scorecard reflect observed impacts. Observer data is not available yet for 2003 but may be available by November or December.

Dr. Radtke summarized that there will be, at most, an additional mt of canary in 2004 and that canary impacts are spread thinly across fishing sectors leaving little room for negotiations. Mr. Anderson stated that there is no reason to assume there will be any room for increased impacts on canary rockfish in 2004.

Dr. McIsaac asked how far south canary rockfish range. Dr. Hastie reported the species is coastwide but with very limited numbers south of Point Conception, California.

Mr. DeVore asked if the Committee wanted to talk about recreational regulations relative to canary rockfish. Mr. Anderson stated that a key piece of information for assessing the impacts of the 2004 recreational fisheries is how the fishery performed in 2003. The degree to which each state was able to stay within projected canary rockfish impacts is an important part of negotiating state by state allocation. Mr. Coenen concurred with Mr. Anderson and asked about the frequency of updates from the ongoing observer program. Dr. Hastie reported that the program is scheduled to provide updates annually. Relative to 2004 management, we are unlikely to get any updates beyond those presented at the April Council meeting or those presented today.

Mr. DeVore asked state GMT representatives for any inseason recreational fishery impacts to overfished species. Mr. Bodenmiller presented the following data for Oregon through May 2003. Estimates are based on dockside sampling. These estimates are on track with expectations and account for about 25% of the annual total.

Estimated Impacts (mt) in Oregon Recreational Fisheries through May 2003.

	Widow	Lingcod	Yelloweye	Canary
Landings (mt)	0.6	28.9	0.8	2.3
Discard (mt)			0.25	0.26

California provided the following RECFIN estimates through February. However, these values are limited to landed catch prior to the season when most of the annual catch and effort will occur.

Estimated Impacts (mt) in California Recreational Fisheries through February 2003.

Black	Bocaccio	Widow	Yelloweye	Canary
3.4	0.1	0.1	0.1	0.0

Washington reported 1.15 mt of yelloweye discard from over 10,600 angler trips targeting groundfish or halibut. The halibut season is nearly complete and expectations are tracking below the 3 mt estimated preseason. Preliminary data suggests that Washington recreational groundfish fishery will also fall at or below the 1.5 mt estimated preseason.

Mr. Strickland asked if the allocation on canary is set in stone. He was concerned that if California has more access to the shelf due to bocaccio improvements there would be the need to review the allocations. Mr. Anderson stated that the 61%:39% allocation is merely the Committee recommendation at this time and the Council will decide the allocation as it moves through the 2004 management measure process. It is not set in stone.

Tribal fishery data has not yet been split out by species but preliminary results suggest that tribal fisheries are tracking with preseason estimates. Tribal representatives will provide estimates by species at the June Council meeting.

Referring to the GMT OY table, Mr. Anderson noted that the values for canary rockfish are based on a 50:50 commercial:recreational catch share. Under a 61%:39% allocation scheme the medium OY would change from the current 44 mt to about 45 mt. The GMT will review this issue and add a line in the OY Table that reflects the Committee recommended catch share (see agenda item D).

Widow Rockfish

Widow rockfish allocation is difficult given the unresolved stock assessment. Additionally, the GMT will need Committee guidance on how to share potentially decreasing allowances of widow rockfish. Dr. Radtke noted that due to the relatively large bycatch in the whiting fisheries, industry input will be critical. Dr. Hastie reported that bycatch rates are based on observation data that shows widow rockfish bycatch in the whiting fishery is highly variable. There can be many tows with little or no bycatch and then one tow with relatively heavy widow rockfish bycatch. Mr. Wespestad and Mr. Myer reported that widow rockfish bycatch is variable and is dependent on the distribution of whiting. When the whiting are north, bycatch tends to be yellowtail rockfish and when whiting are south in Oregon, bycatch tends to be widow rockfish. Therefore, widow rockfish bycatch is highly variable. There are also timing issues that can vary bycatch rates between the catcher-processor, mothership, and shoreside sectors as they occur in different but overlapping seasons.

Mr. Coenen asked about incorporating uncertainty into our management schemes. There are tradeoffs for setting seasons that result in too much harvest now in terms of increased time required to rebuild the species. The resource, the fishers, and the managers would benefit from frequent inseason updates.

Mr. Myer stated that there has been unfair treatment of the widow rockfish bycatch data. There have been tows with large amounts of widow rockfish that get excluded as anomalies in stock assessments but get included when assessing bycatch.

Dr. McIsaac asked the Committee to consider the information presented to develop a reasonable range of harvest alternatives for widow rockfish. Dr. Hastie stated that it is hard to imagine that the low end would be zero as widow rockfish stock status cannot be as low as bocaccio. There was a request by the Committee to look at a sustainability type modeling approach like that done for bocaccio. Dr. He will be contacted about doing this modeling exercise with the new assessment information. [NOTE: the sustainability analysis simulations are presented in the draft widow rockfish rebuilding analysis.]

The Committee and the GMT had a difficult time setting a specific widow OY range but the Committee could still discuss how the fisheries would respond to something in the medium range such as 100 mt. Mr. Coenen proposed a GMT exercise where you hold harmless the fisheries with minimal widow rockfish impacts but consider what percentage of the whiting OY could be harvested at a widow rockfish OY of 100 mt. The Committee estimated that about 17 mt of the 272 mt of estimated total mortality in 2003 were in fisheries with minimal impacts. Mr. Joner reported that there are discrepancies in the current observer program results with the tribal full retention sampling program. The 45 mt of widow rockfish in 2003 tribal midwater fisheries (including whiting) could be an overestimate. Tribal representatives would prefer to revisit the tribal sampling program estimates before considering fishery reductions.

Mr. Anderson referred to the widow rockfish rebuilding analysis and considered model runs ranging from 72 mt to 284 mt. These values represent model runs that do not use the stock-recruit relationship and have power coefficients of 2 or 3. He recommended 178 mt as a logical medium OY value (average of the low and high OY values). Mr. Anderson stated that he could not support a high OY option of 501 mt. Ms. Cooney recommended that the Committee consider the risk analysis provided on page 10 of the rebuilding analysis. Mr. Coenen stated that the 501 mt value came from the GMT table and asked the Team to explain the 501 mt value. The 501 mt value considers model runs with power coefficients of 4 and included runs with the stock-recruitment relationship. These are model results that the SSC may not support and are outside of the range presented by Mr. Anderson. Ms. Vojkovich suggested an alternate allocation exercise that breaks out the range of OYs according to the proportions observed in the fisheries. Ms. Robinson reminded the Committee that the GMT scorecard estimates were not intended as an allocation exercise. This proportional approach may not be fair to all sectors and is not a good use of GMT time.

Mr. Anderson suggested that for the medium and high OY options fisheries with a small widow rockfish impact be held harmless and the other fisheries be reduced proportionally but for the low OY option we consider a management scheme whereby all sectors consider fishing reductions. Mr. Robinson suggested bycatch caps would be an excellent tool here if we had that tool available. Mr. DeVore stated that, with these low OYs and observed tows that can take 70 mt, it is difficult to consider any caps that would be effective.

Mr. Seger reminded the Committee that the zeros in the scorecard, such as those presented for open access fisheries, are often not zero but very small amounts of bycatch that can really complicate an exercise of proportionally reducing every fishery that impacts widow rockfish.

Mr. DeVore asked the industry to speculate what types of strategies might avoid widow rockfish such as fishing at night. Mr. Wespestad reported that nothing is immediately apparent. Vessels are encouraged to fish outside 100 fathoms and it is generally believed that widow rockfish congregate at dawn and dusk. Industry requested that they be allowed to address this issue as they have the professional knowledge and incentive to avoid widow rockfish.

Mr. Anderson stated that for the low OY option of 72 mt, perhaps we should continue to try to avoid impacting fisheries that have very low widow rockfish interceptions. Mr. Coenen looked ahead to the possibility of increasing constraint on the whiting fishery and the concept of allowing whiting fisheries every other year.

Ms. Vojkovich reminded the Committee that the data that went into the widow rockfish assessment was sparse and that the assessment documents state repeatedly that this stock is data poor. This is something to consider before there is a radical change in management. Dr. Hastie reported that NMFS is exploring hydroacoustic technology as a means of improving this situation. Mr. Culver agreed with Ms. Vojkovich and emphasized the importance of sampling.

Mr. DeVore asked Ms. Cooney if there was any case law examples of thresholds of data conditions whereby assessment results are to be determined to not be the best available science because of lack of information. Ms. Cooney stated that there is unlikely to be a legal precedence and that you are on shaky ground by pressing forward with status quo simply because you have poor data.

WEDNESDAY, JUNE 11, 203 - 8 A.M.

Members Present:
Dr. Hans Radtke, Chairman, Pacific Fishery Management Council
Ms. Marija Vojkovich, California Department of Fish and Game
Mr. Neal Coenen, Oregon Department of Fish and Wildlife
Mr. Phil Anderson, Washington Department of Fish and Wildlife
Mr. Bill Robinson, Northwest Region National Marine Fisheries Service

Others Present:
Ms. Eileen Cooney, General Counsel, National Oceanic and Atmospheric Administration
Dr. Jim Hastie, Northwest Fisheries Science Center, National Marine Fisheries Service, GMT
Mr. Rod Moore, West Coast Seafood Processors Association, GAP
Ms. Jamie Goen, Northwest Region National Marine Fisheries Service
Mr. Tom Barnes, California Department of Fish and Game, GMT
Dr. Patty Burke, Oregon Department of Fish and Wildlife
Mr. Peter Huhtala, Pacific Marine Conservation Council
Mr. Chris Dorsett, The Ocean Conservancy
Mr. Kris Northcut, Quileute Tribe
Mr. Mark Saelens, Oregon Department of Fish and Wildlife, GMT
Mr. Don Bodenmiller, Oregon Department of Fish and Wildlife
Mr. Brian Culver, Washington Department of Fish and Wildlife, GMT
Ms. Michele Robinson, Washington Department of Fish and Wildlife, GMT
Ms. Janice Green, Non-charter Recreational Representative, GAP
Ms. Karen Garrison, Natural Resources Defense Council
Mr. Bob Strickland, United Anglers of California, Inc
Mr. Dale Myer, Arctic Storm, Inc., GAP
Mr. Steve Bodnar, Coos Bay Trawlers Association
Mr. Jim Glock, National Marine Fisheries Service
Mr. Mark Cedergreen, Pacific Fishery Management Council
Mr. Steve Joner, Makah Indian Tribe
Mr. Rob Jones, Northwest Indian Fisheries Commission, GMT
Dr. Vidar Wespestad, Pacific Whiting Conservation Cooperative
Dr. Donald McIsaac, Executive Director, Pacific Fishery Management Council
Mr. Ed Waters, Pacific Fishery Management Council staff
Dr. Kit Dahl, Pacific Fishery Management Council staff
Mr. Dan Waldeck, Pacific Fishery Management Council staff
Mr. Jim Seger, Pacific Fishery Management Council staff
Mr. Mike Burner, Pacific Fishery Management Council staff
Mr. John DeVore, Pacific Fishery Management Council staff

Dr. Radtke opened the meeting and stated a desire to adjourn at 1:00 P.M., although the Committee can stay as long as necessary. He asked if the Committee wanted to revisit issues from Tuesday before proceeding with Wednesday's agenda.

Mr. Coenen asked for a clarification of the objective of the meeting. Are we trying to propose allocation scenarios or are we revising the GMT OY recommendations? He asked for clarification on what canary allocation the Committee recommended for 2003. Last year the Committee recommended a 50:50 allocation between commercial and recreational fisheries and the Council adjusted that relationship at the September meeting.

The Committee discussed Council expectations from the Committee between now and the September Council meeting. Mr. Anderson sees this exercise as a first opportunity to set side boards within which decisions for 2004 management will be made. Recommendations received by the Council from this Committee as well as the public and advisory bodies would be considered at the June meeting for the initial adoption of a range of alternatives for 2004. On widow rockfish there are unresolved issues for the SSC to comment on. The products produced here need to be considered separately from what the GMT concludes.

Dr. McIsaac stated that the Committee should consider a range of OYs and management alternatives that could be quickly adopted by the Council. Council staff initially felt an August Committee meeting was unnecessary, but if the Council and the Committee feels it is important, it will be scheduled. If there is a complete range of options after the June Council meeting the states and constituents feel comfortable with working on over the summer, perhaps a second Committee meeting is not necessary.

Mr. Robinson stated that the magnitude of scrutiny of NEPA requirements is increasing and a two meeting process makes thorough analysis even more challenging. All decisions need to be considered early in a preliminary fashion so that Council staff can complete a thorough NEPA analysis,

Ms. Vojkovich stated that, relative to nearshore management, the CFGC is very interested in increased communication with the Council and the California delegation. They are expected to develop nearshore options for 2004 in late August leaving very little time before the September meeting to bring the results back to this Committee.

Mr. Coenen asked about the form of the Committee report to the Council. Mr. DeVore stated that there will be minutes written and made available at the Council meeting. Dr. Radtke stated the Council will discuss future meetings on Friday of the June Council meeting.

J. Allocation Issues (cont.)

<u>Bocaccio</u>

Recent allocation of bocaccio has been around 56%:44% between commercial and sport fisheries. Mr. DeVore stated that in the past the share has been 50:50 and that in 2001 the share was heavier to the recreational fishery. Ms. Vojkovich stated that it seems reasonable to use the 2002 allocation scheme as a starting point as there was no opportunity in 2003. The term allocation is not really appropriate because we are still talking about sharing non-retention impacts. The Committee noted that it would be wise to review the bocaccio sharing in the past. Mr. Moore reviewed previous action by the Committee on lingcod and bocaccio. He stated that in the past the Committee did not specify a bocaccio allocation but rather a recommendation on recreational bag limits with the remaining OY to the commercial fleet. This occurred immediately prior to the crash of bocaccio. For 2003 the OY table states that management will try for the 56:44 split and there has not been a formal allocation split.

Mr. DeVore suggested that the scorecard and the proportions of impacts could be a starting point as well. Mr. Robinson stated that fisheries in California were severely restricted in 2003 making that a questionable approach. Mr. DeVore stated that there are a wide range of constraints and often fisheries are limited by more than a single species. These constraints vary between species and fisheries due to the differential gears deployed making this decision even more complicated.

Dr. McIsaac asked about an assessment of how many bocaccio would be caught in California. The Committee discussed values from 100 - 200 mt. Dr. McIsaac reminded the Committee the available OY for

2004 is not likely to allow a great deal of fishery liberalization and canary rockfish restrictions further complicate the issue. There may not be a strong need for bocaccio allocation decisions.

Mr. DeVore suggested that the states begin to consider impacts to overfished species in every management option. It is critical to the success of the June Council meeting that analyses of fishery impacts are well know for the purpose of deciding an appropriate range or options for 2004.

The Committee took a break to celebrate Dr. Hastie's birthday complete with blueberry muffins baked by Mr. DeVore. Dr. Hastie requested more altos in the choir.

Yelloweye Rockfish

The Yelloweye Rockfish Conservation Area, yelloweye non-retention, and the 100 fathom management lines for fixed gear fisheries are the principle protective measures for yelloweye. Additionally, recreational fisheries are designed to close in areas where yelloweye occur if impact thresholds are met inseason. Mr. Anderson felt that management decisions should not be changed from 2003. The OY for 2004 has increased from 22 to 24 mt but our management systems are not accurate enough to explore any regulation liberalization in response. The extra 2 mt could be used as a buffer against going over the fishing thresholds beyond which Oregon and Washington recreational fisheries are restricted to shallower depths. Information from Tuesday's discussions suggests that the halibut fisheries had lower than expected yelloweye impacts.

G. 2004 Shelf Management Options

Mr. DeVore reported that all proposed management measures will need analytical support showing they are adequate for keeping impacts within the low, medium, and high OY alternatives. GMT members and others have been asked to come to the June Council meeting with well developed management measures that are backed up with credible analyses.

Washington

Mr. Anderson stated that he was concerned that we may not be able to put a lot of detail into the options at this time. It is increasingly difficult to maintain viable fisheries in the face of conservation obligations. He proposed the following management concepts be considered by the GMT and GAP when formulating recommendations next week.

Commercial Fishery Concepts:

- *Status Quo*: Continuation of depth based management, closed areas, reduced bag limits, varying trip limits, incentives to fish in areas that avoid critical species.

- *Specific Area Openings*: Replace the coastwide management line concept with specific areas of fishing opportunity. Fathom lines are not having their desired effect in Washington and are not in tune with the realities of the fishery. There are vessels fishing on the sides of cliffs and on the edges of plateaus and modifications of depth closures by relatively small depth increments is questionable. We do not have the modeling specificity to estimate these fine differences and fishers have a hard time complying with shifting management lines in deep areas with steep contours.

- *Bycatch Caps*: Establish caps by sector and/or vessel with mandatory observer coverage. Vessels would have the ability to fish in areas of their choice so long as they stayed below a hard bycatch cap. Fishers with the skill and the knowledge required to avoid critical stocks would have the opportunity to harvest available species. Patterned after the Arrowtooth EFP, the bycatch cap concept could be coupled with higher trip limits for target species to provide an incentive for fishers to fund observers.
- *Trawl Gear Modifications*: There are six or seven small trawl vessels in Washington that will go out of business if they remain under the regulatory and market trip limits in place while being forced inside of 50 fathoms. It would be wise to consider allowing those trawl vessels which cannot safely participate in deep water to use fixed gear under the fixed gear regulations and available trawl limits. This concept

may require a plan amendment that would require a three meeting process. Fixed gear fisheries will operate with the same depth restrictions as specified in 2003. The Council will need to monitor their incidental halibut take and to assess their ability to access sablefish in the process.

Recreational: No changes in Washington proposed at this time.

The Committee discussed the merits of bycatch caps, ITQs, permit changes to allow trawlers to use fixed gear under the available trawl limits, and reviewed the time and effort required for such changes. Mr. Anderson stated that bycatch caps have worked well in the Arrowtooth EFP and there are vessels that will go out of business before this process is complete. The Council needs to consider these types of alternative approaches as quickly as possible.

Mr. Coenen asked if there is a way to craft an EFP to test the concept of allowing trawlers to use fixed gears while the process of amending the FMP takes place. Mr. Anderson stated that the Council has been working on long term fixes as long as he has been involved with the process and allowing a vessel with a trawl permit to fish with fixed gear is a relatively easy change. Mr. Robinson stated that EFPs are traditionally reserved for the testing of new gear but could be broadened to test alternative management concepts. Ms. Cooney asked if trawl vessels would totally convert to fixed gear or would the vessel be allowed to switch between fixed gear and trawl gear? Mr. Anderson stated this is yet to be determined but in concept the vessel would be able to adjust gear in relation to the changing regulations by period. Mr. DeVore asked about how the buyback program and this concept interact and whether the buyback program could alleviate this. Dr. Hastie stated that the buyback will not occur until September and, if it is successful, the trip limits for 2004 will need to be changed. Dr. McIsaac asked if the concept of using different gears on a trawl permit would require a plan amendment or if it could be done in regulations? Ms. Cooney felt it would likely take an FMP amendment and could not be completed before 2004 regulations were adopted. Mr. Anderson reminded the Committee that this idea is not new and is included in the Strategic Plan. Dr. McIsaac noted that the Council staff is tied up with rebuilding plans and this work would require outside commitment. Mr Coenen asked if the program would be limited in some way to smaller trawl vessels as a means of narrowing the size of the program. Mr. Anderson felt that limiting the program to a subset of vessels would add complexity to the program with uncertain benefits. Vessels that are capable of fishing in the DTS fishery would not likely change to fixed gear in large numbers. Dr. Hastie noted that the plan would add complexity to trawl bycatch modeling and ad hoc decisions to estimate bycatch under such a program could overestimate impacts as a precautionary approach.

Mr. Moore asked for clarification of a few of Mr. Anderson's proposals. He asked if the specific fishing area concept was contemplated for fixed gear as well as trawl vessels? Mr. Anderson stated that the idea was born in the trawl industry and has yet to be considered for other sectors. He stated the open areas would likely be specified by coordinates and could change with seasons. Mr. Moore asked if the bycatch cap concept was for all commercial sectors? Mr. Anderson stated it would have merits for both the fixed gear and trawl sectors but not open access. Mr. Moore asked if the trawl sector includes whiting vessels? Mr. Anderson stated that, given the status of widow rockfish, it would be wise to include the whiting fishery. Mr. Moore asked if the bycatch caps were tradeable and Mr. Anderson said the initial concept was for non-tradeable quotas but he is open for negotiation. Mr. Anderson stated that it is unlikely that these ideas will be in place for the initiation of the 2004 season and there will be more time to discuss the details and develop the concepts. Ms. Robinson noted that full retention of rockfish in the EFP combined with observers is what makes the program successful. Mr. Saelens thanked Mr. Anderson for the proposals and stated that fishers in Oregon have expressed similar ideas. Mr. Moore asked about rewards for staying within bycatch caps in terms of increased opportunity in subsequent periods? Mr. Anderson suggested an additional optional platoon ("C" Platoon) where vessels are held to bycatch caps. This platoon would be allowed higher trip limits. Another alternative would be to require bycatch caps for the entire fleet rather than just an additional platoon.

Mr. Coenen asked if gear conversions within a trawl permit as a concept is a first step towards broad flexibility across all sectors. Weak stock management and limited harvest opportunities may warrant these new approaches. Mr. Anderson stated that there are no hidden agendas in the concept and said the idea was conceived with a specific trawl issue in mind.

California

New Management Lines Proposed for Commercial and Recreational Fisheries:

- Año Nuevo (between San Francisco and Half Moon Bay)
- Lopez Point (between Monterey Bay and Point Conception)
- Oregon / California border

RCA Boundary Changes:

- *South of Lopez Pt. or Pt. Conception*: consider moving the shallow line from 20 fathoms deeper in increments of 10 fathoms to as far as 80 fathoms for sport and commercial fisheries. This will need to be balanced with considerations of season length. Move the deep line from 200 fathoms back to 150 fathoms. Cowcod Conservation Area (CCA): consider outside lines in 10 fathom increments from 160-200 fathoms dependent on estimated impacts.

- *Lopez Pt. or Pt. Conception to Año Nuevo*: consider moving the shallow line from 20 fathoms to 30 fathoms and moving the deep line from 200 fathoms by 10 fathom increments as shallow as 70 fathoms.

- *Año Nuevo to Cape Mendocino (40°10' N. lat.)*: consider moving the shallow line from 20 fathoms to 30 fathoms and moving the deep line from 200 fathoms back to 150 fathoms.

- *North of Cape Mendocino (40°10' N. lat.)*: no changes proposed at this time.

Size Limit and Retention Changes:

- Cabezon slot limit of 15 to 21 inches for sport and commercial fisheries.
- Increase the greenling minimum size for commercial fisheries.
- Lingcod minimal size increase form 24 inches to 26 inches for recreational fisheries as a means of slowing the catch and rebuilding more quickly.
- Bocaccio retention allowance for shelf fisheries, if possible, combined with increasing trip limits for chilipepper rockfish and other co-occurring species.

Seasons:

- Consider the 2002 recreational season structure including 6-10 month seasons south of 40°10' N. lat.

Miscellaneous:

- BRDs will be required for the ridgeback prawn trawl fishery.

Ms. Garrison encouraged CDFG to consider adopting regulatory language limiting the types of BRDs to those mandated in Oregon and Washington pink shrimp fisheries.

The Committee complemented California for bringing these types of conceptual ideas out early.

Oregon

Recreational Considerations:

- Seasonal structure including potential closures.
- Specific closed areas similar to the YRCA.
- Non-retention of canary rockfish, widow rockfish, and/or yelloweye rockfish.
- Slot limits for cabezon and greenling.
- Change the inseason closure outside of 27 fathoms to outside of 30 fathoms to match with halibut regulations.

Mr. Anderson asked about spot prawn regulations. Dr. Burke reported that the fishery will limited to pots in 2004.

Mr. Anderson asked about the analysis of moving lines by 10 fathom increments including who will do the analyses? Ms. Vojkovich said CDFG staff will be bringing information and resources to the GMT for this task. Mr. Anderson asked if the data that is refined to that level of specificity? California proposed the use of MRFSS, Triennial Trawl, and charter boat observer data as potentially useful information in this endeavor.

Mr. DeVore asked about efforts to allow recreational opportunity on the slope. Ms. Vojkovich stated that this is no longer an option.

H. 2004 Slope Management Options

Mr. DeVore stated that there may be additional constraints to trawl fisheries that will be difficult to assess during this meeting due to the uncertainties around POP. There is also a point of concern for blackgill rockfish in the south.

Dr. Hastie asked about increasing the slope fixed gear limits if it can be demonstrated that they can avoid critical species such as darkblotched rockfish and yelloweye rockfish? The observer program is collecting information on these fisheries currently that could be used for inseason adjustments in 2004 once the data is available. The results of these possible changes need to be included in the range of alternatives analyzed in the EIS.

There may be merits in moving the slope RCA south to Año Nuevo.

Ms. Vojkovich brought up the issue of open access fisheries and nearshore restrictions. As we contemplate moving out onto the shelf we are still faced with the uncontrolled effort in this sector. Nearshore permit restrictions have been effective but overcapacity on the shelf is still an issue.

Dr. Hastie reminded the Committee that in the north he used 25 fathom increments in shallow areas and 50 fathom increments in deep areas. In California for 2003 he used 10 fathom increments due to the critical bocaccio constraints. Preliminary trawl modeling coastwide is limited to shallow lines at 50, 75, and 100 fathoms, and deep lines at 150,180, 200, and 250 fathoms. This is not likely to change prior to next week. Other lines can be considered but the model is limited for the June Council meeting. Additionally, the management lines proposed by California are not in the bycatch model. The closest line to the proposed Año Nuevo line is at 38° N. lat.

Mr. Moore recalled that there is virtually no take of POP outside the 250 fathom deep line and there is minimal take outside of 200 fathoms. Therefore, access to other species between 200 and 250 fathoms could be considered without substantial impacts to POP.

Ms. Vojkovich asked why the observer program was structured to report results through August instead of through the calendar year? Dr. Hastie responded that, at first, it was an artifact of when the program got started. However, it is expected to work well with biennial management in the future. Realtime observer results are not possible given the level of data analysis required and the available staff to do these analyses.

I. 2004 Tribal Management Options

Mr. Joner reported that the tribes are proposing a lingcod harvest guideline of 25 mt. There has been confusion in previous years about tribal trip limits. The limits proposed are 450 pounds per day and 1,350 pounds per week round weight for the longline fisheries. Sablefish allowance is proposed as the status quo 10% of the OY. Observer programs are in place. Any adjustments to status quo will be proposed in September with status quo proposed in June. There is interest in increasing thornyhead landing limits but interactions with sablefish will need to be assessed. Results from the midwater observer program will be available in late August. Mr. Anderson asked if the newly proposed harvest of lingcod was for all tribes? Mr. Jones reported that, although it will likely be for all tribes, the catch will be concentrated in waters off northern Washington.

K. Status of Groundfish Fisheries and Initial Policy Consideration of Inseason Adjustments

Mr. Anderson asked about the Committee's role in inseason matters? It is not clear what role, if any, this Committee is charged with relative to inseason management. Mr. Coenen spoke in general about the endless cycle of repeated inseason adjustments. He spoke in favor of more inseason monitoring and developing specific checkpoints during a biennial process. Mr. DeVore stated that the GAP and the GMT will be starting to address inseason adjustments on Sunday and would appreciate any discussions that can help focus those discussions. Mr. Moore stated that changing OYs inseason in response to new information is not common practice and should be approached with caution. Observer data has been utilized inseason with mixed response. Mr. Moore stated that the GAP focus on Sunday will be to assess the status of landed catch and bycatch by sector. Ms. Vojkovich felt that inseason changes to OYs should be considered. Dr. McIsaac reported that the agenda item is scheduled to consider possible adjustments to OYs. Ms. Cooney stated that is not just a question of the best available science but also a question of management process. Mr. Robinson stated the FMP itself was constructed to not allow inseason changes to OY for reasons of management stability and if the Council wanted to change an OY inseason it would require an emergency FMP amendment. An emergency amendment would likely require a NEPA analysis and take several months to complete. Ms. Cooney reported that the rationale for an inseason OY change would have to be explicit and may be difficult to implement for only one newly assessed species. Dr. McIsaac asked about the range of bocaccio OYs that was analyzed in the EIS for 2003. Mr. DeVore stated that the No Action alternative analyzed the high end of the range (100 mt) and zero was the low end. Mr. Moore, speaking for himself and not the GAP, stated that the difference between observer data and new assessments as best available science for use inseason is a technical one. He feels that the Council made a mistake with inseason use of new observer data and should not change OYs inseason. Dr. McIsaac stated that this issue is significant when considering biennial management and that strategies for considering mid-course corrections or management thresholds are currently being crafted. Mr. Anderson feels that prior to Council action on this topic the GAP and GMT would be wise to proceed as if OYs were not going to change until further notice. The Committee agreed that discussions at this meeting should be written and conveyed to the rest of the Council family to help facilitate discussions on Tuesday of the June meeting. The Committee should stop short of making a tentative decision. Mr. Coenen applauded the efforts to specify thresholds for mid-course corrections during biennial management. Mr. Robinson agreed with Mr. Coenen and mentioned that the parameters in rebuilding plans have similar issues surrounding when and how they get revised. Mr. Coenen felt that since bocaccio, although seemingly much improved from the previous assessment, is still in an overfished situation and the Council should approach changing the bocaccio OY with caution.

L. Trawl Individual Transferrable Quotas (ITQs)

Dr. Radtke received a letter referencing a meeting in Canada of people tasked to work on ITQs. Mr. Seger is tentatively scheduled to attend the meeting on behalf of the Council. Additionally, Council Member Mr. Bob Alverson sent a proposal for ITQs for Committee consideration. The moratorium on ITQs has been lifted so the Council is free to begin to consider the merits of such an approach. Mr. Robinson spoke in favor of exploring ITQs and reported any program will likely require a fee assessment for funding the tracking and management of an ITQ system. Mr. Moore recalled his participation on a Trawl Permit Stacking Work Group and its conclusion that ITQs would be preferable to permit stacking. Additionally, he stated that the industry has spoken in favor of completion of the trawl buyback program before proceeding with ITQs. Mr. Coenen asked how ITQ consideration can be worked into the Council's long term workload planning? There will be a workload planning exercise next Friday during the Council meeting.

M. Other?

Mr. Anderson asked Ms. Vojkovich about the California program to limit the open access fleet and whether the program is limited to state waters? Ms Vojkovich reported that the program is regulated by landing requirements and is permitted by species complex (shallow nearshore rockfish, deeper nearshore rockfish, and California scorpionfish). Mr. Anderson asked what additional work needs to be done to limit the open access fleet size? Ms. Vojkovich stated that the system in place is only effective for nearshore species so shelf and slope species still need to be addressed. The shelf is under federal management, is unrestricted by permit limitations, and is open to anyone with a commercial license. Mr. Anderson confirmed that the California nearshore species complexes contain federally managed species and that some of the permitted vessels land fish from federally managed areas. Ms. Cooney stated that expanding this approach to species taken exclusively in federal waters could bring court challenge and would likely need matching federal regulation.

Conclusions

Mr. DeVore thanked the Committee for their contributions and asked that everyone stay focused on the challenges of the June Council meeting.

ADJOURN
(12:30 P.M.)

PFMC
06/12/03

GROUNDFISH ADVISORY SUBPANEL STATEMENT ON ADOPTION OF A PROPOSED RANGE OF 2004 GROUNDFISH MANAGEMENT MEASURES

The Groundfish Advisory Subpanel (GAP) reviewed the preliminary 2004 harvest levels adopted by the Council and developed a range of management measures designed to be used within those harvest levels. The GAP also discussed several management options suggested by the Ad Hoc Allocation Committee. In some cases, these management alternatives were rejected.

As has been the practice in the past, the GAP broke into working groups based on fisheries/areas to develop initial recommendations. These were then compiled into a single document and discussed by the entire GAP. The GAP also discussed the alternatives with the Groundfish Management Team. The result of this series of meetings is the comments we are presenting today.

The GAP has attempted to fully describe a range of alternatives where possible; to provide a rationale for the alternatives; to identify preferred alternatives where it can; and to identify alternatives that were rejected and the reasons for the rejection.

For ease of Council and public consideration of the GAP alternatives, this report lists them on separate pages.

PFMC
06/20/03

LIMITED ENTRY TRAWL

The trawl options are identical in structure, but the numerical values (i.e. cumulative limits) will vary based on the OY values adopted by the Council.

1. Follow the basic structure used in 2003 of adopting depth-based management and two month cumulative trip limits throughout the year. This includes continuing establishment of the Rockfish Conservation Area (RCA).

2. Modify the boundaries of the RCA to minimize the area closed and maximize the area fished, while minimizing the impacts of species of concern. Where appropriate the inside (eastern) boundary of the RCA should be move deeper (west) and the outside (western) boundary moved shallower (east). The GAP believes that such boundary changes would be most applicable in the area south of 40°10'.

3. If possible, better identify areas that produce the highest catch of species of concern and structure the RCA boundaries around these areas so that a greater amount of area with low impacts may be made available for fishing.

4. If the outside boundary of the RCA is set deeper than 150 fathoms, identify petrale harvest zones beginning at 150 fathoms and moving deeper which will be open during periods 1 and 6.

5. Under all OY values, establish a mid-water fishery and consider a bottom-trawl fishery for chilipepper rockfish south of 40°10' for some periods of the year.

6. Other general management measures, including the establishment of A and B platoons should remain in place.

7. Assuming that positive results continue through the end of the EFP analysis, the GAP recommends Council consideration of allowing a selective flatfish trawl design as an option for appropriate 2004 management measures, including allowances for increased trip limits and/or access to areas that would otherwise be closed.

8. The GAP recommends that the Council adopt as an option creating a trawl opportunity for arrowtooth flounder that would require vessel-funded observer coverage for compliance monitoring, bycatch caps specific to that trawl opportunity, and full retention of rockfish regardless of size or condition.

The GAP believes that given current data and legal constraints, maintaining the basic structure of the trawl fishery as identified will best meet the requirements of National Standard #1 to achieve optimum yield while preventing overfishing. The harvesting and processing sectors of the industry have adapted to this general management structure and can best plan - given the uncertainties of harvest levels and in-season adjustments - their operations if radical changes are not made. By continuing the basic structure, the Council and the industry can better analyze the long-term effects of that structure.

In regard to maintaining the A & B platoons, the GAP understands that there may be some minor additional cost and inconvenience with the dual platoon structure. However, it is the experience of both fishermen and processors who are involved with the dual platoon system that having the ability to better spread deliveries - even of smaller amounts of fish - produces a better product and more economic efficiency. Vessels also have more opportunities to take advantage of weather breaks, thereby promoting vessel safety, a key component of Magnuson-Stevens Act requirements and an issue often raised by the Coast Guard member of the Council. Use of a dual platoon system does not detract from conservation but does promote the economic welfare of coastal communities. In sum the dual platoon system directly embodies National Standards 8 and 10.

In regard to selective flatfish trawls, research conducted in 2001-2 demonstrated that a selective flatfish cutback trawl design results in a bycatch rate for rockfish species, including canary and yelloweye, that result in rates that are significantly lower than existing trawl rates. During 2003, this trawl net design is being examined at different depths under an EFP. Although the research is still under way, preliminary results verify lower rockfish bycatch rates which are similar to the earlier research results from 150 fathoms to shore. In regard to arrowtooth trawl opportunities, the GAP notes that the exempted fishing permit studies on arrowtooth that have been conducted by Washington have shown a low bycatch rate and have enabled vessels to access fish that otherwise would be unavailable. Sufficient data now exists to provide this heretofore limited opportunity to a greater number of vessels, subject to appropriate conditions and restrictions. Any such opportunity must remain within the overall mortality numbers assumed for rockfish and not serve to redistribute scarce rockfish to from other gears or trawl fleet sectors.

RESPONSE TO THE ALLOCATION COMMITTEE REPORT

The GAP reviewed trawl management alternatives discussed by the Allocation Committee and concluded that they were not appropriate for action in 2004.

Bycatch caps - Individual caps would constitute an IFQ and would not be permitted without a plan amendment. If the caps were to be separate for each sector, then this would constitute an allocation and would need to follow the allocation procedure specified in the Pacific Groundfish Fishery Management Plan. The lack of data precision and the fact that most data - including observer and fish ticket data - is several months old by the time it is ready for use could lead to caps being exceeded before any action could be taken. If the states and / or the federal government develop the infrastructure - such as electronic reporting or “swipe cards” - that is used in other fisheries around the world, then caps might be an option for the future.

Discrete open trawl areas - The data does not currently exist for the RCA to be limited to discrete areas of identified habitat. The GAP notes that NMFS and the Council are developing a more extensive essential fish habitat (EFH) analysis. Once this analysis has been completed, the Council could re-examine the establishment of discrete open trawl areas.

Landing trawl limits with limited entry fixed gear - To allow trawl vessels to begin landing groundfish with longline or pot gear would require a plan amendment. While there is some interest in exploring this option in the future, it is very unlikely that such an amendment could be completed in time for the 2004 season.

Bycatch caps in the whiting fishery - Although bycatch is a very small proportion of total catch in the whiting fishery, all sectors are sensitive to the need to reduce bycatch to the lowest level attainable, a standard more strict than required by law, especially for widow rockfish, salmon, and other rebuilding species.

The at-sea sectors of the whiting fishery monitor catch daily through Sea-State, a contract service that compiles NMFS observer catch reports of target and bycatch species. Sea-State notifies vessels of catch trends and alerts vessels if bycatch levels become a problem.

For 2004, the at-sea sector plans to avoid areas of known widow rockfish concentration; establish daily catch reporting and bycatch monitoring; voluntarily leave areas with high bycatch; communicate bycatch information among vessels; and continue bycatch reduction research.

The shoreside sector participates in the Pacific Whiting Shoreside Observation Project which was established in 1992. The Project relies on fishermen obtaining permits to land unsorted catch. Permit conditions and restrictions include requirements to sign bycatch control agreements with fishermen and processors which involve establishing action plans to avoid high bycatch areas and restrictions on individual vessels which don’t comply.

Because bycatch caps would have to be imposed on sectors, rather than individual vessels fo reasons noted above, a single disaster haul could result in an entire fishery sector being shut down prematurely. As data precision increases in future years, opportunities for individual vessel caps and trade-able bycatch limits may become feasible. However, these alternatives would require extensive analysis and fishery management plan amendments that could not be completed in time for the 2004 season.

LIMITED ENTRY AND OPEN ACCESS FIXED GEAR

In general, as with trawl, the fixed gear options are identical in structure, but the numerical values (i.e. cumulative limits) will vary based on the OY values adopted by the Council. The table for northern fixed gear open access limits is based on the median OY values adopted by the Council.

1. Follow the basic structure used in 2003 of adopting depth-based management and two month cumulative trip limits throughout the year for species other than sablefish. This includes continuing establishment of the Rockfish Conservation Area (RCA).

2. Modify the boundaries of the RCA to minimize the area closed and maximize the area fished, while minimizing the impacts of species of concern.

3. If possible, better identify areas that produce the highest catch of species of concern and structure the RCA boundaries around these areas so that a greater amount of area with low impacts may be made available for fishing.

4. For sablefish, continue the daily trip limit (DTL) fishery and sablefish tier fishery as in 2003, with catch limits appropriate to the optimum yield value adopted by the Council. The DTL fishery should maintain options of daily and weekly limits within a two-month cumulative limit.

5. All other general management measures including tier limits and permit stacking will continue to apply.

The GAP believes that given current data and legal constraints, maintaining the basic structure of the fixed gear and sablefish fisheries as identified will best meet the requirements of National Standard #1 to achieve optimum yield while preventing overfishing. The harvesting and processing sectors of the industry have adapted to this general management structure and can best plan - given the uncertainties of harvest levels and in-season adjustments - their operations if radical changes are not made. By continuing the basic structure, the Council and the industry can better analyze the long-term effects of the basic structure.

2004 Management Measures for the Northern Open Access Fisheries

Option 1. - A range of minor nearshore rockfish species harvest between 3,000 and 8,000 lbs / 2 mos, with a sub-limit of 900 to 1,250 lbs of species other than black or blue rockfish.

Option 2. - If the northern open access fishery is projected to attain or exceed catch levels for overfished species, restrict the fishery inside depth lines structured to avoid that incidental catch.

Option 3. - Restrict the catch of minor nearshore rockfish species, including blue and black rockfish, to the same level of harvest as the 2002 fishery.

From the results of the 2003 Black rockfish assessment, it is apparent that the austerity measures being applied to the commercial near shore fishery are now unnecessary. The state of California has closed entry into its nearshore fishery. Oregon has a permit bill pending to do the same thing. These management measures in 2002 produced a combined commercial landed catch of 192 MTs of black rockfish for both states. There were also no overages in the " other nearshore rockfish" species category. Thus the expected commercial 2004 catch in both states will not exceed any proposed division of black rockfish stock now being considered between states. This buffer should be viewed as a guard against over-harvest by either user group between scheduled opportunities for mid season adjustments.

BLACK ROCKFISH CATCH SHARING

The GAP suggests the following Harvest Guideline proposals for 2004 to address split of increases in the Black Rock fish OY between Oregon and California. (Values In Metric Tons)

1. Split the increase in catch from recent (e.g. 2002 or 2003) catch levels 50/50 between states, and add to the historic catch for each state, within the bounds of this year's OY.

Ratio: OR = 60% CA = 40%

2. Use the area of coastline in each state's affected area as a percentage of catch for year 2004 HGs.

Ratio: OR = 56% CA = 44%

3. Subtract 2003 caps from 2004 OY, and then split the left over amount of 2004 OY 50/50 between the states.

Ratio: OR = 77% CA = 23%

4. Ratio based on catch history: Average catch from 1985 through 2002

Ratio: OR = 60% CA = 40%

5. Ratio based on catch history: Average catch from 1990 through 2002

Ratio: OR = 62% CA = 38%

EXEMPTED TRAWL GEAR & OTHER GEARS

1. The management measures applicable to exempted trawl gear in 2003 will continue to apply in 2004. The amount of groundfish catch available to exempted gear will vary depending on the OY levels adopted by the Council.

2. North of 40°10', salmon troll vessels may continue to incidentally retain and land up to 1 lb of yellowtail rockfish for every 2 lbs of salmon, with a cumulative landed limit of 200 lbs / month, both within and outside the RCA. Other catch of groundfish by salmon troll vessels coastwide will be subject to the same seasons and restrictions as apply to open access vessels.

3. Commercial Ridegeback Prawn Trawl Fishery: Require use of bycatch reduction devices (BRDs) for the ridgeback prawn trawl fishery. The types of BRDs appropriate for the ridgeback prawn trawl fishery will be identified by CDFG.

Groundfish is harvested at incidental levels by a variety of gear types in fisheries that are not directly regulated by the Pacific Groundfish FMP. Harvest of groundfish at minimal levels in these fisheries has a negligible impact on the total catch and avoids increasing discards.

Alternatives Rejected

The GAP rejected the alternative of disallowing the inciental take of Pacific groundfish in exempted trawl gear and by salmon troll vessels. Some incidental take in these other fisheries is unavoidable and prohibiting landing will simply increase the amount of fish being discarded. Since all landings are accounted for, the impact of incidental take is minimal.

WASHINGTON RECREATIONAL

Option 1
A recreational groundfish bag limit of 15 groundfish, including rockfish and lingcod, open year-round (except lingcod). The following sublimits apply: 10 aggregate rockfish which includes a sublimit of 1 canary and no retention of yelloweye rockfish; 2 lingcod with 24-inch minimum size limit, lingcod season open Mar 16-Oct 15.

Option 2
Same as Option 1, except the rockfish sublimits would be changed to: 10 aggregate rockfish with no retention of canary rockfish and no retention of yelloweye rockfish.

Option 3
To be combined with either Option 1 or 2: Change the lingcod season to be open from the Saturday closest to March 15 through the Sunday closest to October 15.

Option 4
Continue the "C"-shaped closed area in WDFW Marine Catch Area 3 (La Push) to protect yelloweye rockfish; this area would be closed to recreational bottomfish and halibut fishing. This area is defined by the following coordinates:

48°18'00"	125°18'00"
48°18'00"	124°59'00"
48°11'00"	125°11'00"
48°11'00"	124°59'00"
48°04'00"	125°11'00"
48°04'00"	124°59'00"
48°00'00"	125°18'00"
48°00'00"	124°59'00"

The preferred option is a combination of options 1, 3, and 4.

OREGON RECREATIONAL

Option I: Status quo for the 2004 season including:

* Daily bag limits: 10 marine fish bag (including rockfish, greenling, cabezon and other species, not including salmon, lingcod, perch sp., sturgeon, sand dabs, striped bass, tuna and bait fish (herring, smelt, anchovies and sardines), with a sublimit of one yelloweye and one canary rockfish).
* One Pacific halibut during authorized seasons (32” min. length)
* Two lingcod (24” or 26” min. length)
* No canary or yelloweye rockfish retention if Pacific halibut on board vessel during all-depth season

This option continues to give opportunity to all ports up and down the Oregon coast, and allows flexibility in fisheries strategies, so as not to force recreational boats into a limited area, which could cause management-induced overfishing of nearshore areas. This option also keeps Oregon recreational fisheries inside the guidelines and limits currently set by PFMC and NMFS.

Option II: Same as Option I except closed to bottom fishing outside of 50 fathoms for the month of July.

This option would create some savings on canary but the closure would occur during the more liberal coho salmon season Oregon has been experiencing in recent years.

Option III: Same as option I or II except close offshore bottom fishing 2-4 months from either 30, 40, or 50 fathoms.

This option would create additional reductions in catch on lingcod, canary, yelloweye, and widow rockfish.

Potential for all options

* Separate harvest guidelines for Oregon for black rockfish, other nearshore rockfish, cabezon, and greenling. Guideline for other nearshore rockfish equal to modified 2003 harvest guidelines. Greenling and cabezon modified harvest guideline equal to or a 10 to 20% increase over 2003 harvest guideline.

[NOTE: modified nearshore rockfish harvest guidelines now include shore and estuary catch in addition to ocean boat catch]

* Greenling minimum length of 10-12 inches.

* Cabezon minimum length 16 inches

CALIFORNIA NEAR-SHORE AND RECREATIONAL

1. Establish new management lines for recreational and commercial fixed gear fisheries:

   A) Pedro Point (between San Francisco and Half Moon Bay)
   B) Oregon / California border

2. Modify the RCA boundary for commercial fixed gear and recreational fisheries:

   A) Move deep line in from 200 fathoms to 150 fathoms coastwide.

   B) South of Pt. Conception: Consider moving the shallow line from 20 fathoms deeper in increments of 10 fathoms to as far as 80 fathoms. This will need to be balanced with considerations of season lengths. Cowcod Conservation Area (CCA): Consider outside lines in 10 fathom increments from 160 to 200 fathoms depending on estimated impacts.

   C) *Pt. Conception to Lopez Pt.*: Consider moving the shallow line from 20 fathoms deeper in increments of 10 fathoms to as far as 60 fathoms. This will need to be balanced with considerations of season lengths.

   D) *Lopez Pt. to Pedro Point*: Consider moving the shallow line out from 20 fathoms deeper in increments of 10 fathoms to as far as 40 fathoms, and consider moving the deep line in from 150 fathoms by 10 fathom increments as shallow as 70 fathoms.

   E) *Pedro Point to Cape Mendocino (40°10' N. lat.)*: Consider moving the shallow line from 20 fathoms deeper in increments of 10 fathoms to as far as to 40 fathoms for the *mainland coast only*.

   F) *North of Cape Mendocino (40°10' N. lat.)*: no changes proposed at this time.

Size Limit and Retention Changes:

Cabezon (commercial and recreational): Establish a cabezon slot limit of 15 to 21 inches for recreational and commercial fisheries.

1 Greenling (commercial): Increase the greenling minimum size for commercial fisheries.
2 Lingcod (commercial & recreational): Consider increasing minimum lingcod size from 24 inches to 26 inches for recreational fisheries as a means of slowing the catch and rebuilding more quickly.
3 Bocaccio (recreational): Consider a bocaccio recreational bag sub-limit of zero to two bocaccio.
4 Bocaccio (commercial): Consider providing for bocaccio retention in shelf fisheries in a range of 50 to 150 lbs.
5 Ocean Whitefish (Recreational): Consider allowing retention of ocean whitefish year-round south of Pt. Conception (34°27’ N. lat.).
6 Nearshore rockfish (commercial): South of 40°10' to Point Conception, for periods 1 - 3 and 5 - 6, establish a trip limit of 400 lbs / 2 mos, of which no more than 200 lbs may be species other than blue or black rockfish; for period 4, a trip limit of 800 lbs / 2 mos, of which no more than 200 lbs may be species other than blue or black rockfish.
7 Minor shelf rockfish (commercial): South of 40°10' coastwide, increase trip limits to a range of 100 to 1,500 lbs / month.
8 Chilipepper (commercial): South of 40°10' coastwide, establish a trip limit in the range of 550 to 2,000 lbs / 2 mos, depending on depth limits allowed.

Bocaccio split, commercial and recreational

Share bocaccio between commercial and recreational fisheries in a range of 50% - 50% to 56% recreational - 44% commercial.

Seasons:

1. Recreational: Consider the 2002 recreational season structure including a 6- to 10-month season south of 40º10' N. lat.
2. If possible, maintain the same recreational and commercial open periods within each area.

GROUNDFISH MANAGEMENT TEAM REPORT ON PROPOSED 2004 GROUNDFISH MANAGEMENT MEASURES

The Groundfish Management Team (GMT) discussed various management measures for the 2004 groundfish fisheries, and recommends that the following preliminary alternatives be approved for public review:

CREATION OF NEW MANAGEMENT LINES

The GMT supports the creation of the following latitudinal lines for management purposes:

Nearshore Rockfish Fisheries

1. Line at the Washington/Oregon border (46°16'N latitude)
2. Line at the Oregon/California border (42°00'N latitude)

California Fixed Gear and Recreational Fisheries

- Pedro Point (between San Francisco and Half Moon Bay)

COMMERCIAL MANAGEMENT MEASURES - COASTWIDE

Limited Entry Trawl, Fixed Gear, and Open Access

The GMT plans to develop specific management alternatives for 2004 that provide for harvest opportunities while staying within the OYs adopted by the Council earlier this week. These management measures will include, but are not limited to, trip limits, and depth restrictions by time and area. In general, northern depth options for trawl will be analyzed using 25-fathom increments in shallow areas and 50-fathom increments in deep areas. For the area south of 40°10', 10-fathom increments will be used. Options may include restrictions using shallow lines at 50, 60, 75, and/or 100 fathoms, and deep lines at 150, 180, 200 and/or 250 fathoms. Specific results of preliminary runs of the bycatch model for the limited entry trawl fishery are contained in the section of this report addressing trawl bycatch modeling for 2004. For nearshore fixed gear and open access, the GMT recommends inclusion of an option for zero retention of cabezon.

Trawl “B” Platoon

The GMT believes that the costs to our management and regulatory systems resulting from offering the “B Platoon” option to the groundfish trawl fishery currently outweigh the benefits to the industry. Implementation and enforcement of inseason line movements, administration of vessel monitoring systems, bycatch modeling, real time catch accounting and observer scheduling are all complicated by a trawl fleet fishing under two different regulatory time periods. Additionally, the GMT notes that only 28 vessels are currently in the B platoon and smoothing of product flow can be accomplished by the scheduling of landings between the vessel and processor. Also, should an emergency fishing closure be required as a result of attaining an OY for an overfished species, the B platoon could be deprived of fishing time equal to the rest of the fleet or, the Council could be faced with the decision of allowing continued fishing in order to provide equal opportunity to the B platoon. Therefore, the GMT recommends that the B platoon be removed from management measures for 2004 and beyond.

Trawl Gear Modifications

The GMT supports the inclusion of an option identified in the draft minutes of the Allocation Committee meeting (Exhibit B.14.b., Supplemental Ad Hoc Allocation Committee Report) which would allow vessels that cannot safely participate in deep water to use fixed gear under the fixed gear regulations (fixed gear RCA) and available trawl large footrope limits for one or more periods. (Note: Only one gear type per period.) While this concept may require a plan amendment that would require a three-meeting process, the GMT supports this option going forward with the initiation of the necessary process as soon as possible.

Nearshore Trawl Selective Flatfish Fishery

The GMT recommends the Council consider allowing a selective flatfish trawl gear design as an option for 2004 management measures, including allowances for increased trip limits and/or access to areas that would otherwise be closed, pending results from the current 2003 Oregon and California nearshore flatfish EFPs. Research conducted in 2001 and 2002 demonstrated that a selective flatfish cutback trawl design results in bycatch rates for some rockfish species, including canary and yelloweye, that are significantly lower than existing trawl rates. During 2003, this trawl net design is being examined at different depths under an Oregon Department of Fish and Wildlife-sponsored EFP, and a separate California Department of Fish and Game-sponsored EFP. Although the research is still underway, preliminary results verify lower rockfish bycatch rates which are similar to the earlier research results from 150 fathoms to shore (for Oregon) and from 100 fathoms to shore (for California). The GMT plans to coordinate the states' efforts concerning modified trawl gear, including EFPs, development of gear configuration requirements and regulatory language to enhance the process of applying results coastwide.

Directed Trawl Fishery for Arrowtooth Flounder

The GMT supports the Washington Department of Fish and Wildlife proposal to explore the feasibility of applying the results of their Arrowtooth Flounder Exempted Fishery Permit (EFP) fisheries to create a fleetwide trawl opportunity for arrowtooth flounder (i.e., convert the EFP provisions into federal regulations). These provisions include:

- Observer coverage for compliance monitoring (vessel-funded)
- Bycatch caps
- Full retention of rockfish (regardless of size or condition)

Options for Sharing of Black Rockfish

The GMT recommends that the following options for the sharing of black rockfish between the states of Oregon and California be approved for analysis and review:

3. Ratio based on catch history using the average catch from 1985-2002

4. Ratio based on catch history using the average catch from 1990-2002

5. Use 2003 pre-season target take as a baseline for each state, and apply any increase or decrease based on a changing OY equally to each state (50:50)

6. Same as Option 3, except use 2002 catches

COMMERCIAL MANAGEMENT MEASURES - CALIFORNIA

Specific Rockfish Conservation Area (RCA) and Cowcod Conservation Area (CCA) Boundary Changes for California Trawl Gear

7. Move seaward RCA line in from 200 fathoms to 150 fathoms south of 40^0 10' N. Lat.

8. Reconfigure the Cowcod Conservation Area (CCA): Move seaward lines in 10-fathom increments from 160 to 200 fathoms, depending on estimated impacts. Maintain 20-fathom line.

Specific Rockfish Conservation Area (RCA) and Cowcod Conservation Area (CCA) Boundary Changes for California Non-Trawl Gear

1. South of Pt. Conception: Move the shoreward line out from 20 fathoms by 10-fathom increments, to as far as 80 fathoms except for the CCA..

2. Pt. Conception to 36o N. lat.: Move the shoreward line out from 20 fathoms by 10-fathom increments, to as far as 60 fathoms.

3. 36º N. lat. to Pedro Point: Move the shoreward line out from 20 fathoms by 10-fathom increments, to as far as 40 fathoms

4. 36º N. lat. to Pedro Point: Move the seaward line in from 150 fathoms by 10-fathom increments, to as shallow as 70 fathoms.

5. Pedro Point to Cape Mendocino (40º 10' N. lat.): Move the shoreward line out from 20 fathoms by 10-fathom increments, to as far as to 40 fathoms for the mainland coast only.
6. North of Cape Mendocino (40º 10' N. lat.): No changes proposed at this time, except to conform to Oregon RCA boundary changes.

7. Reconfigure the Cowcod Conservation Area (CCA): Move seaward lines in 10-fathom increments from 160 to 200 fathoms, depending on estimated impacts. The inside line remains at 20 fathoms.

Size Limits and Retention Allowances

1. Establish a slot limit for cabezon of 15 to 21 inches

2. Increase the greenling minimum size limit to between 13 and 16 inches

3. Consider providing for bocaccio retention in shelf fisheries in a range of 50 to 150 pounds per cumulative 2 month period

4. Blue/black rockfish: Increase north of 40 o 10' N. lat. in a range of 3,000 to 8,000 pounds per 2 month period

5. Deeper nearshore rockfish: Increase south of 40 o 10' N. lat. in a range of 200-800 pounds, of which no more than 400 pounds may be species other than black/blue rockfish

6. Minor shelf rockfish: Increase south of 40 o 10' N. lat. in a range of 100 to 1,500 pounds per month

7. Chilipepper rockfish: Increase south of 40 o 10' N. lat. in a range of 550 to 2,000 pounds, if shelf fishing grounds are opened to 70 fathoms or deeper

Commercial Ridgeback Prawn Trawl Fishery

1. Ridegeback Prawn Trawl Fishery (Commercial): Require use of bycatch reduction devices (BRDs) for the ridgeback prawn trawl fishery. The types of BRDs appropriate for the ridgeback prawn trawl fishery will be identified by CDFG

Options for Sharing of Bocaccio

1. Share bocaccio between commercial and recreational sectors in a range of 50:50 and 56:44

Trip Limit Ranges

1. Blue/black rockfish: Increase north of 40º 10' N. lat. in a range of 3,000 to 8,000 pounds per 2 month period

2. Deeper nearshore rockfish: South of 40° 10' N. lat. For periods 1, 2, 3, 5 and 6, increase trip limits in a range up to 400 pounds per 2 month cumulative period, of which no more than 200 pounds may be species other than black/blue rockfish. For period 4,increase trip limits in a range up to 800 pounds per 2 month cumulative period, of which no more than 400 pounds may be species other than black/blue rockfish.

3. Minor shelf rockfish: Increase south of 40° 10' N. lat. in a range of 100 to 1,500 pounds per month

4. Chilipepper rockfish: Increase south of 40° 10' N. lat. in a range of 550 to 2,000 pounds, if shelf fishing grounds are opened to 70 fathoms or deeper.

COMMERCIAL MANAGEMENT MEASURES - OREGON

1. Include defined winter petrale fishing areas for Periods 1 and 6

2. Define fixed gear RCA as 30-fms to 75-, 100-, or 125-fms north of 40°10'N lat.

3. Commercial halibut fishery outside of a revised 100-fm line

4. Use video monitoring aboard shoreside whiting vessels

RECREATIONAL MANAGEMENT MEASURES

The GMT reviewed the options for state recreational fisheries and recommends they be adopted for public review. These options are:

Washington

1. (Status quo) A recreational groundfish bag limit of 15 groundfish, including rockfish and lingcod, open year-round (except lingcod). The following sublimits apply: 10 aggregate rockfish which includes a sublimit of 1 canary and no retention of yelloweye rockfish; 2 lingcod with 24-inch minimum size limit, lingcod season open Mar 16-Oct 15.

2. Same as Option 1, except the rockfish sublimits would be changed to: 10 aggregate rockfish with no retention of canary rockfish and no retention of yelloweye rockfish.

3. To be combined with either Option 1 or 2: Change the lingcod season to be open from the Saturday closest to March 15 through the Sunday closest to October 15.

4. To be combined with any of the options listed above: Continue the "C"-shaped closed area in WDFW Marine Catch Area 3 (La Push) to protect yelloweye rockfish; this area would be closed to recreational bottomfish and halibut fishing. This area is defined by the following coordinates:

48°18'00"	125°18'00"
48°18'00"	124°59'00"
48°11'00"	125°11'00"
48°11'00"	124°59'00"
48°04'00"	125°11'00"
48°04'00"	124°59'00"
48°00'00"	125°18'00"

48°00'00" 124°59'00"

NOTE: Under any of the options listed above, WDFW plans to monitor its recreational catches inseason and may take action to restrict recreational fishing, by area, to inside a line that approximates 30 fathoms (defined by lat/long).

Oregon

1. (Status quo) A recreational marine fish bag limit of 10 (including rockfish, greenling, cabezon, and other species, and excluding salmon, lingcod, perch species, sturgeon, sand dabs, striped bass, tuna and baitfish–herring, smelt, anchovies and sardines) with a sublimit of one yelloweye and one canary rockfish. Additional limits of one halibut (32-inch minimum size) and two lingcod (24-inch minimum size). No canary or yelloweye retention if halibut on board during all-depth season.

2. Same as Option 1, except with lingcod minimum size limit of 26 inches.

3. Combined with Option 1 or 2, except closed to bottomfishing outside of 50 fathoms for the month of July.

4. Combined with Option 1 or 2, except closed to bottomfishing for 2-4 months from either 30, 40 or 50 fathoms.

5. Same as Options 2 and 3, except that exclusions to the general fathom closures would be instituted to give opportunity to ports with no nearshore fishing opportunity.

6. Set minimum length for greenling of 10-12 inches to bring landings of greenling within state harvest guidelines.

7. Set minimum length for cabezon of 16 inches.

California

1. RCA boundary options for recreational fisheries same as for California fixed gear fisheries described above.

2. CCA boundary options for recreational fisheries same as for California fixed gear fisheries described above.

3. Establish a slot limit for cabezon of 15 to 21 inches.

4. Increase minimum lingcod size from 24 inches to 26 inches.

5. Establish a bocaccio recreational bag sublimit of one to two bocaccio.

6. In state regulation, establish an exemption from rockfish closure periods for shore-based recreational fishing.

7. In state regulation, establish an exemption for any established cabezon slot limit for shore-based recreational fishing.

8. In state regulation, allow retention of ocean whitefish year-round south of Pt. Conception.

9. Adopt a 6- to 10-month season south of 40°10'N. lat.

10. If possible, maintain the same recreational and commercial open periods within each area.

11. Set separate recreational and commercial open periods within each area (status quo).

12. Share bocaccio between the recreational and commercial sectors in a range of 50:50 to 56:44 recreational to sport ratios.

ADDITIONAL RECREATIONAL OPTIONS

The GMT recommends consideration of management measures that include zero retention of both canary and yelloweye that would discourage any targeting by recreational fisheries to reduce the potential of additional targeted catch of those species beyond true unavoidable catch to be included for analysis. This action should be considered for review even if it results in creating some limited discard (estimated to be very small by the states) because of the low and uncertain stock status of those species, the uncertainty in our ability to track actual removals in all fisheries and the disproportionate effects of recreational removals on rebuilding trajectories.

The GMT also recommends inclusion of an option for zero retention of cabezon in recreational fisheries.

MODELING ISSUES FOR THE 2004 GROUNDFISH TRAWL FISHERY

The purpose of this section of the GMT report is three-fold: to update the Council on issues that will be addressed and approaches that will be utilized in modeling trawl options for the 2004 fishery; to request input from the Council regarding additional considerations that should be addressed; and, to request specific guidance from the Council regarding the identification of trawl targets to be used for several bycatch species in the modeling exercise.

The last of these items is of fundamental importance for developing a NEPA analysis package that is concise, yet thorough. Three overfished species–bocaccio, canary, and lingcod--have the potential to be caught in significant quantities by all sectors of the fishery. For each of these species, it is critical that guidance be provided regarding the anticipated distribution of the OY between sectors, and in particular the amounts/percentages of the total OYs that should be used in modeling the trawl options. Given the ranges under consideration for these species, it would be beneficial to know if the same distributions should be used over the entire range of OYs.

For another species–darkblotched–the Council elected to manage the 2003 fishery to a target that was well below the adopted OY. For the range of 2004 OYs under consideration, the GMT needs to know if the Council intends to continue this policy in 2004, or to allow access to the entire OY.

The modeling of 2004 management alternatives will utilize the same general approach as was used for the 2003 fishery. The modeling will seek to identify the minimum closed depth range that allows the fullest possible harvest of target species while constraining bycatch of overfished species to acceptable levels. Management lines that will be available in the modeling will include shallow lines at 50 fm, 60 fm, 75 fm, and 100 fm; and deep lines at 150 fm, 180 fm, 200 fm, and 250 fm. It should be noted that comments regarding the removal of a 60 fm line from consideration at the recent Allocation Committee meeting were in error. Alternative model runs with no closure will also be provided for comparison. Bycatch rates that will be used in the modeling are shown in Table 1.

Given the increase in the bocaccio OY, opportunities for targeting chilipepper south of 40º10' during a portion of the year will be explored. Based on the Council inseason discussion at this meeting, a priority will be placed on having a shallow line at depths of at least 75 fm during periods 4 and 5 to protect molting crabs.

The analysis will include a sufficient range of landed catch target amounts to accommodate whatever decisions are made in September regarding revised discard estimates for target species. An effort will also be made to provide some ranging of the potential effects of a successful vessel/permit buyback on 2004 trip limits. Additionally, the potential for inseason incorporation of differential trip limits and/or areas when specified selective gear for avoiding rockfish is used will be explored. For bocaccio, the effect of increased trawl selectivity of the large incoming 1999 year class will be explored through adjusting bycatch rates using changes in catchability that have been estimated by Dr. MacCall.

Two examples of management limits/depths are provided in Tables 2a and 3a, with associated bycatch implications shown in Tables 2b and 3b. Management lines in Version 1 (Table 2a) yield a closed area between 100 fm and 150 fm south of 38º throughout the year. North of 38º, the deep lines are at 200 fm throughout the year, except for petrale areas during periods 1 and 6. Between 38º and 40º10', the shallow line is at 100 fm in all periods. North of 40º10', the shallow line is set at 75 fm throughout most of the year, with one period at 50 fm. Trip limits for major target species are also shown in Table 2a. Projected bycatch under this suite of options is provided in Table 2b. In Version 2, the deep line is set at 150 fm throughout the year for the entire coast. South of 40º10', the shallow line is at 100 fm, throughout the year. North of 40º10', the shallow line is at 75 fm for most of the year, and at 60 fm in 2 periods.

Table 1.--Bycatch ratios for overfished species that will be used in modeling the 2004 fisheries

Subarea	<= 50 fm	<= 60 fm	<= 75 fm	<= 100 fm	> 150 fm	>180 fm	> 200 fm	> 250 fm
Lingcod								
N. of 40°10'	2.424%	3.622%	4.479%	5.555%	0.085%	0.061%	0.000%	0.000%
38°-40°810'	1.285%	0.788%	0.869%	2.901%	0.085%	0.061%	0.000%	0.000%
S. of 38°	1.285%	0.788%	0.869%	2.901%	1.299%	1.391%	0.023%	0.011%
Canary								
N. of 40°10'	0.103%	0.258%	0.724%	1.005%	0.011%	0.000%	0.000%	0.000%
38°-40°810'	0.211%	0.037%	0.053%	0.111%	0.011%	0.000%	0.000%	0.000%
S. of 38°	0.211%	0.037%	0.053%	0.111%	0.000%	0.000%	0.000%	0.000%
Widow								
N. of 40°10'	0.002%	0.052%	0.035%	0.057%	0.010%	0.004%	0.003%	0.000%
38°-40°810'	0.311%	0.033%	0.012%	0.015%	0.010%	0.004%	0.003%	0.000%
S. of 38°	0.311%	0.033%	0.012%	0.015%	0.006%	0.001%	0.000%	0.000%
Bocaccio								
N. of 40°10'	0.000%	0.000%	0.000%	0.000%	0.000%	0.000%	0.000%	0.000%
38°-40°810'	2.431%	0.810%	0.511%	3.772%	0.001%	0.000%	0.000%	0.000%
S. of 38°	2.431%	0.810%	0.511%	3.772%	0.311%	0.313%	0.000%	0.000%
Cowcod								
N. of 40°10'	0.000%	0.000%	0.000%	0.000%	0.000%	0.000%	0.000%	0.000%
38°-40°810'	0.000%	0.000%	0.004%	0.010%	0.000%	0.000%	0.000%	0.000%
S. of 38°	0.000%	0.005%	0.006%	0.090%	0.014%	0.000%	0.000%	0.000%
Yelloweye								
N. of 40°10'	0.001%	0.005%	0.027%	0.033%	0.001%	0.000%	0.000%	0.000%
38°-40°810'	0.311%	0.032%	0.011%	0.010%	0.001%	0.000%	0.000%	0.000%
S. of 38°	0.311%	0.032%	0.011%	0.010%	0.000%	0.000%	0.000%	0.000%
Darkblotched								
N. of 40°10'	0.000%	0.076%	0.230%	0.504%	1.197%	0.924%	0.521%	0.000%
38°-40°810'	0.000%	0.000%	0.000%	0.049%	1.197%	0.924%	0.521%	0.000%
S. of 38°	0.000%	0.000%	0.000%	0.049%	0.126%	0.098%	0.042%	0.000%
POP								
N. of 40°10'	0.018%	0.027%	0.292%	0.506%	1.046%	0.692%	0.552%	0.000%
38°-40°810'	0.000%	0.000%	0.000%	0.000%	0.008%	0.000%	0.000%	0.000%
S. of 38°	0.000%	0.000%	0.000%	0.000%	0.008%	0.000%	0.000%	0.000%

Table 2a.--DRAFT 2004 TRAWL MANAGEMENT MEASURES, VERSION 1

Subarea	Footrope	Bi-monthly period 1	2	3	4	5	6
N. of 40°10							
shallow line depth		75	75	75	50	75	75
deep line depth		150	200	200	200	200	150
Sablefish	large ft-rp	9,100	9,200	9,200	9,200	9,200	9,100
	sm. ft-rp	5,500	5,500	5,500	5,500	5,500	5,500
Longspine	large ft-rp	13,000	14,000	14,000	14,000	14,000	13,000
	sm. ft-rp	5,000	5,000	5,000	5,000	5,000	5,000
Shortspine	large ft-rp	2,500	2,600	2,700	2,700	2,700	2,500
	sm. ft-rp	1,500	1,500	1,500	1,500	1,500	1,500
Dover	large ft-rp	32,000	32,000	32,000	32,000	32,000	32,000
	sm. ft-rp	15,000	15,000	15,000	15,000	15,000	15,000
Arrowtooth	large ft-rp	999,999	150,000	150,000	150,000	150,000	999,999
	sm. ft-rp	5,000	5,000	5,000	5,000	5,000	5,000
Petrale	large ft-rp	999,999	130,000	130,000	130,000	130,000	999,999
	sm. ft-rp	20,000	20,000	20,000	20,000	20,000	20,000
Other flatfish	large ft-rp	100,000	100,000	100,000	100,000	100,000	100,000
	sm. ft-rp	50,000	50,000	50,000	50,000	50,000	50,000
38°-40°10							
shallow line depth		100	100	100	100	100	100
deep line depth		150	200	200	200	200	150
Sablefish	All	9,100	9,200	9,200	9,200	9,200	9,100
Longspine	All	13,000	14,000	14,000	14,000	14,000	13,000
Shortspine	All	2,500	2,600	2,700	2,700	2,700	2,500
Dover	All	32,000	32,000	32,000	32,000	32,000	32,000
Arrowtooth	All	999,999	10,000	10,000	10,000	10,000	999,999
Petrale	All	999,999	20,000	20,000	20,000	20,000	999,999
Other flatfish	All	100,000	100,000	100,000	100,000	100,000	100,000
S. of 38°							
shallow line depth		100	100	100	100	100	100
deep line depth		150	150	150	150	150	150
Sablefish	All	9,100	9,200	9,200	9,200	9,200	9,100
Longspine	All	13,000	14,000	14,000	14,000	14,000	13,000
Shortspine	All	2,500	2,600	2,700	2,700	2,700	2,500
Dover	All	32,000	32,000	32,000	32,000	32,000	32,000
Arrowtooth	All	999,999	10,000	10,000	10,000	10,000	999,999
Petrale	All	999,999	20,000	20,000	20,000	20,000	999,999
Other flatfish	All	100,000	100,000	100,000	100,000	100,000	100,000

Notes: Large footrope ("large ft-rp") limits may be used only if no small footrope nets (other than midwater) are used during a period; small footrope ("sm. ft-rp") limits apply whenever whenever non-midwater nets with a footrope less than 8 inches are used during a period.
Limits shown as "999,999" indicate no limit during that period.

Table 2b.--DRAFT 2004 TRAWL MANAGEMENT MEASURE BYCATCH, VERSION 1

										Target tonnage	
		Lingcod	Canary	POP	Darkblotched	Widow	Bocaccio	Yelloweye	Cowcod	shallow	deep
North	1	3.3	0.5	22.7	25.9	0.2	0.0	0.0	0.0	32.2	2,158.1
	2	6.2	1.0	13.3	12.5	0.1	0.0	0.0	0.0	138.2	2,329.9
	3	21.0	3.4	13.3	12.4	0.2	0.0	0.1	0.0	468.1	2,169.4
	4	7.9	0.3	7.5	7.0	0.0	0.0	0.0	0.0	327.5	1,349.6
	5	13.8	2.2	11.8	11.0	0.2	0.0	0.1	0.0	307.9	1,974.3
	6	3.6	0.5	14.9	16.9	0.2	0.0	0.0	0.0	54.4	1,405.4
	Total	55.8	8.0	83.4	85.7	1.0	0.0	0.3	0.0	1,328.3	11,386.7
South	1	8.7	0.2	0.1	4.9	0.1	7.7	0.0	0.2	183.3	616.3
	2	10.6	0.3	0.0	2.4	0.1	9.6	0.0	0.2	228.2	676.9
	3	11.5	0.2	0.0	2.3	0.1	9.6	0.0	0.3	223.1	714.1
	4	11.9	0.2	0.0	3.1	0.1	8.6	0.0	0.2	188.2	947.9
	5	9.9	0.2	0.0	3.1	0.1	7.9	0.0	0.2	178.4	862.3
	6	7.5	0.2	0.1	6.7	0.1	5.2	0.0	0.1	113.9	815.1
	Total	60.2	1.3	0.2	22.6	0.4	48.5	0.1	1.3	1,115.1	4,632.6
Coast	1	12.0	0.7	22.7	30.8	0.3	7.7	0.0	0.2	215.4	2,774.4
	2	16.8	1.3	13.3	14.9	0.2	9.6	0.1	0.2	366.4	3,006.8
	3	32.4	3.6	13.4	14.7	0.3	9.6	0.1	0.3	691.2	2,883.4
	4	19.8	0.5	7.5	10.1	0.1	8.6	0.0	0.2	515.7	2,297.5
	5	23.7	2.4	11.8	14.1	0.2	7.9	0.1	0.2	486.3	2,836.6
	6	11.1	0.7	14.9	23.7	0.2	5.2	0.0	0.1	168.3	2,220.5
	Total	115.9	9.3	83.7	108.3	1.4	48.5	0.4	1.3	2,443.4	16,019.3

Table 3a.--DRAFT 2004 TRAWL MANAGEMENT MEASURES, VERSION 2

Subarea		Footrope	Bi-monthly period 1	2	3	4	5	6
N. of 40°10								
	shallow line depth		75	60	60	75	75	75
	deep line depth		150	150	150	150	150	150
	Sablefish	large ft-rp	8,900	8,900	8,900	8,900	8,900	8,900
		sm. ft-rp	5,500	5,500	5,500	5,500	5,500	5,500
	Longspine	large ft-rp	13,000	13,000	13,000	13,000	13,000	13,000
		sm. ft-rp	5,000	5,000	5,000	5,000	5,000	5,000
	Shortspine	large ft-rp	2,500	2,500	2,500	2,500	2,500	2,500
		sm. ft-rp	1,500	1,500	1,500	1,500	1,500	1,500
	Dover	large ft-rp	30,000	30,000	30,000	29,000	30,000	30,000
		sm. ft-rp	15,000	15,000	15,000	15,000	15,000	15,000
	Arrowtooth	large ft-rp	999,999	150,000	150,000	150,000	150,000	999,999
		sm. ft-rp	5,000	5,000	5,000	5,000	5,000	5,000
	Petrale	large ft-rp	999,999	130,000	130,000	130,000	130,000	999,999
		sm. ft-rp	20,000	20,000	20,000	20,000	20,000	20,000
	Other flatfish	large ft-rp	100,000	100,000	100,000	100,000	100,000	100,000
		sm. ft-rp	50,000	50,000	50,000	50,000	50,000	50,000
38°-40°10								
	shallow line depth		100	100	100	100	100	100
	deep line depth		150	150	150	150	150	150
	Sablefish	All	8,900	8,900	8,900	8,900	8,900	8,900
	Longspine	All	13,000	13,000	13,000	13,000	13,000	13,000
	Shortspine	All	2,500	2,500	2,500	2,500	2,500	2,500
	Dover	All	30,000	30,000	30,000	29,000	30,000	30,000
	Arrowtooth	All	999,999	10,000	10,000	10,000	10,000	999,999
	Petrale	All	999,999	20,000	20,000	20,000	20,000	999,999
	Other flatfish	All	100,000	100,000	100,000	100,000	100,000	100,000
S. of 38°								
	shallow line depth		100	100	100	100	100	100
	deep line depth		150	150	150	150	150	150
	Sablefish	All	8,900	8,900	8,900	8,900	8,900	8,900
	Longspine	All	13,000	13,000	13,000	13,000	13,000	13,000
	Shortspine	All	2,500	2,500	2,500	2,500	2,500	2,500
	Dover	All	30,000	30,000	30,000	29,000	30,000	30,000
	Arrowtooth	All	999,999	10,000	10,000	10,000	10,000	999,999
	Petrale	All	999,999	20,000	20,000	20,000	20,000	999,999
	Other flatfish	All	100,000	100,000	100,000	100,000	100,000	100,000

Note: Large footrope ("large ft-rp") limits may be used only if no small footrope nets (other than midwater) are used during a period; small footrope ("sm. ft-rp") limits apply whenever whenever non-midwater nets with a footrope less than 8 inches are used during a period.
Limits shown as "999,999" indicate no limit during that period.

Table 3b.--DRAFT 2004 TRAWL MANAGEMENT MEASURE BYCATCH, VERSION 2

		Lingcod	Canary	POP	Darkblotched	Widow	Bocaccio	Yelloweye	Cowcod	Target tonnage	
										shallow	deep
North	1	3.3	0.5	22.5	25.7	0.2	0.0	0.0	0.0	32.0	2,142.9
	2	5.1	0.5	25.3	29.0	0.3	0.0	0.0	0.0	83.9	2,416.1
	3	15.1	1.2	20.8	23.9	0.4	0.0	0.0	0.0	371.5	1,974.9
	4	26.3	4.2	23.8	26.6	0.4	0.0	0.2	0.0	546.4	2,118.6
	5	15.8	2.5	22.0	24.9	0.3	0.0	0.1	0.0	314.8	2,018.8
	6	3.5	0.5	14.4	16.4	0.2	0.0	0.0	0.0	53.0	1,362.0
	Total	69.1	9.3	128.8	146.5	1.7	0.0	0.4	0.0	1,401.7	12,033.2
South	1	8.7	0.2	0.1	4.9	0.1	7.6	0.0	0.2	183.2	614.7
	2	10.7	0.3	0.1	5.0	0.1	9.4	0.0	0.2	224.8	672.2
	3	11.3	0.3	0.1	4.6	0.1	9.3	0.0	0.2	217.3	700.7
	4	11.6	0.2	0.1	6.0	0.1	8.3	0.0	0.2	180.9	903.8
	5	9.8	0.2	0.1	6.7	0.1	7.3	0.0	0.2	165.5	861.5
	6	7.4	0.2	0.1	6.5	0.1	5.2	0.0	0.1	113.7	793.0
	Total	59.5	1.5	0.4	33.6	0.5	47.2	0.1	1.2	1,085.4	4,545.9
bimo	1	12.0	0.7	22.6	30.6	0.3	7.6	0.0	0.2	215.2	2,757.6
	2	15.8	0.8	25.4	33.9	0.4	9.4	0.0	0.2	308.7	3,088.3
	3	26.5	1.4	20.8	28.5	0.5	9.3	0.1	0.2	588.8	2,675.6
	4	37.9	4.4	23.8	32.6	0.5	8.3	0.2	0.2	727.3	3,022.4
	5	25.6	2.7	22.1	31.5	0.4	7.3	0.1	0.2	480.3	2,880.3
	6	10.9	0.7	14.5	23.0	0.2	5.2	0.0	0.1	166.7	2,155.0
	Total	128.6	10.8	129.2	180.2	2.3	47.2	0.5	1.2	2,487.0	16,579.2

Preliminary Tribal Proposal Regarding 2004 Groundfish Management Measures

Black Rockfish - The 2004 tribal harvest guidelines will be set at 20,000 pounds for the management area between the US/Canada border and Cape Alava, and 10,000 pounds for the management area located between Destruction Island and Leadbetter Point. No tribal harvest restrictions are proposed for the management area between Cape Alava and Destruction Island.

Sablefish - The 2004 tribal set aside for sablefish will be set at 10 percent of the Monterey through Vancouver area OY minus 3 % to account for expected discard mortality. Allocations among tribes and among gear types, if any, will be determined by the tribes.

Lingcod - The tribes propose an overall harvest guideline of 25 mt for all tribal fisheries. Tribal fisheries will be restricted to 450 pound per day and 1350 pound per week limits for all fisheries, which may be adjusted inseason to stay within the overall harvest guideline.

For all other tribal groundfish fisheries the following trip limits will apply:

Thornyhead rockfish - Tribal fisheries will be restricted to a 300 pound per trip limit. This trip limit will be for short and longspine thornyheads combined.

Canary rockfish - Tribal fisheries will be restricted to a 300 pound per trip limit.

Other Minor Nearshore, Shelf and Slope Rockfish - Tribal fisheries will be restricted to a 300 pound per trip limit for each species group, or the limited entry trip limits if they are less restrictive than the 300 pound per trip limit.

Yelloweye Rockfish – The tribes will continue developing depth, area, and time restrictions in their directed Pacific halibut fishery to minimize impacts on yelloweye rockfish. Tribal fisheries will be restricted to 100 pounds per trip.

For Makah Trawl fisheries the following trip limits will apply:

Pacific Whiting - For the 2004 Pacific whiting fishery, the tribal set aside will be as provided in the Makah tribe's proposed allocation framework.

Mid-water Trawl Fishery- Treaty mid-water trawl fishermen will be restricted to a cumulative limit of yellowtail rockfish, based on the number of vessels participating, not to exceed 150,000 pounds per two month period for the entire fleet. Their landings of widow rockfish must not exceed 10% of the poundage of yellowtail rockfish landed in any given period. Fishermen will not be permitted to carry-over portions of the cumulative limit that are not used in any previous two-month period. The tribe may adjust the cumulative limit for any two-month period to minimize the incidental catch of canary and widow rockfish, provided the average cumulative limit does not exceed 150,000 pounds for the fleet.

Bottom Trawl Fishery - Treaty fishermen using bottom trawl gear will be subject to the trip limits applicable to the limited entry fishery for Pacific cod, petrale sole, English sole, rex sole, arrowtooth flounder, and other flatfish. Because of the relatively small expected harvest, the trip limits for the tribal fishery will be those in place at the beginning of the season in the limited entry fishery and will not be adjusted downward, nor will time restrictions or closures be imposed, unless in-season catch statistics demonstrate that the tribes have taken ½ of the harvest in the tribal area. Fishermen will be restricted to PFMC approved trawl gear.

Observer Program – The Makah tribe has an observer program in place to monitor and enforce the limits proposed above.

ZIONTZ, CHESTNUT, VARNELL, BERLEY & SLONIM
ATTORNEYS AT LAW

STEVEN H. CHESTNUT
JAMES L. VARNELL
RICHARD M. BERLEY *
MARC D. SLONIM
JOHN B. ARUM
BRIAN W. CHESTNUT
ANASTASIA M. TELESETSKY **

OF COUNSEL:
ALVIN J. ZIONTZ

* ALSO ADMITTED IN NEW YORK
** ALSO ADMITTED IN CALIFORNIA

2101 FOURTH AVENUE, SUITE 1230
SEATTLE, WASHINGTON 98121-2391
TELEPHONE 206-448-1230
FACSIMILE 206-448-0962

Via Telefax

June 16, 2003

Bob Lohn
Regional Administrator
National Marine Fisheries Service
7600 Sand Point Way NE
Seattle, WA 98115-0070

Re: Treaty Indian Groundfish Fisheries in 2004

Dear Mr. Lohn:

We have been asked to write to you on behalf of the Makah Indian Tribe. Pursuant to 50 C.F.R. § 660.324(d), the Tribe requests that provision be made for harvest of groundfish by Pacific coast treaty Indian tribes in 2004 by continuing, with two exceptions, the treaty regulations and allocations in effect in 2003, including the Makah allocation in the Pacific whiting fishery, with adjustments to reflect changes in Optimum Yields as determined by the Pacific Fishery Management Council and the National Marine Fisheries Service for 2004.

The exceptions involve widow rockfish and ling cod. With respect to widow rockfish, the Tribe is concerned about the current uncertainty in the stock assessment and rebuilding analysis, and its effect on the determination of Optimum Yield. Once Optimum Yield is determined, Tribal representatives will work with federal and state managers to develop measures to hold impacts in Tribal fisheries to appropriate levels. With respect to ling cod, the Tribe proposes a treaty harvest guideline of approximately 25 metric tons round weight, with base trip limits of 450 pounds round weight per day and 1,350 pounds round weight per week.

Tribal representatives attending the Council meeting this week will respond to questions you or your staff may have regarding the Tribe's planned 2004 fisheries.

Very truly yours,

ZIONTZ, CHESTNUT, VARNELL,
BERLEY & SLONIM

Marc D. Slonim

cc: Bill Robinson
Eileen Cooney
Russ Svec
Steve Joner

ENFORCEMENT CONSULTANTS REPORT ON ADOPTION OF A PROPOSED RANGE OF 2004 GROUNDFISH MANAGEMENT MEASURES

The existence of a B Platoon continues to provide an additional layer of complexity to regulations due to staggering implementation of related management measures by fifteen days. The Enforcement Consultants (EC) recommend the Council consider eliminating B Platoon, so one set of regulations apply to the entire limited entry trawl fleet beginning in the year 2004.

Utilizing depth contours versus latitude - longitude lines when enforcing depth based management is not the tool of choice, according to the majority EC opinion. However, a 20 fathom contour curve currently exists for recreational and commercial fisheries in California, South of Point Conception. Our understanding is that the extension of the existing contour line concept to 30 fathoms is based upon consistency with the current regime and bathymetric considerations. While we understand the unique situation South of Point Conception, we believe that impacts from violations by sport fishers can be as significant as that from commercial fishers. So, ensuring our ability to fly over closed areas to identify incursions with precision is important. The EC will continue to resist erosion of the Council's latitude - longitude enforcement policy.

PFMC
06/20/03

Proposed Oregon Commercial Groundfish Options for 2004 Fishery

June 20, 2003

Option 1: Consider EFP impacts after all 2004 fishery management options are reviewed and 2004 fishery management options have been addressed.

Option 2: Schedule a Pacific whiting IQ briefing/scoping agenda item for the September 2003 PFMC meeting. This will stage the start of a three meeting process which will begin in November.

Option 3: Coast-wide adoption of the selective flatfish trawl as a management mechanism for allowing increased bottom trawl trip limits and access to areas that would otherwise be closed.

Option 4: Consider all trawl depth management options provided by GMT (shoreward management lines at 50, 60, 75 or 100 fm; offshore management lines at 150, 180, 200 or 250 fm).

Option 5: Defined winter petrale fishing areas for January-February and November and December.

Option 6: Define non-trawl RCA as 30 fm to 75, 100 or 125 fm.

Option 7: Commercial halibut fishery outside of a revised 100 fm line

Option 8: Allow trawl vessels to use fixed-gear under existing trawl limits.

Option 9: Use video monitoring aboard shoreside whiting vessels**.**

-Continued on Reverse-

Proposed Oregon Recreational Groundfish Options for 2004 Fishery
June 20, 2003

Option I: Status quo for the 2004 season including:
Daily bag limits: 10 marine fish bag (including rockfish, greenling, cabezon and other species, not including salmon, lingcod, perch sp., sturgeon, sand dabs, striped bass, tuna and bait fish (herring, smelt, anchovies and sardines), with a sublimit of one yelloweye and one canary rockfish).

- **One Pacific halibut during authorized seasons (32" min. length)**
- **Two lingcod (24" or 26" min. length)**
- **No canary or yelloweye rockfish retention if Pacific halibut on board vessel during all-depth season**

This option continues to give opportunity to all ports up and down the Oregon coast, and allows flexibility in fisheries strategies, so as not to force recreational boats into a limited area, which could cause management-induced overfishing of nearshore groundfish. This option also keeps Oregon recreational fisheries within the current guidelines and limits.

Option II: Same as Option I except closed to bottom fishing outside of 50fms for the month of July. This option would create some savings on lingcod, canary, yelloweye and widow rockfish (overfished species), but the closure would occur during the more liberal coho salmon season Oregon has been experiencing in recent years.

Option III: Same as option I or II except close offshore bottom fishing 2-4 months from either 30, 40 or 50 fathoms. This option would create additional reductions in catch on lingcod, canary, yelloweye and widow rockfish.

And (could be added to all options):

Separate harvest guidelines for Oregon for black rockfish, other nearshore rockfish, cabezon, and greenling. Black rockfish guideline equal to either 62% of OR/CA OY of 775 mt, or 2003 OR/CA harvest guidelines applying any increase or decrease based on a changing OY, split equally to each state. Guideline for other nearshore rockfish equal to modified* 2003 harvest guidelines. Greenling and cabezon modified* harvest guideline equal to or a 10 to 20% increase over 2003 harvest guideline.

*NOTE: modified nearshore rockfish harvest guidelines now include shore and estuary catch in addition to ocean boat catch.

- Greenling minimum length of 10-12 inches.
- Cabezon minimum length 16 inches

RECEIVED
JUN - 3 2003
PFMC

Pacific Fishery Management Council
7700 NE Ambassador Place, Suite 200
Portland, Oregon 97220-1384
503-326-6352

Concerned: SPORT FISHERMAN

I am extremely upset that the people that are charged with protecting our marine resources for future generations are buckling under the pressure from the environmental extremists. On the central coast there is very little sport fishing pressure on the resource but we are singled out to solve the problem while the real problem of commercial over fishing and coastal pollution are overlooked. There is new science that supports 12-month rock cod seasons with a ten rockfish bag limit out to 50 fathoms or 300 ft for the sport fisherman. They owe it to us since they made emergency closures last year and mistakenly took away our season this year for no reason.
Also there should be smaller management zones with individual quotas for each zone. This way each zone is not closed or opened depending on fish that were caught somewhere else (northern or southern California) but based on the resource that is within that zone. For us that would be a management zone from Pt. Sur to Pt. Conception.

Sincerely
Terry Schafer

OUTER BANKS

253 Highland Drive
Channel Islands Beach
California 93035
Tim Athens, Owner

Commercial Fisheries
(805) 984-5338
Fax:(805) 985-JAWS
email: NeptuneOBS@aol.com

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JUN 3 2003
PFMC

Members of the PFMC and GMT

2 JUNE 2003

RE: CCA / RCA boundaries; groundfish allocation; restricted access; LE fleet trip limits

It has come to my attention that the Council may consider easing restrictions on shelf rockfish fishing in the second half of 2003 in light of new information concerning the status of the bocaccio resource. First, I'd like to take the opportunity to commend those involved in making revisions to some of the fundamental variables in the scientific population model this year by their use of the most up-to-date biological information. These modifications have produced a much-more realistic estimate of the current population size.

That being said, I would like you to know that I have been commercially fishing various shelf rockfish species off the coast of southern California for nearly 30 years, am a 'federal A fixed gear permittee', and serve on the PFMC's Habitat Technical Review Committee.

The PFMC and GMT now have some difficult decisions ahead on how best to handle the need to ease these restrictions, respecting the need to maintain existing protection for other overfished rockfish species. Furthermore, the situation now prompts the question of how to allocate 'the shelf' between fishery sectors. I would like to make a few recommendations on these matters.

1. For offshore southern California waters, the Cowcod Conservation Area (CCA) goals, objectives, and boundaries need immediate re-examination relative to the Rockfish Conservation Area (RCA). When we were first faced with the giant swath of closed area in the CCA, we were told that this much area needed to be placed off-limits to ensure adequate protection for 50 percent of the cowcod population. While cowcod have specific depth ranges, it was decided, for enforcement purposes, that only big square or rectangular dimensions would be enforceable, causing the loss of many hundreds of square miles of deeper fishable habitat for minor slope rockfish, blackcod and thornyheads. Yet in 2001, the PFMC moved to the use of closure areas defined by depth contours, and has continued with this strategy ever since. No management action has been taken to reduce the CCA boundaries to compensate for this additional protection which came on-line with the RCA. Clearly, it is arbitrary, redundant, and not in the spirit of sound scientific management to leave the current boundaries of the CCA status quo while enforcing the current RCA boundaries. Without question, the current CCA boundaries are antiquated. Now, with requirements looming for VMS to address enforcement concerns, the limited entry commercial fishery should be given additional access to deeper waters needlessly closed in the CCA. Moving the 'outward line' in to 180 fathoms would be a good start.

2. On the matter of allocation of the bocaccio OY between sectors, it seems most sensible, fair, and equitable to return to the 56/44 percent split between recreational and commercial resources that was in place in 2002. Loss of access to shelf resources was imposed equally between sectors for 2003, and thus the return of access should be dealt with in the same manner.

3. However, in the case of the commercial allocation of bocaccio, it is imperative that the PFMC and GMT be cautious in how this catch is subdivided between the limited entry and open-access fleet. Percentages and splits aside, management MUST take into account that we need to do everything possible to PROHIBIT NEW FISHING EFFORT ON THE SHELF by establishing shelf trip limits for open-access that allow for incidental landings, but serve to deter new involvement. The West Coast groundfish crisis is not over, and we need to remember that there is still a substantial open-access component to this fishery. It does not need to increase in size. Inexplicably, to this day, if the shelf were opened, vessel owners who have never landed a rockfish can still register their vessel commercially, buy a commercial license and go out on the shelf and fish for rockfish. Given California's recent actions restricting access to the nearshore, we need to prevent effort shift ont the shelf. If the PFMC believes in their policies regarding the value of the use of restricted access as a mechanism to reduce effort in a fishery, setting these trip limits for open access should be of utmost importance.

4. Set appropriate trip limits that allow us to more fully utilize the minor shelf OY. Efforts to protect bocaccio have resulted in a loss of access for everybody to this OY. As you are aware, the level at which our minor shelf trip limits are set is far more important than the volume of bocaccio we will be authorized to take, as other shelf species are more important to our markets. In the past, the PFMC has provided a 200-pound monthly trip limit, which was paired with a 1,000 pound per month shelf trip limit. Given our ability to more purely target species such as vermilion, and chilipepper rockfish etc. I'd suggest, for the COMMERCIAL LIMITED ENTRY FLEET ONLY, that ratio perhaps be loosened so that we can target the shelf species which are not overfished by implementing higher shelf limits. Such a strategy would still accomplish the goal of prohibiting discard of bocaccio, yet would authorize the take of this resource by the component of the commercial fishery that the PFMC has identified as having priority.

Thank you for your consideration,

Tim Athens

Tim Athens

CC: PFMC GMT F&G Commission Voikovich Wolf Barnes

GROUNDFISH MANAGEMENT TEAM STATEMENT ON ALTERNATIVE LONG-TERM GROUNDFISH MANAGEMENT STRATEGIES

The Groundfish Management Team (GMT) has struggled over the past few years with how to develop management strategies other than status quo. Alternative management strategies are often entertained in meetings ancillary to the Council's annual specification process such as the Strategic Planning, Allocation, and Programmatic Environmental Impact Statement Oversight committees. However, these measures typically receive no serious consideration as we engage in the intense process of developing annual management specifications. These measures include, but are not limited to, bycatch caps, differential trip limits with increased monitoring, full rockfish retention, new gear specifications/requirements, and area management based upon species distributions other than coastwide depth contours.

The GMT feels that such management measures are worth exploring and should be given consideration by the Council. However, we do not have any time available during our regularly scheduled meetings to have meaningful discussions on these issues.

We would have liked to have considered alternatives to the current management regime and developed options for the Council's consideration for the 2004 management cycle, but that was not possible given our current schedule and workload. The GMT feels strongly that these measures should be given consideration for 2005 and 2006. To that end, the GMT requests the Council allow us to have an additional meeting following the November Council meeting dedicated to the discussion of alternative management strategies.

PFMC
06/19/03

STOCK ASSESSMENTS AND REBUILDING ANALYSES FOR 2004 GROUNDFISH MANAGEMENT

Situation: The Council process for setting groundfish harvest levels and other specifications depends on periodic assessments of the status of groundfish stocks, rebuilding analyses of those stocks that are overfished and managed under rebuilding constraints, and a report from an established assessment review body or, in the Council parlance, a Stock Assessment Review (STAR) Panel. As appropriate, the Scientific and Statistical Committee (SSC) recommends the best available science for groundfish management decision-making in the Council process. The SSC reviews new assessments, rebuilding analyses, and STAR Panel reports and recommends the data and analyses that should be used to set groundfish harvest levels and other specifications for the following year (or biennial management period in the context of multi-year management).

Seven new groundfish stock assessments have been conducted and reviewed by STAR Panels for use in setting groundfish harvest levels in 2004. Of these seven stocks, five are overfished and are the subject of rebuilding analyses that are also important for establishing 2004 harvest levels. The seven groundfish stocks with new assessments include Pacific ocean perch, widow rockfish, bocaccio, black rockfish, darkblotched rockfish, yellowtail rockfish, and cowcod. Pacific ocean perch, widow rockfish, bocaccio, darkblotched rockfish, and cowcod are overfished and managed under management strategies influenced by rebuilding analyses. Of these five overfished stocks, four have new rebuilding analyses that should be considered when deciding 2004 harvest specifications. The cowcod analysis is not a typical assessment or rebuilding analysis, but is instead a review of how well management measures have worked to control fishing mortality to within the harvest levels set by the Council since the stock was declared overfished. A more complete cowcod assessment and rebuilding analysis was not possible given the closed area and non-retention strategies used to rebuild the stock and the lack of targeted research on stock status.

The Council should consider the new assessments, rebuilding analyses, and STAR Panel reports, as well as the advice of the SSC, other advisory bodies, and the public before adopting the new stock assessments and rebuilding analyses for use in 2004 groundfish management.

Council Task:

1. **Consider Approving Stock Assessments for Use in 2004.**
2. **Consider Approving Rebuilding Analyses for Use in 2004 Fishery Management and Long Term Rebuilding Plans**

Reference Materials:

1. Status and Future Prospects for the Pacific Ocean Perch Resource in Waters off Washington and Oregon as Assessed in 2003 (Exhibit B.3, Attachment 1).
2. Rebuilding Analysis for Pacific Ocean Perch for 2003 (Exhibit B.3, Attachment 2).
3. Pacific Ocean Perch STAR Panel Meeting Report (Exhibit B.3, Attachment 3).
4. Status of the Widow Rockfish Resource in 2003 (Exhibit B.3, Attachment 4).
5. Rebuilding Analysis for Widow Rockfish in 2003 (Exhibit B.3, Attachment 5).
6. Widow Rockfish STAR Panel Meeting Report (Exhibit B.3, Attachment 6).
7. Status of Bocaccio Off California in 2003 (Exhibit B.3, Attachment 7).
8. Bocaccio Rebuilding Analysis for 2003 (Exhibit B.3, Attachment 8).
9. Bocaccio STAR Panel Report (Exhibit B.3, Attachment 9).
10. The Status of Black Rockfish (*Sebastes melanops*) Off Oregon and Northern California in 2003 (Exhibit B.3, Attachment 10).
11. Black Rockfish STAR Panel Report (Exhibit B.3, Attachment 11).
12. Cowcod Rebuilding Review (Exhibit B.3, Attachment 12).
13. Draft STAR Lite Panel Report (Exhibit B.3, Attachment 13).
14. Status of the Yellowtail Rockfish Resource in 2003 (Exhibit B.3, Attachment 14).
15. Darkblotched Rockfish Stock Assessment (Exhibit B.3, Supplemental Attachment 15).
16. Darkblotched Rockfish Rebuilding Analysis (Exhibit B.3, Supplemental Attachment 16).

Agenda Order:

a. Agendum Overview — John DeVore
b. Reports and Comments of Advisory Bodies
c. Public Comment
d. **Council Action:** Approve Stock Assessments and Rebuilding Analyses

PFMC
05/30/03

Exhibit B.5
Situation Summary
June 2003

STATUS OF GROUNDFISH FISHERIES AND INITIAL POLICY CONSIDERATION OF INSEASON ADJUSTMENTS

Situation: In the current groundfish management program, the Council sets annual harvest targets (optimum yield [OY] levels) and various management measures, with the understanding these management measures will likely need to be adjusted periodically through the year in order to attain, but not exceed, the OYs.

The Groundfish Management Team (GMT) will present information on the status of ongoing fisheries, and any need for adjustments in typical management measures, such as trip limits and seasons. The Council will also need to consider policy guidance on two other issues that could manifest a need for inseason adjustments. A policy decision at this initial stage is necessary so as to provide Advisory Bodies with the guidance necessary to prepare recommendations for appropriate adjustments. These two issues are: (1) the use of any new information from the observer program, with particular relevance to bycatch rates and; (2) the use of new stock assessment information being presented for use in the 2004 fishing year.

At the April meeting, the Council received a report from the Northwest Fisheries Science Center on the West Coast Groundfish Observer Program including the issues and schedule for incorporating the observer data into fishery management decision making. Compared with logbook-based bycatch rates originally used to model 2003 groundfish trawl specifications, observer-based bycatch rates generally show substantially higher estimated bycatch of some overfished species. In response, the Council recommended that bycatch results from the West Coast Groundfish Observer Program be incorporated into fishery management as soon as feasible. Preliminary program results for trawl fisheries were incorporated as new observer-based bycatch rates by the GMT when analyzing inseason adjustments at the April meeting. The Council is scheduled to consider the status of observer data implementation under agenda item B.2, there may be the need for a policy determination about the use of additional preliminary information for purposes of further inseason adjustments.

The Council is scheduled to approve stock assessments and rebuilding analyses for 2004 groundfish management under agenda item B.3. The stock assessment schedule for 2004 management is ambitious and covers seven species including species designated as overfished such as bocaccio, darkblotched rockfish, widow rockfish, and Pacific ocean perch. It is anticipated the results from some of these assessments may be substantially different from what is currently known about the status of these stocks. The Council needs to make a policy determination about wether stock assessment results prepared for management of fisheries in 2004 represent the best available science for inseason adjustment of fisheries in 2003.

The Council is to consider advice from Advisory Bodies and the public on observer program data, stock assessment results and recommended inseason adjustments to the groundfish fishery and adopt tentative changes as necessary. Review of the tentative changes and final adoption of inseason adjustments to 2003 groundfish management measures is scheduled for Wednesday, June 18 under agenda item B.8.

Council Action:

1. **Consider information on the status of ongoing fisheries.**
2. **Discuss and provide guidance on any new information provided from the observer program.**
3. **Discuss and provide guidance on whether stock assessments and rebuilding analyses for 2004 groundfish management represent the best available science for inseason adjustment of fisheries in 2003.**
4. **Adopt tentative inseason adjustments, if necessary.**

Reference Materials:

1. Exhibit B.5.d, Public comments received by May 30, 2003.

Agenda Order:

a. Agendum Overview — Mike Burner
b. Groundfish Management Team Report — Michele Robinson
c. Reports and Comments of Advisory Bodies
d. Public Comment
e. **Council Action:** Establish Guidelines for Consideration of Inseason Adjustments and Adopt Tentative Adjustments, If Necessary.

PFMC
06/02/03

STANDARDS AND CRITERIA FOR APPROVING EXEMPTED FISHING PERMITS

Situation: Exempted fishing permits (EFPs) allow fishing activities that would otherwise be prohibited. As an example, EFPs provide a process for testing innovative fishing gears and strategies to substantiate methods for prosecuting sustainable and risk-averse fishing opportunities. The Council has signaled its intent to make greater use of EFPs in the new groundfish management regime of depth restrictions and widespread area closures to reduce harvest of overfished species. However, there are potential drawbacks to significant EFP proliferation. Low optimum yields (OYs) for overfished species force hard allocation decisions between allowing immediate fleet-wide fishing opportunities in directed and incidental groundfish fisheries versus the longer term potential benefits ascribed to gaining new information from EFPs. Additionally, concerns were expressed about the need to manage the EFP approval process in a more timely manner and based on more explicit scientific criteria. For these reasons, the Council tasked the Groundfish Management Team (GMT) with recommending standards and criteria for approving EFPs.

The GMT recommended a draft Council Operating Procedure (COP) that prescribes a set schedule and other protocols for Council consideration in approving EFP applications at the April meeting. The Council approved the new COP but asked the GMT to reconsider a recommended timeline for reviewing and recommending EFPs that would better synchronize with the new Council process for setting specifications and management measures under multi-year management. The GMT has complied with the Council request for reconsidering the timeline and offers a Proposed Council Process for Consideration of Exempted Fishing Permits for Multi-Year Management (Exhibit B.6.b, GMT Report 2) and a Revised Proposed Council Operating Procedure: Protocol for Council Consideration of Exempted Fishing Permits for Pacific Coast Groundfish Fisheries (Exhibit B.6.b, GMT Report 3). The Council task at this meeting is to consider GMT recommendations for the EFP approval process and approve a new COP outlining a protocol for Council consideration of EFPs.

Council Action:

1. Adopt a new Council Operating Procedure of criteria and scientific standards for approving EFPs.

Reference Materials:

1. GMT Report on Standards and Criteria for Approving EFPs (Exhibit B.6.b, GMT Report 1).
2. Proposed Council Process for Consideration of Exempted Fishing Permits for Multi-Year Management (Exhibit B.6.b, GMT Report 2).
3. Revised Proposed Council Operating Procedure: Protocol for Council Consideration of Exempted Fishing Permits for Pacific Coast Groundfish Fisheries (Exhibit B.6.b, GMT Report 3).

Agenda Order:

a. Agendum Overview — John DeVore
b. Reports and Comments of Advisory Bodies
c. Public Comment
d. **Council Action:** Adopt Criteria and Standards for Approving EFPs

PFMC
06/02/03

FINAL ACTION ON GROUNDFISH INSEASON MANAGEMENT

Situation: Tentative adjustments to the 2003 groundfish management measures will be adopted as necessary by the Council under agenda item B.5 on Tuesday, June 17. These tentative adjustments will be reviewed by the Groundfish Management Team (GMT) and the Groundfish Advisory Subpanel (GAP). The Council is to consider advice from the GMT, the GAP, and the public on further refinements or changes and adopt final inseason adjustments to the 2003 groundfish management measures as necessary.

Council Action:

1. Consider and adopt final inseason adjustments, if necessary.

Reference Materials:

1. Supplemental reports may be provided by the GMT and the GAP.

Agenda Order:

a. Agendum Overview — Mike Burner
b. Reports and Comments of Advisory Bodies
c. Public Comment
d. **Council Action:** Consider and Adopt Inseason Adjustments, if Necessary

PFMC
06/02/03

Exhibit B.9
Situation Summary
June 2003

IMPLEMENTATION OF A VESSEL MONITORING SYSTEM

Situation: A Vessel Monitoring System (VMS) is a shoreside tracking system that allows shoreside personnel to remotely track vessel locations. Depth-based restrictions are a fundamental aspect of the current groundfish management regime but, fathom contours and management lines can be erratic in shape and difficult to follow and enforce, particularly in deep water. Therefore, the Council has recommended VMS measures be required in 2003 for groundfish fishery limited entry vessels.

The Ad Hoc VMS Committee met for the first time in Portland, Oregon on October 11, 2002 and drafted a range of alternatives for VMS implementation and NMFS prepared a draft Environmental Assessment (EA). The Council identified a preferred alternative at the October 28 - November, 2002 meeting and recommended that NMFS, in consultation with the Ad Hoc VMS Committee, prepare a proposed rule for a pilot VMS program for implementation at some point in 2003. The Ad Hoc VMS Committee reconvened at the Council office in Portland, Oregon on December 18, 2002 to review the Council recommendations, consider the content and language of the NMFS draft proposed rule, and discuss costs, performance and features of VMS equipment.

At the April Council meeting in Vancouver, Washington, a joint session of the GAP and the EC was held to discuss VMS issues. The session was well attended and discussions primarily centered on VMS related costs, coverage requirements for the smallest vessels, the need to have VMS transponders continuously operable regardless of the West Coast fishery in which the vessel participates, and restrictions on activities within the rockfish conservation areas. The GAP recommendation was to lengthen the public comment period to coincide with a Council meeting giving any attending advisory body the opportunity to review and respond to the proposed VMS regulations as a group. The Council recommended and NOAA Fisheries concurred to extend the public comment period for the proposed rule from 30 days to 60 days allowing the public comment period to coincide with the June Council meeting.

The proposed rule and EA are attached. NMFS is soliciting public input on the proposed rule during the 60-day open comment period. Written comments will be accepted by NMFS through July 21, 2003 and oral comments will be taken under agenda item B.9.c.

The Council is to consider advice from the Advisory Bodies and the public on the draft proposed rule and EA and make further recommendations to NMFS as necessary. The Council may also discuss next steps in the VMS implementation process.

Council Action:

1. **Consider the Environmental Assessment (EA), the Proposed Rule, and Make Recommendations to NMFS as Necessary.**
2. **Consider Next Steps in the Process and Provide Guidance as Necessary.**

Reference Materials:

1. Exhibit B.9, Attachment 1, Environmental Assessment/Regulatory Impact Review/Regulatory Flexibility Analysis for a Program to Monitor Time-Area Closures in the Pacific Coast Groundfish Fishery, NMFS, Northwest Region.
2. Exhibit B.9, Attachment 2, Proposed Rule on VMS, NMFS, Northwest Region.
3. Exhibit B.9.c, Public comments received by May 30, 2003.

Agenda Order:

a. Agendum Overview — Mike Burner
b. Reports and Comments of Advisory Bodies
c. Public Comment
d. **Council Action:** Consider the Environmental Assessment, the Proposed Rule, and Next Steps in Process - Make Recommendations as Necessary

PFMC
06/02/03

GROUNDFISH STOCK ASSESSMENT REVIEW PROCESS FOR 2005 THROUGH 2006

Situation: In November 2002, the Council approved a new multi-year process for implementing groundfish specifications and management measures. Groundfish management specifications and regulations will be adopted and implemented biennially with the first biennial management period being 2005 through 2006. As part of this new process, the Council will decide specifications and management measures during the course of three meetings beginning this November and culminating in final decisions in June 2004. Therefore, any new stock assessments and rebuilding analyses must be conducted and reviewed by a Stock Assessment Review (STAR) Panel prior to the November 2003 Council meeting if they are to be used for 2005-2006 groundfish management.

This agendum affords the Council, it's advisory bodies, and NMFS the opportunity to shape the details of how and when new stock assessments should be conducted and reviewed for the 2005-2006 management period. The Council's Scientific and Statistical Committee (SSC) is expected to recommend a new Terms of Reference for the groundfish stock assessment and review process for 2005-2006 management at this meeting. The Council is tasked with approving the process, including the details of which stocks are to be assessed and when STAR Panel reviews are to occur, as well as formally adopting a new STAR Terms of Reference.

Council Action:

1. **Approve a STAR process for use in the 2005-2006 management cycle.**
2. **Approve Terms of Reference for the 2005-2006 STAR process.**

Reference Materials:

1. Draft Terms of Reference for the Groundfish Stock Assessment and Review Process During 2005-2006 (Exhibit B.10, Attachment 1).

Agenda Order:

a. Agendum Overview — John DeVore
b. NMFS Report — Elizabeth Clarke
c. Reports and Comments of Advisory Bodies
d. **Council Action:** Approve Process and Terms of Reference

PFMC
06/02/03