The Status of Black Rockfish off Oregon and California in 2007

David B. Sampson
Professor of Fisheries

Oregon State University
Coastal Oregon Marine Experiment Station
and Department of Fisheries and Wildlife
Hatfield Marine Science Center
Newport, OR 97365

Email: David.Sampson@oregonstate.edu

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EXECUTIVE SUMMARY

Stock

This assessment applies to the black rockfish (*Sebastes melanops*) that reside in the waters south of Cape Falcon, Oregon and north of Point Piedros Blancos, California, corresponding to the Pacific Marine Fisheries Commission statistical areas 2C, 2B, 2A, 1C, and 1B. The assessment treats the black rockfish in this area as a unit stock. Wallace et al. (2007) separately assessed a northern stock, north of Cape Falcon to the US border with Canada, and determined that the spawning potential of that stock was above the management target (40% of the unexploited level). Black rockfish are also harvested from the waters off British Columbia and in the Gulf of Alaska, but there have not been any formal assessments of stock status for those areas.

Catches

Black rockfish are caught by a wide variety of gear types and can be an important component of nearshore commercial fisheries, either as incidental catch by the troll fishery for salmon or as directed catch by jig fisheries for groundfish. In recent years there have been almost no trawl-caught landings of black rockfish, but trawl landings in the past were fairly substantial. For the past several decades black rockfish have been an important target of recreational marine fisheries, especially during periods of reduced fishing opportunities for salmon or halibut. In recent years the recreational fishery has accounted for most of the black rockfish harvest.

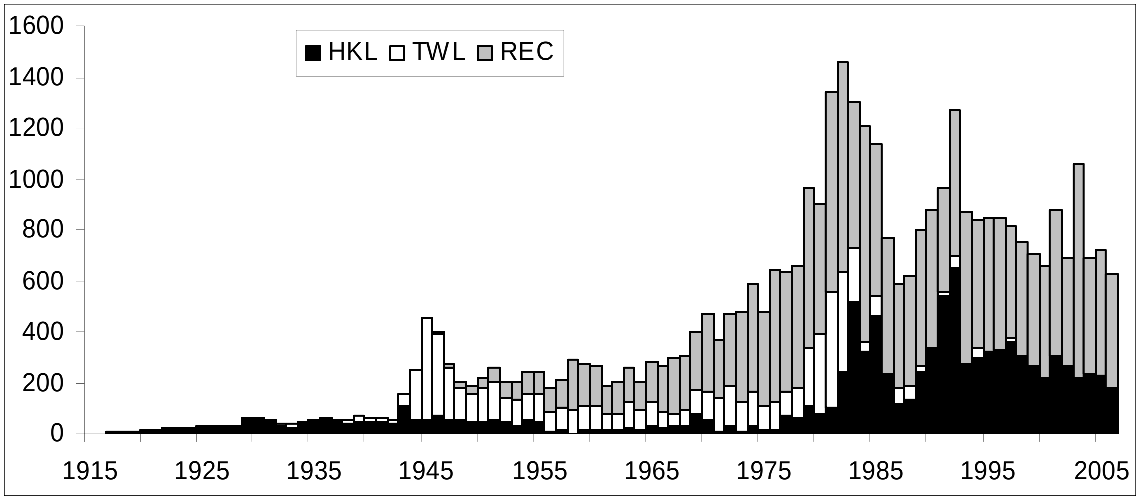
Detailed reports of commercial landings of black rockfish are generally unavailable prior to 1981, when the Pacific Fishery Information Network database began. The catch series prior to 1981 for this assessment were derived by applying assumed values for the percent black rockfish to reported landings of rockfish. The assessment assumes that total catch mortality is equal to the landed catch. Observer data, which are available only in recent years, indicate low levels of discarding of black rockfish.

Because of their nearshore distribution and low abundance compared to other rockfish species, black rockfish are unlikely to have ever comprised a large percentage of rockfish landings, but it seems quite certain that they have been more than a trivial component for many years. Black rockfish were one of only four rockfish species mentioned by scientific name in reports of rockfish landings in Oregon during the 1940s, and they were one of only six rockfish species mentioned by scientific name in reports of rockfish landings in California during the same period.

Recent landings of black rockfish (mt) in the southern assessment region.

	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
Oregon												
non-trawl	128.8	191.2	217.8	206.4	196.6	159.8	192.5	163.5	150.7	160.7	138.9	112.2
trawl	2.0	0.2	1.7	0.4	0.0	0.0	0.0	0.0	0.0	0.2	0.2	0.0
sport	350.8	376.8	343.6	339.6	282.5	308.2	329.3	270.2	341.2	330.8	309.6	259.8
California												
non-trawl	186.8	128.7	144.1	94.0	65.6	55.1	112.4	100.6	68.1	76.3	85.7	71.7
trawl	2.3	10.4	12.2	5.5	3.8	1.3	1.3	2.0	0.5	1.2	0.0	0.0
sport	176.5	143.2	94.9	108.7	154.7	131.0	240.4	152.7	500.4	117.3	183.3	183.5
Total	847.3	850.5	814.3	754.7	703.2	655.4	876.0	689.1	1060.9	686.5	717.7	627.2

Reconstruction of catches (MTs) of black rockfish in the southern assessment area.



Data and Assessment

The current assessment uses a similar approach and structure as the last assessment, which was completed in 2003. The assessment is structured into six fisheries: a set of trawl (TWL), commercial non-trawl (HKL), and recreational (REC) fisheries for Oregon and a similar set for California. The fisheries for each state are based on fish capture location rather than place of landings and therefore represent separate geographic areas. The model in this assessment, however, does not include any underlying spatial structure in the population dynamics. Like the previous assessment, abundance indices for tuning the assessment are based on recreational catch-per-unit-effort (CPUE) data with two independent indices available for each state. The standard research trawl surveys along the US West Coast do not operate in shallow enough water to catch appreciable numbers of black rockfish and therefore do not provide any fishery independent index of stock biomass for black rockfish. The current assessment has two additional abundance indices that were not available for the previous assessment: a black rockfish pre-recruit index for 2001-2006 and estimates from a tag-recapture study of exploitable black rockfish abundance off Newport, Oregon for 2003-2005. The current assessment uses the Stock Synthesis 2 software (version 2.00g), whereas the 2003 assessment used the Stock Synthesis 1 program.

Unresolved Problems and Major Uncertainties

The catch history for black rockfish is highly uncertain because this species was generally landed in mixed rockfish market categories, for which sampling to determine species composition was often very limited or non-existent. Trawl landings of rockfish accounted for the vast majority of commercial rockfish landings and received much more species composition sampling than non-trawl landings. However, trawl landings were essentially un-sampled prior to the 1970s. Even as recently as the 1980s, when species composition estimates were available for most of the trawl-caught rockfish, there were very low levels of species composition sampling of commercial non-trawl rockfish landings. Uncertainties in the estimated catch data were not directly incorporated into the uncertainty estimates for the assessment results. As a consequence, the estimated confidence limits for stock status estimates are too narrow. Sensitivity analyses using alternative assumed catch histories indicated that uncertainty in the catch series had relative little effect on the model's estimates of how depleted the stock is, but the level of catch had considerable influence on the model's estimates of the absolute size of the stock and its maximum sustainable yield (MSY).

The current assessment used the same sex- and age-specific formulation for natural mortality (M) that was used in the assessment for northern black rockfish, but there is little evidence to confirm that the assumed formulation is correct. Sensitivity analyses that explored different combinations of values of M for young versus old females indicated that the values have a strong influence on estimates of depletion, MSY, and other measures of stock status. Because the natural mortality coefficients were included in the model as fixed parameters, uncertainties in the coefficients do not propagate into the model's estimated confidence limits, which are narrower than they should be.

The current assessment uses a fixed value (0.6) for the so-called steepness parameter, which controls the curvature in the relationship between spawning biomass (output of larvae) and the resulting recruitment, and which thus governs how rapidly the stock responds to fishery removals or other perturbations. Although the steepness value assumed for this assessment is consistent with values estimated for other rockfish stocks, steepness for this stock could not be directly estimated from the available data. Sensitivity analyses indicated that the value assumed for steepness has a strong influence on the model's estimates of depletion, MSY, and other measures of stock status. Because steepness was a fixed parameter, the model's estimated confidence limits are narrower than they should be.

The recreational fishery CPUE indices may not be reliable as abundance indices for numerous reasons, including long-term changes in fishing gear and fishing locations, and due to the increasing influence of restrictive management actions in recent years. The ODFW tagging study off Newport offers a promising alternative source of information about stock size and exploitation rate. Further, this source of information appears to be much less subject to bias than a CPUE index. However, it is not clear how to scale measures of localized abundance and exploitation to the much broader stock assessment area. The stock could be locally abundant off Newport, as evidenced by the estimates of abundance and exploitation rate from the Newport tagging study, but in a depressed condition off central California. The current assessment model estimated a catchability coefficient for the tagging study, which represents the fraction of the exploitable population that resides within the tagging study area. The estimated value for this coefficient was reasonably consistent with informal prior expectations, but those expectations were predicated on an assumed spatial distribution for the black rockfish population. The assumed proportions of black rockfish in Oregon versus California may be incorrect.

The assessment estimates of current stock status are largely driven by above-average recruitment throughout the 1990s, including two very strong year-classes. The available age- and length-composition data provide little coherent evidence to support the variations in year-class strength. The model's estimates of year-class strength appear to be driven by subtle shifts from year to year in the leading edges of the length-composition data from the California recreational fishery. This fishery catches more small fish than the surveys or other fisheries. Because the model has selection curves that do not vary from year-to-year, the model tends to interpret shifts in the frequency of small fish as a recruitment signal, but the shifts could instead reflect changing selection due to variation in fishing patterns.

Because no age-composition or length-at-age data were available for the California fisheries, the assessment made the strong but untested assumption that the sex-specific growth curves for black rockfish were the same throughout the assessment region. The substantial differences in the general shape and appearance of the length-composition data from the recreational fishery in

California compared to Oregon, however, could be due to unequal growth curves in the two areas. The current assessment model accommodates the conflicting length composition data by means of very different selection curves for the two recreational fisheries, with peak selection in the California fishery occurring 6 cm smaller than peak selection in the Oregon fishery.

The final base model for the assessment was only partially "tuned" with respect to the model's fit to the mean length-at-age observations. That is, the level of "noise" in the mean length-at-age data that was input to the model was much less than the noise that the model internally ascribed to this data source. Further, the mean length-at-age data were very influential in determining the final set of model parameters and results. The mean length-at-age data, relative to many of the other data sources, were pulling the model towards a more productive stock. The tension between the mean length-at-age data and the other data sources could have been reduced with additional iterations of model tuning, which would have down-weighted the mean length-at-age data. However, doing so would have exaggerated some systematic but small discrepancies between the base model's estimates of mean length-at-age and the observations of mean length-at-age. The fully tuned model predicted that all fish older than about 10 yr were larger on average than what had been observed. This result seemed unreasonable. Because the assessment model is largely dominated by the length-composition data, and the model generates its predicted length-compositions by applying the growth curve to predictions of age-composition, it is crucial that the model have a reasonable growth curve. Tuning down the relative importance of the mean length-at-age data would have been appropriate if these data were considered to be unreliable, but in this instance the observations of mean length-at-age were based on length and age measurements from thousands of fish and should have been one of the more reliable data sources. The reason for the discrepancy between the mean length-at-age data and the other data sources remains unresolved, however.

Reference Points

For rockfish species managed by the Pacific Fishery Management Council (PFMC) the default target rate of fishing is F50%, which is the fishing rate that reduces the spawning potential ratio (SPR) to 50% of the level experienced in the absence of fishing. The Council's default harvest control rule for groundfish stocks specifies that a stock will be considered to be overfished if the stock's spawning output, often measured in terms of spawning biomass (SB), drops below 25% of the unexploited level, SB(0). In this assessment spawning output was measured in terms of millions of black rockfish larvae.

The base model from the current assessment estimated that the southern black rockfish stock can support a maximum sustainable yield (MSY) of about 1000 mt annually, but the accuracy of this estimate is highly dependent on the values assumed for the catch history, natural mortality, and steepness of the spawner-recruit relationship.

Management reference points for southern black rockfish.

	Point estimate	Uncertainty in estimates (approx. 95% confidence limits)	
Unfished Spawning Output (SB_0) (millions of larvae)	4578.5	3772.3	5384.7
Unfished Summary Age 2+ Biomass (B_0) (mt)	29099.6	na	na
Unfished Recruitment (R_0) at age 0 (1000s of fish)	7852.0	6459.2	9244.8
Reference points based on $SB_{40\%}$ and F50%			
Spawning Output at $SB_{40\%}$ (millions of larvae)	1831.4	1508.9	2153.9
SPR resulting in $SB_{40\%}$ ($SPR_{SB40\%}$)	0.5	none because steepness was fixed	
Exploitation rate resulting in $SB_{40\%}$	0.07227	na	na
Yield with $SPR_{SB40\%}$ at $SB_{40\%}$ (mt)	1035.4	853.1	1217.7
Reference points based on estimated MSY values			
Spawning Output at MSY (SB_{MSY}) (mill. larvae)	1444.6	1189.7	1699.5
SPR_{MSY}	0.4296	0.4288	0.4304
Exploitation Rate corresponding to SPR_{MSY}	0.08864	na	na
MSY (mt)	1064.6	877.1	1251.9

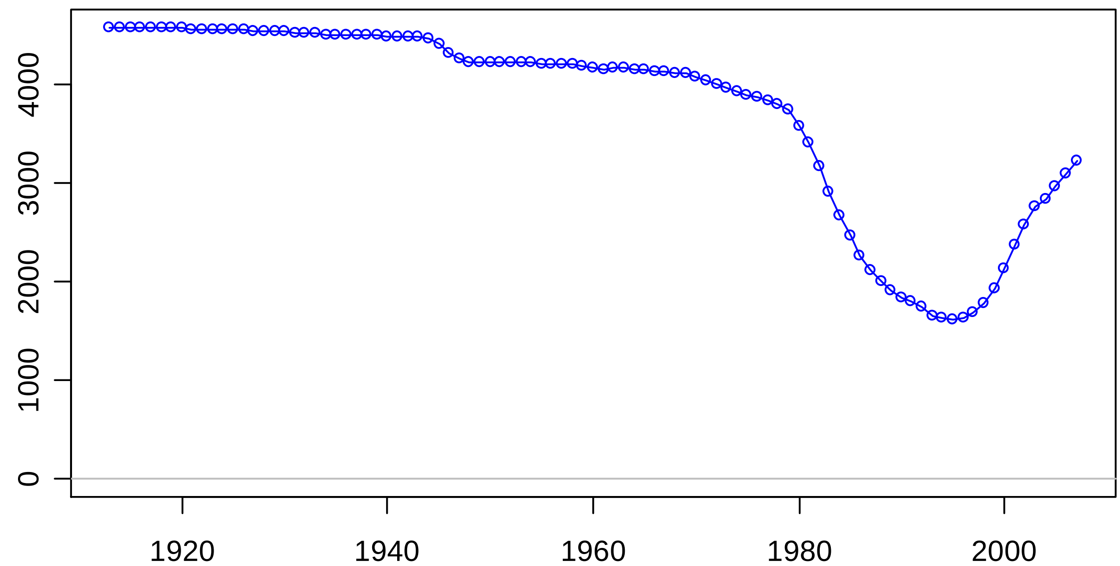
Stock Biomass

The base model estimated the unexploited spawning output to be about 4,600 million larvae and it estimated the spawning output at the start of 2007 to be about 3,200 million larvae, equivalent to 70% of the unexploited level. The model's estimates of spawning output and age 2+ biomass reached their lowest points in the mid 1990s and have been rising steadily since.

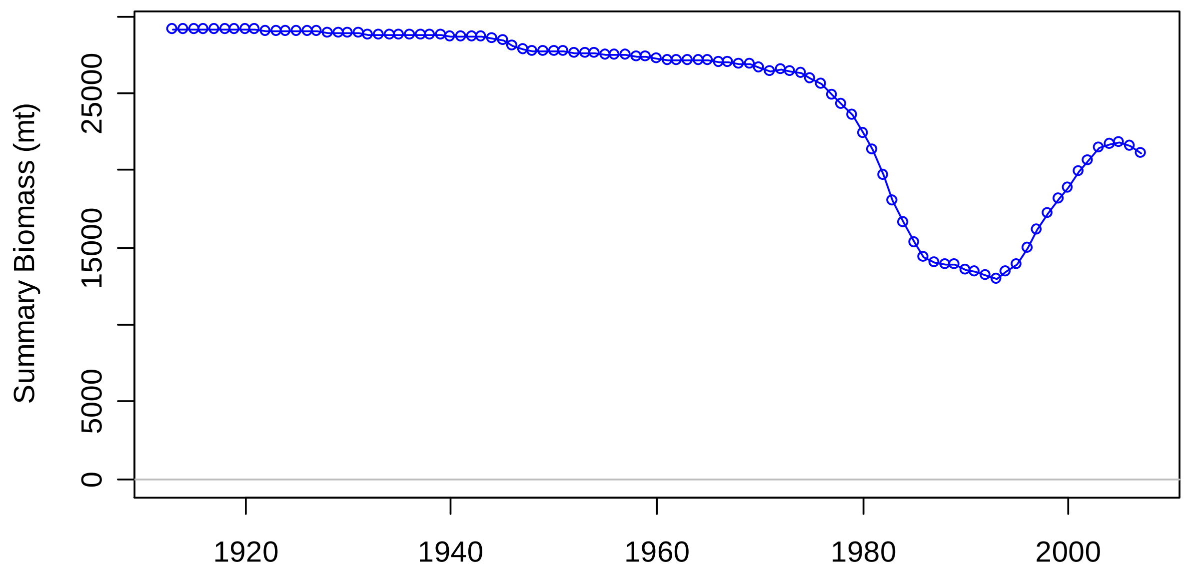
Recent trends in southern black rockfish spawning output, depletion, and biomass

	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
Spawning output (millions larvae)	1633	1684	1779	1924	2127	2375	2581	2760	2845	2970	3100	3227
% of Virgin	36%	37%	39%	42%	46%	52%	56%	60%	62%	65%	68%	70%
Age 2+ biomass (1000s mt)	14978	16105	17174	18133	18866	19946	20630	21475	21662	21775	21555	21109

Southern black rockfish spawning output (millions of larvae)



Age-2+ biomass for southern black rockfish



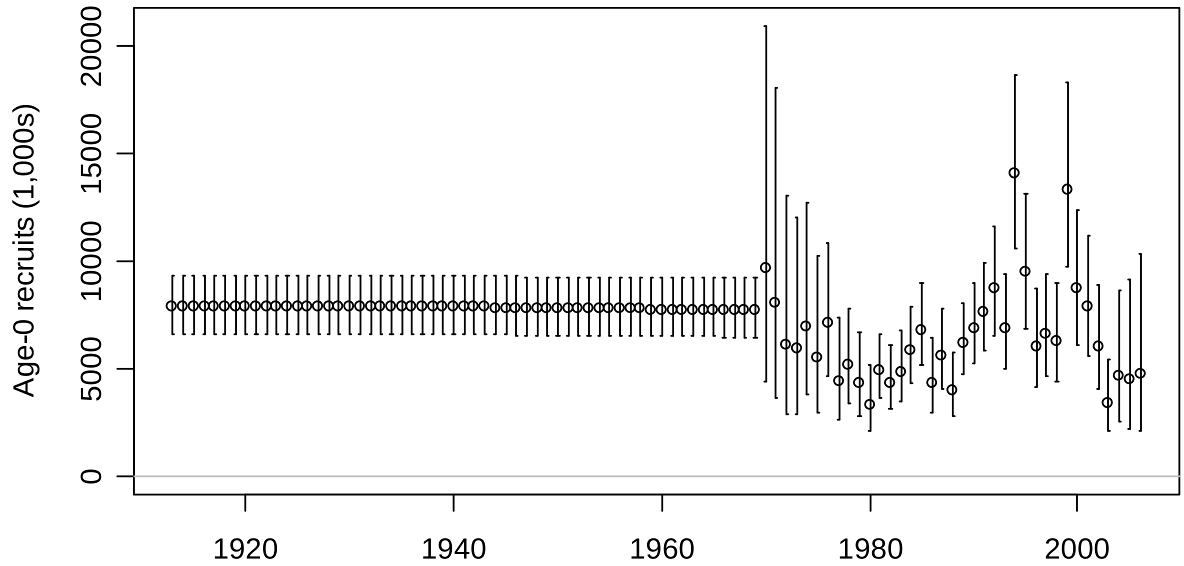
Recruitment

The above-average recruitment that occurred throughout the 1990s was the driver for the increases in spawning output and age-2+ biomass since the mid-1990s. The 1994 and 1999 year-classes were the strongest and second strongest estimated recruitment events in the series. Estimated recruitment for 2002 through 2006 was below average.

Recent trends in southern black rockfish recruitment

	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
Recruits (millions)	6007	6603	6270	13305	8678	7900	6013	3359	4681	4510	4700	7339

Age-0 recruitment for southern black rockfish
and approximate 95% confidence limits



Exploitation Status

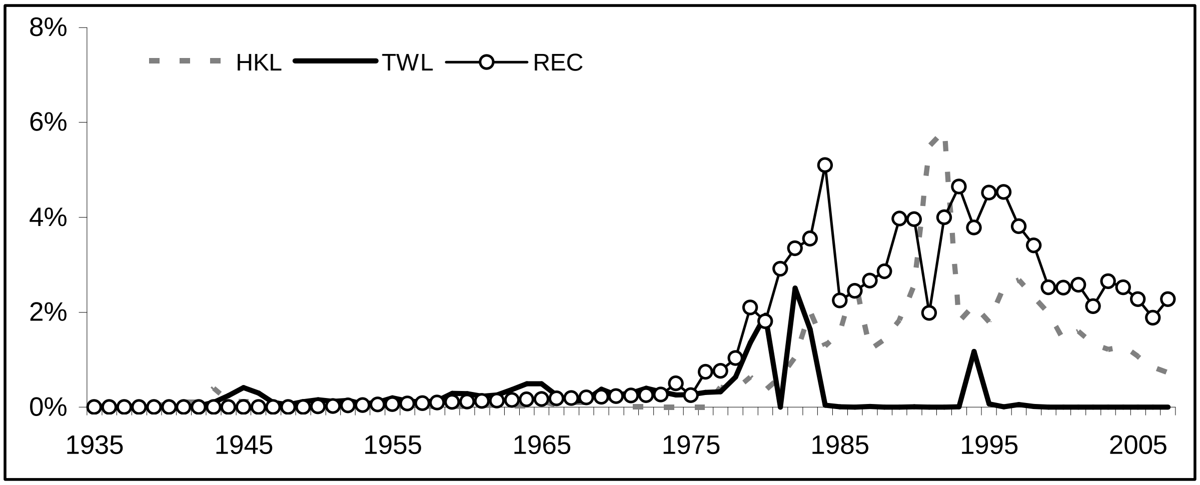
The harvest rates for black rockfish (catch over exploitable biomass) have generally been modest, with recent rates for individual fisheries generally being less than 3%. The peak estimated rate for any individual fishery was 6.6% by the California trawl fishery in 1981, when over 450 mt of black rockfish were landed in Eureka, CA (as reported in PacFIN). The recreational fisheries are now the dominant source of fishing mortality for black rockfish.

Recent trends in southern black rockfish harvest rate

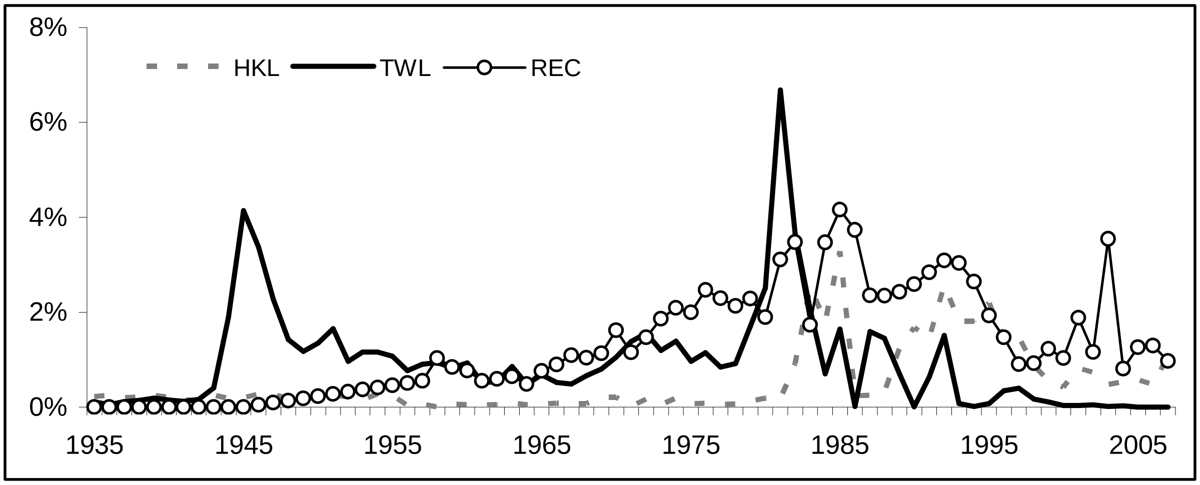
Fishery	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
Oregon												
non-trawl	2.5%	2.7%	2.3%	2.0%	1.4%	1.6%	1.3%	1.2%	1.3%	1.1%	0.8%	0.7%
trawl	0.0%	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
sport	4.5%	3.8%	3.4%	2.5%	2.5%	2.6%	2.1%	2.7%	2.5%	2.3%	1.9%	2.3%
California												
non-trawl	1.4%	1.5%	0.9%	0.5%	0.4%	0.8%	0.7%	0.5%	0.5%	0.6%	0.5%	1.1%
trawl	0.3%	0.4%	0.2%	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
sport	1.5%	0.9%	0.9%	1.2%	1.0%	1.9%	1.2%	3.5%	0.8%	1.3%	1.3%	1.0%
Total	5.6%	5.0%	4.3%	3.8%	3.4%	4.3%	3.3%	4.9%	3.2%	3.3%	2.9%	1.6%

Over most of the stock's history the fishing rate has been smaller than the F50% target fishing rate. The estimated spawning output has been above the target level (40% of unexploited) during all years except 1991 to 1998, and has never dropped below the overfished level (25% of unexploited).

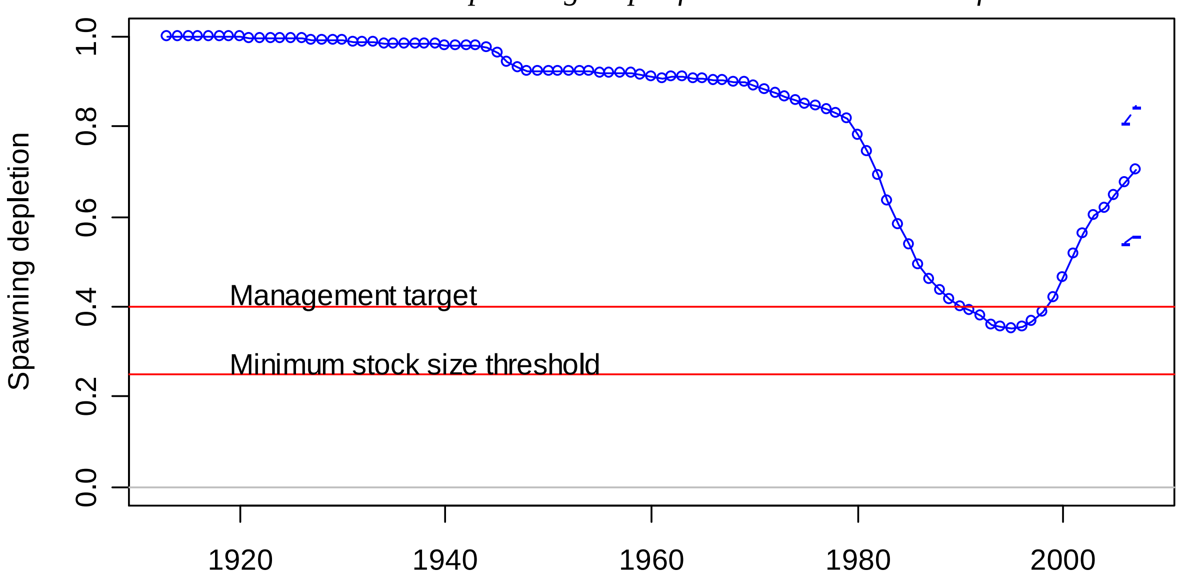
Harvest rates for southern black rockfish by Oregon fisheries



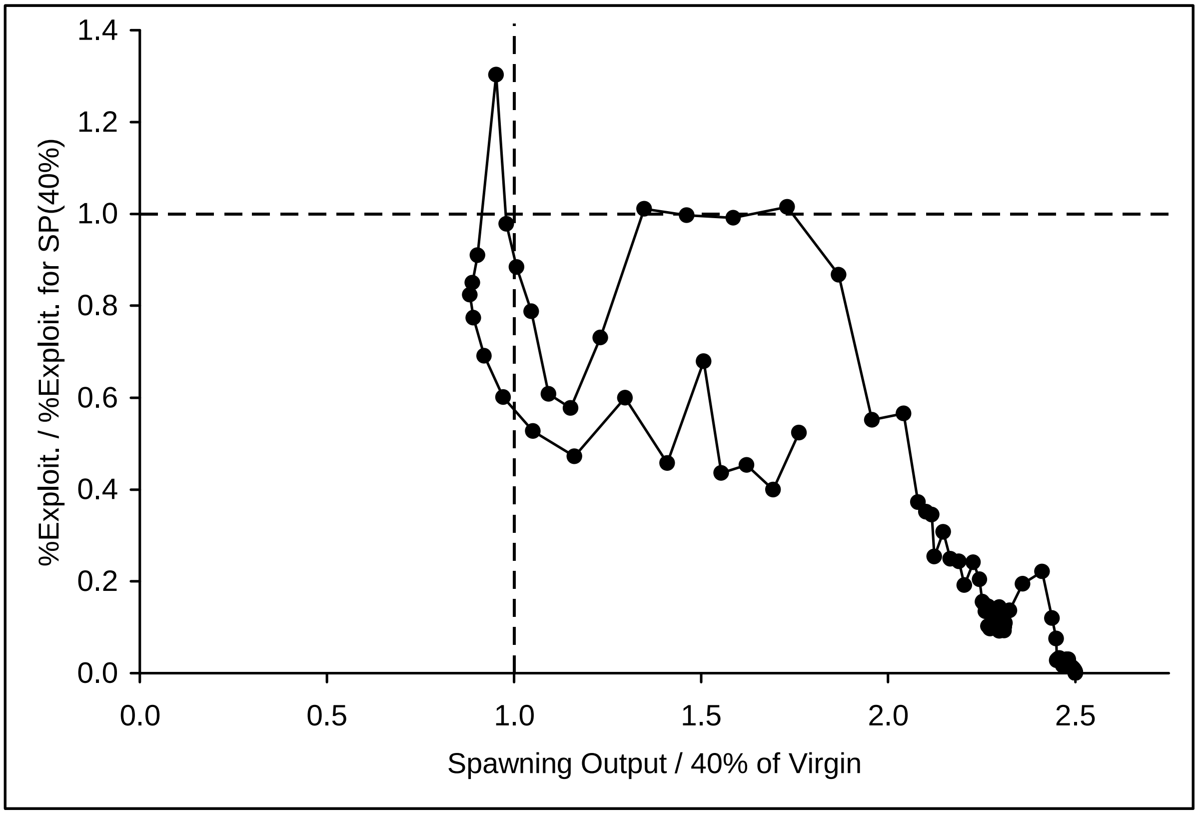
Harvest rates for southern black rockfish by California fisheries



Estimated relative spawning output for southern black rockfish



Evolution of exploitation rate and stock status for southern black rockfish



Management Performance

Prior to 2000 the Council managed black rockfish as part of the *Sebastes* complex and there were no separate ABC or OY values for black rockfish. For 2000 through 2003 the Council established ABC values for black rockfish caught north of Cape Mendocino, but left black rockfish south of Cape Mendocino as part of the "other rockfish" category, and without separate ABC or OY values. For 2004 the Council established a management boundary at the border between Oregon and Washington, and designated separate ABC and OY values for the two regions.

Management performance: black rockfish ABCs, OYs, and catches

	2000	2001	2002	2003	2004	2005	2006	2007
ABC = OY (mt)								
N of Cape Mendocino	1200	1115	1115	1115				
CA + OR					775	753	736	722
WA					540	540	540	540
Total	1200	1115	1115	1115	1315	1293	1276	1262
Catch (mt)								
S of Cape Falcon	655	876	689	1061	687	718	627	696
N of Cape Falcon	226	190	241	237	269	333	324	566
Total	882	1066	930	1298	956	1050	951	1262

Note: Catch values for 2007 were set at the Council's current OY values.

For all years with explicit ABC and OY values for black rockfish the estimated catches of black rockfish have been less than the ABC and OY values. In 2003 the estimated coast-wide catch exceeded the OY by 183 mt for the region north of Cape Mendocino, but 290 mt of this coast-wide catch was recreational harvest taken south of Cape Mendocino.

Forecasts

Projections of future catches through 2016 were made based on an F50% target rate of fishing mortality and the following assumptions:

- catches during 2007 and 2008 would be at the Optimum Yield (OY) levels specified by the Council (722 mt each year less an adjustment of 26 mt to account for catches from North of Cape Falcon);
- fishery selection curves estimated for 2006 and earlier years would continue unchanged into the future;
- 58% of each annual catch would be taken by Oregon fisheries, of which the Oregon recreational fishery would take 76% and the Oregon non-trawl fishery would take 26% (leaving Oregon trawl with no catch); and
- 42% of each annual catch would be taken by California fisheries, of which the California recreational fishery would take 55% and the California non-trawl fishery would take 45% (leaving California trawl with no catch).

Because the spawning output values for the projection period were always greater than the management target (40% of the unexploited level), the 40:10 harvest control rule adjustments did not apply, and the OY values were all equivalent to the Acceptable Biological Catch (ABC) values.

Forecasts of F50% Optimum Yields, spawning output, and depletion

	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Total catch (mt)	696	696	1454	1303	1203	1156	1146	1153	1163	1170
Spawning output (millions larvae)	3227	3293	3284	3077	2844	2616	2422	2277	2181	2122
% of Virgin	70.5%	71.9%	71.7%	67.2%	62.1%	57.1%	52.9%	49.7%	47.6%	46.3%

Decision Table

The decision table was developed with assistance from the STAR Panel. Although there are numerous dimensions of uncertainty regarding the results of this stock assessment, it was agreed that combining uncertainty in the formulation of natural mortality with uncertainty in the catch history could adequately capture the axis of uncertainty for the decision table. The three alternative states of nature were defined as follows.

- The least productive state of nature had a natural mortality coefficient (M) of 0.14 $^{-yr}$ for all males and for young females to age 10 yr, an M of 0.21 $^{-yr}$ for females 15 yr and older, and the catch history prior to 1981 for the trawl fisheries was based on low assumed values for the percentages of black rockfish in the landings of rockfish (0% in northern OR, 1.2% in southern OR, 3.6% in northern CA, and 0% in southern CA).

- The most productive state of nature had an M of 0.18^{-yr} for all males and for young females to age 10 yr, an M of 0.27^{-yr} for females 15 yr and older, and the catch history prior to 1981 for the trawl fisheries was based on high assumed values for the percentages of black rockfish in the landings of rockfish (0.4% in northern OR, 5.0% in southern OR, 14.0% in northern CA, and 0.2% in southern CA).
- The base-run model state of nature had a natural mortality coefficient (M) of 0.16^{-yr} for all males and for young females to age 10 yr, an M of 0.24^{-yr} for females 15 yr and older, and the catch history prior to 1981 for the trawl fisheries was based on the base-run assumed values for the percentage of black rockfish in the landings of rockfish (0.2% in northern OR, 2.5% in southern OR, 7.0% in northern CA, and 0.1% in southern CA).

The STAR and STAT agreed that the base-run model state of nature could be viewed as being twice as likely as the two alternative states of nature, and that the low-productivity and high-productivity states were equally likely.

Three alternative management actions were defined in terms of the stream of OY catches projected from each of the three alternative states of nature. The low productivity state of nature produced a stream of low catches, the high productivity state of nature produced a stream of high catches, and the base-model state of nature produced a stream of intermediate catches. The OY catch streams considered in the management actions of the decision table all have an abrupt increase in catch from 2009 to 2010 when the new stock assessment results first have an influence on the OY.

Southern black rockfish decision table.

Management Action		State of Nature: Low Productivity (mal-M=0.14, fem-M=0.21, low trawl catch; 25% probability)		Medium Productivity (mal-M=0.16, fem-M=0.24, medium trawl catch; 50% probability)		High Productivity (mal-M=0.18, fem-M=0.27, high trawl catch; 25% probability)	
Year	Catch	Spawning output	Depletion	Spawning output	Depletion	Spawning output	Depletion
Low Catch Series: F50% OY stream from the Low Productivity State							
2007	696	2160	53.0%	3227	70.5%	5660	91.9%
2008	696	2203	54.1%	3293	71.9%	5748	93.3%
2009	909	2195	53.9%	3284	71.7%	5710	92.7%
2010	831	2099	51.6%	3168	69.2%	5518	89.6%
2011	782	1981	48.6%	3015	65.9%	5258	85.4%
2012	765	1860	45.7%	2855	62.3%	4982	80.9%
2013	772	1756	43.1%	2714	59.3%	4737	76.9%
2014	789	1683	41.3%	2614	57.1%	4555	74.0%
2015	806	1641	40.3%	2556	55.8%	4446	72.2%
2016	819	1623	39.9%	2534	55.3%	4399	71.4%
Medium Catch Series: F50% OY stream from the Medium Productivity State							
2007	696	2160	53.0%	3227	70.5%	5660	91.9%
2008	696	2203	54.1%	3293	71.9%	5748	93.3%
2009	1454	2195	53.9%	3284	71.7%	5710	92.7%
2010	1303	2007	49.3%	3077	67.2%	5428	88.1%
2011	1203	1804	44.3%	2844	62.1%	5092	82.7%
2012	1156	1612	39.6%	2616	57.1%	4753	77.2%
2013	1146	1450	35.6%	2422	52.9%	4458	72.4%
2014	1153	1329	32.6%	2277	49.7%	4237	68.8%
2015	1163	1242	30.5%	2181	47.6%	4094	66.5%
2016	1170	1180	29.0%	2122	46.3%	4017	65.2%
High Catch Series: F50% OY stream from the High Productivity State							
2007	696	2160	53.0%	3227	70.5%	5660	91.9%
2008	696	2203	54.1%	3293	71.9%	5748	93.3%
2009	2660	2195	53.9%	3284	71.7%	5710	92.7%
2010	2333	1802	44.3%	2876	62.8%	5231	84.9%
2011	2112	1416	34.8%	2467	53.9%	4726	76.7%
2012	1994	1072	26.3%	2096	45.8%	4252	69.0%
2013	1945	796	19.5%	1791	39.1%	3854	62.6%
2014	1930	583	14.3%	1557	34.0%	3551	57.7%
2015	1925	415	10.2%	1380	30.2%	3339	54.2%
2016	1918	271	6.7%	1244	27.2%	3197	51.9%

Prioritized Research and Data Needs

- A comprehensive analysis of historic rockfish landings is needed to further refine the landings series for black rockfish and other rockfish species. The analysis should make consistent use of available species composition data and documented historical developments, such as the directed fisheries for Pacific ocean perch and widow rockfish.
- The ODFW tagging study off Newport should be continued and expanded to other areas. To provide better prior information on the spatial distribution of the black rockfish stock, further work should be conducted to map the extent of black rockfish habitat and the densities of black rockfish residing there.
- Age composition data should be developed for black rockfish caught commercially in California, and the data should be entered into the California commercial fishery database (CALCOM).
- If otoliths are available for black rockfish from the recreational fishery in California, they should be identified and read in a manner consistent with the processing of commercial fishery samples.
- A program should be established that routinely collects otoliths from black rockfish and other species harvested by the recreational fishery in California.
- Growth of black rockfish in California should be examined. The current assessment model assumes that black rockfish in California have the same growth curve as black rockfish in Oregon, but differences in growth could be an alternative explanation for the large differences in the length composition data between Oregon and California. Except for some published growth curves based on limited data, no length-at-age data are currently available for California.
- Additional age-reader comparisons should be conducted to resolve the apparent differences in mean length-at-age measurements between readers. Cross-validation experiments should be conducted with age-readers from Washington and California to confirm consistency in age-reading results.
- If otoliths are available from the older Oregon samples that were excluded from the current assessment, they should be re-read to extend the series of age composition data farther back in time.
- Length composition data, including gender, should be collected from the California fisheries to help better define the selection curves and the sex-specific natural mortality process. Currently all the length composition data from the California fisheries are combined-sex samples. Sex-specific length composition samples from the commercial fisheries in California would be particularly informative because these fisheries tend to catch larger black rockfish than the recreational fishery. The apparent lack of older females, which is evident in the age composition data from the Oregon recreational fishery, could be an artifact of the highly domed length-selection by the Oregon recreational fishery.

Rebuilding Projections

The southern stock of black rockfish is estimated to be well above the overfished level. No rebuilding is required.

Regional Management Concerns

Estimating how much of a stock's exploitable biomass should be assigned to separate management areas is an extremely challenging problem given the data currently available. This new assessment for the southern stock of black rockfish included considerable exploration of an area-based assessment model that split the assessment region into two latitudinal areas in Oregon and two areas in California. Each area had its own separate age-structured population and local fisheries, but the areas were linked by their pooled contribution to spawning biomass and the resulting recruits. With this spatial model one could have looked for regional differences in productivity and localized depletion. Unfortunately, despite considerable time and modeling effort, the STAT was unable to find a model configuration that produced stable and plausible results with the available sets of data. The fundamental problem seemed to be the lack of any reliable data to distribute recruiting fish to the different areas. The catch-per-unit-effort indices that are available for black rockfish on a regional basis may provide reliable measurements of trends in fish densities within each region, but they do not provide a good basis for gauging the distribution of fish between regions. If catch-per-angler-day in region A is double the catch-per-angler-day in region B, it is incorrect to assume that there are twice as many fish in region A, even if the relationship between catch rates and fish densities is an exactly consistent. The abundance of fish in the two areas depends not only on the relative fish densities, but also on the spatial extent of the fishing grounds in the two areas. If trawl survey estimates of swept-area biomass had been available for black rockfish, those data might have provided a consistent basis for the area-based model to apportion recruitment to the separate areas. With the data available for black rockfish, however, it did not appear feasible to go forward with the area-based model. Instead, the Oregon and California region was modeled as a single assessment area.

Summary Tables

Management reference points for southern black rockfish.

	Point estimate	Uncertainty in estimates (approx. 95% confidence limits)	
Unfished Spawning Output (SB_0) (millions larvae)	4578.5	3772.3	5384.7
Unfished Summary Age 2+ Biomass (B_0) (mt)	29099.6	na	na
Unfished Recruitment (R_0) at age 0 (1000s of fish)	7852.0	6459.2	9244.8
Reference points based on $SB_{40\%}$			
Spawning Output at $SB_{40\%}$ (millions of larvae)	1831.4	1508.9	2153.9
SPR resulting in $SB_{40\%}$ ($SPR_{SB40\%}$)	0.5	none because steepness was fixed	
Exploitation rate resulting in $SB_{40\%}$	0.07227	na	na
Yield with $SPR_{SB40\%}$ at $SB_{40\%}$ (mt)	1035.4	853.1	1217.7
Reference points based on F50% proxy for MSY			
Spawning Output at SPR (SB_{SPR}) (mill. larvae)	1831.4	1508.9	2153.9
$SPR_{MSY\text{-}proxy}$	0.5		
Exploitation rate corresponding to $SPR_{MSY\text{-}proxy}$	0.07227	na	na
Yield with $SPR_{MSY\text{-}proxy}$ at SB_{SPR} (mt)	1035.4	853.1	1217.7
Reference points based on estimated MSY values			
Spawning Output at MSY (SB_{MSY}) (mill. larvae)	1444.6	1189.7	1699.5
SPR_{MSY}	0.4296	0.4288	0.4304
Exploitation Rate corresponding to SPR_{MSY}	0.08864	na	na
MSY (mt)	1064.6	877.1	1251.9

Note: The reference points based on SB40% are equivalent to the reference points base on the F50% proxy for F(MSY) because the steepness parameter was fixed at 0.6. When steepness is 0.6, fishing at F50% reduces spawning output to 40% of the unexploited level.

Recent trends in estimated exploitation and stock levels for the base model for southern black rockfish	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
Landings (mt)										
Northern assessment region	337	226	226	190	241	237	269	333	324	566
Southern assessment region	755	703	655	876	689	1061	687	718	627	696
Coastwide	1092	929	882	1066	930	1298	956	1050	951	1262
Estimated Discards (mt)	0	0	0	0	0	0	0	0	0	0
Estimated Total Catch (mt)										
Northern assessment region	337	226	226	190	241	237	269	333	324	566
Southern assessment region	755	703	655	876	689	1061	687	718	627	696
Coastwide	1092	929	882	1066	930	1298	956	1050	951	1262
ABC = OY (mt)										
N of Cape Mendocino			1200	1115	1115	1115				
CA + OR							775	753	736	722
WA							540	540	540	540
Total			1200	1115	1115	1115	1315	1293	1276	1262
SPR	0.6468	0.6931	0.7302	0.6654	0.7292	0.6191	0.7413	0.7366	0.7649	0.7414
Exploitation Rate (total catch/summary biomass)	0.0439	0.0388	0.0347	0.0439	0.0334	0.0494	0.0317	0.0330	0.0291	0.0165
Summary Age 2+ Biomass (B) (mt)	21206	22210	23003	21576	22989	20519	23242	23134	23764	23232
Spawning Output (*SB*) (millions of larvae)	1779	1924	2127	2375	2581	2760	2845	2970	3100	3227
~95% Confidence interval	1218	1305	1435	1596	1714	1817	1839	1902	1966	2031
	2340	2542	2819	3155	3448	3702	3851	4039	4234	4422
Recruitment at age 0	6270	13305	8678	7900	6013	3359	4681	4510	4700	7339
~95% Confidence interval	3989	8989	5544	5057	3612	1701	1695	1149	780	-174
	8552	17621	11812	10744	8414	5018	7667	7871	8619	14853
Depletion (SB/SB0)	0.3885	0.4201	0.4645	0.5187	0.5637	0.6027	0.6214	0.6488	0.6771	0.7047
Uncertainty in Depletion estimate	na	na	na	na	na	na	na	na	na	na

Introduction

Black rockfish (*Sebastes melanops*) are an important component of the commercial and recreational fisheries in the nearshore waters off central and northern California, Oregon, and Washington and they range as far north as Amchitka and Kodiak islands in Alaska. Adults tend to occur in schools over rocky structure at depths less than 40 fathoms, and sometimes feed actively on or near the surface. They feed on a wide variety of prey including zooplankton, krill, mysids, sandlance, and juvenile rockfish (Love 1969), and are subject to predation by lingcod and marine mammals. Although tagging studies have documented some individuals moving long-distances (several hundreds of miles), the vast majority of recaptured individuals were found close to the areas of initial capture and tagging (Culver 1987, Ayres 1988, Starr and Green 2007).

Like all members of the genus *Sebastes* black rockfish have internal fertilization and bear live young approximately two months after insemination. Black rockfish are quite fecund, with a six-year-old female annually producing about 300,000 embryos and a 16-year-old producing about 950,000 embryos (Bobko and Berkeley 2004). Parturition of larvae occurs during winter (Wyllie-Echeverria 1987) and larvae and small juveniles are pelagic for several months to a year (Boehlert and Yoklavich 1983). Settlement occurs in estuaries, tide-pools, and in the nearshore at depths less than 20 m (Stein and Hassler 1989). Black rockfish begin recruiting to nearshore fisheries at 3-4 years of age, corresponding to a fork length of about 25-30 cm, and 50% of females attain maturity at about 6-8 years, corresponding to a fork length of about 38-42 cm. Adult female black rockfish grow 3-5 cm larger than males, with a few females attaining fork lengths greater than 55 cm.

Stock Structure

Recent assessments of black rockfish off Washington (Wallace et al. 1999, 2007) describe a study of coastal black rockfish genetic structure using 10 samples collected from northern California to southern British Columbia during 1995-97. Results of that study support the notion of separate genetic stocks north and south of Cape Falcon. However, a later study (Baker 1999) of black rockfish collected from eight sites along the northern Oregon coast concluded that black rockfish from north and south of Cape Falcon were genetically very similar. The previous assessment of black rockfish off Oregon and California (Ralston and Dick 2003) reviewed the evidence supporting genetic stock structure for black rockfish and other rockfish off the US West Coast. That assessment concluded that the Oregon and California populations of black rockfish are probably not genetically heterogeneous, and the assessment treated the black rockfish off California and Oregon as a unit stock.

Although it seems reasonable to draw a stock boundary line at the Columbia River, both because it is a state fishery management boundary and because the Columbia River plume is likely to be a natural barrier to the north-south exchange of black rockfish adults and larvae, the current assessment differs slightly from Ralston and Dick (2003) in placing the northern boundary at Cape Falcon rather than at the Columbia River. The boundary was changed to avoid overlap with the separate northern assessment (Wallace et al. 2007) and to simplify the process of assembling commercial landings data, which are largely available in terms of Pacific Marine Fisheries Commission (PMFC) statistical areas. The northern boundary of PMFC Area 2C is at Cape Falcon (Fig. 1). Given the spatial resolution of the available commercial fishery data, it is very problematic to estimate the catch of black rockfish taken north of Cape Falcon but south of the Columbia River.

The Fisheries for Black Rockfish

Black rockfish are harvested by a wide variety of fishing methods including trawling, trolling, and hook and line fishing with jigs and long-lines. Although black rockfish have never been a dominant component of any commercial fisheries, they are important as incidental catch in the troll fishery for salmon and the troll and jig fisheries for groundfish. With the decline of salmon fishing opportunities in late 1970s and early 1980s black rockfish became a vital target of marine recreational fisheries in Oregon and Washington, especially during periods of restricted or slack fishing for salmon, halibut, and tuna. Black rockfish are also an important component of the recreational fisheries in northern California but are of less significance south of Cape Mendocino due to their reduced prevalence compared to other species. Since 1990 recreational harvests of black rockfish have averaged about 300 tons annually off Oregon and about 200 tons annually off California. Commercial harvests during the same period averaged about 200 tons annually by non-trawl gear types in Oregon and about 120 tons by non-trawl gear types in California. Harvests by trawl on average during this period have been less than 10 tons annually for both states combined.

Management History and Performance

Prior to 2000 Pacific Fishery Management Council (PFMC) managed the fishery for black rockfish as part of the *Sebastes* complex, with no separate Acceptable Biological Catch (ABC) or Optimum Yield (OY) for black rockfish. In 2000 the Council established an ABC of 1,200 mt for black rockfish caught north of Cape Mendocino (in the Eureka, Columbia, and Vancouver INPFC statistical areas), but left black rockfish south of Cape Mendocino as part of the "other rockfish" category. For 2001 through 2003 the ABC for black rockfish caught north of Cape Mendocino was 1,115 mt annually, and black rockfish south of Cape Mendocino remained part of the "other rockfish" category and without a separate ABC or OY.

Regulation of the black rockfish fisheries prior to 2004 was accomplished primarily by trip limits for commercial fisheries and bag-limit restrictions for recreational fisheries, with different limits applying in different geographic regions (Table 1, from Ralston and Dick, 2003, with slight modification). Some important changes that occurred include the following.

- In 2000, black rockfish began to be managed as a minor nearshore species. Commercial trip-limits were significantly reduced, with specific restrictions applying to black rockfish. California instituted seasonal closures for commercial and recreational fisheries inside 20 fathoms, reduced the bag limit for rockfish from 15 to 10 fish, and limited recreational gear to one line with three hooks.
- In 2002, California adopted a Nearshore Fishery Management Plan and began more active management of nearshore fisheries including the use of seasonal, regional, and depth-specific closures. Oregon adopted an Interim Nearshore Fishery Management Plan in anticipation of increased pressure on nearshore stocks due to reduced fishing opportunities for groundfish in federal waters.
- In 2003, the Council established Rockfish Conservation Areas to control catches of overfished rockfish species, and large portions of the shelf were closed to fishing. In California the commercial and recreational fisheries for rockfish were closed early.
- In 2004, the sport fishery in Oregon closed in September due to early attainment of the state's limit for sport-caught black rockfish. This was the first time that the sport rockfish fishery in Oregon had not been open all year. In 2005 it closed early again.

In 2004 the coast wide ABC established for black rockfish was based on the projected yields derived from separate northern (Wallace et al. 1999) and southern (Ralston and Dick 2003) stock assessments. The northern assessment covered the Washington coast and the northernmost portion of Oregon, from Cape Falcon to the WA/OR border at the Columbia River. The southern assessment covered the entire Oregon coast and the California coastline north of Point Arena. To account for the spatial overlap of the two assessment areas, 12% of the projected yield from the northern assessment was transferred to the southern region when deriving the coast wide ABC and OY values of 1,315 mt for 2004. State-by-state Harvest Guidelines were established: 326 mt for California, 450 mt for Oregon, and 540 mt for Washington. A similar approach was taken in 2005 and 2006 and the OY for the area south of the Columbia River was apportioned to Harvest Guidelines for California and Oregon based on a 42:58 split. The basis for this apportionment is unclear.

Year		ABC	OY	Catch
2000	Black rockfish – N. of Cape Mendocino	1,200	na	
	Black rockfish – coast wide			881
2001	Black rockfish – N. of Cape Mendocino	1,115	na	
	Black rockfish – coast wide			1066
2002	Black rockfish – N. of Cape Mendocino	1,115	na	
	Black rockfish – coast wide			930
2003	Black rockfish – N. of Cape Mendocino	1,115	na	
	Black rockfish – coast wide			1298
2004	Black rockfish – OR and CA	775	775	687
2005	Black rockfish – OR and CA	753	753	717
2006	Black rockfish – OR and CA	736	736	627

In all years when there has been an OY specified for black rockfish the estimated catch has been less than the OY, except for 2003 when the estimated coast wide catch exceeded the ABC for north of Cape Mendocino. In 2003 the estimated coast-wide catch exceeded the OY by 183 mt for the region north of Cape Mendocino, but 290 mt of this coast-wide catch was recreational harvest taken south of Cape Mendocino.

The Historical Fishery

A significant issue in the most recent assessment of black rockfish, completed in 2003, was its treatment of catch history. Because of concerns about the effects of initial equilibrium assumptions on the level of depletion estimated by the preliminary base model, the 2003 Stock Assessment Review (STAR) panel worked with the Stock Assessment Team (STAT) to develop a catch history that avoided the need to assume historical catch and equilibrium conditions in the first year of the assessment. The assumed catch reconstruction began in 1946, ramping up from zero in 1945 and all prior years. In hindsight, this may not have been a good assumption, as indicated by the following text from Cleaver (1951) that describes catches of rockfish from 1941 to 1949 in Oregon.

> "The rockfish are caught by otter trawl and long-line gear. The principal species caught by the otter trawl are the black rockfish (*Sebastodes melanops*); green or yellow-tail rockfish (*S. flavidus*); red or orange rockfish (*S. pinniger*); and rosefish (*S. alutus*). …

> The landings of rockfish (all species) rose rapidly during the war from 1,301,400 pounds in 1941 to a peak of over 17,000,000 in 1945. Subsequently the landings fell rapidly because of decreased demand and leveled off at about 4,000,000 per year in 1949."

Cleaver also states, in an introductory section on Bottom Fisheries, that the "otter trawl fishery accounts for at least 95 percent by weight of the bottom fish landings."

That black rockfish is one of only four species that Cleaver identifies as composing the large landings of rockfish in Oregon during the War years suggests that black rockfish were not a trivial fraction of the large catches taken during the 1940s. One might also suppose that the otter trawl fishery took a large portion of the landings of black rockfish. Cleaver's statements are certainly at odds with the catch reconstruction developed in the previous assessment.

It seems that black rockfish were also landed in appreciable quantities in California during the 1940s. Black rockfish was identified by scientific name as one of the "half-dozen of the larger and more abundant species [that] make up over half of the annual California commercial poundage landed …" (Anon. 1949).

A major task for the current assessment was developing a plausible reconstruction of historical landings of black rockfish and exploring the consequences of those landings.

ASSESSMENT DATA

Landings

The systems along the US West Coast for monitoring commercial fishery landings in the past did not keep track of the landings of individual rockfish species, largely because many rockfish species have similar market characteristics and therefore were landed as an unsorted mix of species. Black rockfish in particular, which are a nearshore species and much less abundant than many of the offshore rockfish species, were generally landed in mixed-species categories. As a consequence the historical records do not provide a detailed accounting of the landings of black rockfish. The basic approach taken in this assessment to develop the landings series was to apply values for the percentage of black rockfish to the reported landings of rockfish. Data on the percentages of black rockfish, however, are sparse, with the consequence that the landings reconstruction is very uncertain.

The landings data series (Table 2, Fig. 2) was assembled from five primary sources: the Pacific Fishery Information system (PacFIN) for 1981 to 2006; the Pacific Marine Fisheries Commission (PMFC) landings data series for 1956 to 1980; Fishery Statistics of the U.S. for 1927 to 1955; the Oregon Department of Fish and Wildlife's (ODFW) Ocean Recreational Boat Survey for 1979 to 2006 (provided by D. Bodenmiller, ODFW); and the Recreational Fishery Information system (RecFIN, http://www.recfin.org/). Data from California Department of Fish and Game (CDFG) Commercial Passenger Fishing Vessel (CPFV) logbooks for 1957 to 2006 (provided by D. Aseltine-Neilson, CDFG) were also used in an auxiliary manner to derive estimates of rockfish landings prior to 1980, the start of the RecFIN series.

The different landings data sources differ in their level of detail regarding location where the catches were taken and regarding the method of capture. It seemed impossible to resolve the catch locations for the entire data series to any scale finer than PMFC statistical area. Therefore, for this assessment the data were initially partitioned into four geographic areas, A to D, corresponding to PMFC areas 1B, 1C, 2A plus 2B, and 2C (Fig. 1). The spatial separations were maintained during data compilation because preliminary explorations of the data indicated important differences between areas in terms of the historical changes in rockfish landings and because of likely differences among areas in the percentages of black rockfish in the landings of generic rockfish. For input into the stock assessment model the landings data were aggregated into two sets corresponding to the states (OR=A+B, CA=C+D). Regarding capture methods, the data were partitioned into three "gear" groups: trawl (TWL), commercial non-trawl (referred to as HKL, hook and line, in the tables and figures of this document), and recreational (REC). The stock assessment model and data were thus partitioned into six fisheries.

The PacFIN Era – 1981 to 2006

The PacFIN system provides estimates of rockfish landings by species for those strata (year, quarter, port, area, gear type, and market category) that have species composition data available to apportion the landings to species. If no species composition data are available, the system reports the landings as the nominal species or as the mixed-species category, depending on how the landings were originally reported. The amount of unspecified rockfish that cannot be apportioned to species varies by year, area, and gear type. In many instances the landings of unspecified rockfish reported by PacFIN are quite substantial.

The landings data series for black rockfish landed in California and Oregon during 1981 to 2006 were assembled from two PacFIN data sets. The first PacFIN data set (Table 3) consisted of direct PacFIN estimates of black rockfish landings by PMFC area, which PacFIN derives from fish tickets, species composition estimates, and trawl-logbooks provided to PacFIN by ODFW and CDFG. Almost comparable data are available for fish landed at Washington ports, but the PacFIN system does not provide landings estimates by PMFC area for landings at Washington ports. The Washington Department of Fish and Wildlife (Farron Wallace) provided estimates of commercial fishery landings during the PacFIN era of black rockfish harvested off Oregon and California by vessels landing at ports in Washington (Table 4). These landings totaled only 3.5 mt for the period 1981 to 2006.

The other PacFIN data set (Table 5) was derived from landings of rockfish for which species composition sample estimates were unavailable, but which might feasibly contain some black rockfish. This derivation involved applying estimates of the percentages of black rockfish (%Black) to the landings of unspecified rockfish. Estimates of the percentages of black rockfish among the landings of unspecified rockfish were developed by area and gear-group from the first PacFIN data set, for which species composition sample estimates were available. In the PacFIN series prior to 1990 for Oregon there were almost no species composition data for the non-trawl gear types; in later years the species composition data for this gear type were limited. To develop annual estimates of %Black for Oregon, the data from the two Oregon areas (A+B) were pooled and an average estimate was developed for the early years by using all data available for the early years and also by "borrowing data" from the early 1990s (Fig. 3). The final values for black rockfish landings by year and area were the sum of the original PacFIN estimates, to which were added the nominal landings of black rockfish (listed as black rockfish on fish tickets but not verified by sampling) and the estimates of black rockfish in the unspecified rockfish landings. The landings of black rockfish estimated directly by PacFIN were about 25% greater than the amounts derived from the unspecified rockfish plus the nominal black rockfish.

The landings series during the PacFIN era are quite erratic, sometimes exhibiting large variations between years. While these changes could be a true reflection of changing fishing patterns, they may be no more than artifacts of low levels of species composition sampling. A recent study of the groundfish landings estimates for California (Pearson et al. 2007) evaluated the reliability of species composition sampling for various rockfish species. The study noted that black rockfish are easily readily misidentified as blue rockfish, that the hook and line fishery in California was not well sampled until the 1990's, and that many of the California landings estimates are based on "borrowed" data or by treating the black rockfish market category as "pure".

The PMFC Era – 1956 to 1980

The landings data series for black rockfish during 1956 to 1980 were derived primarily from the Pacific Marine Fisheries Commission (PMFC) data series on rockfish landings (all rockfish species) (Table 6). This data series shows considerable variation between areas in the level of landings and in the timing of peak landings. Because landings for the non-trawl gears were not reported in the PMFC series prior to 1971, values for these years were derived by applying the ratio of non-trawl to trawl landings of rockfish reported in the US Fishery Statistics series, which included landings by gear and area of landing. For some years at the end of the series the landings data were taken from state landings reports (documented in footnotes to Table 7).

The US Fishery Statistics Era – 1927 to 1955

The landings data series for black rockfish during 1927 to 1955 (Table 7) were derived from a compilation of rockfish landings data (all rockfish species) from the annual series of Fishery Statistics of the United States. This data source, unlike the PMFC data series, does not indicate catch locations, but it does tabulate the landings data to broad geographic regions where the landings occurred. The Oregon data are divided into a Columbia River versus coastal region, and the California data are sectioned into three relevant regions: a northern region; a San Francisco region, and a Monterey region. For this assessment, the rockfish landings at Oregon coastal ports were apportioned 50:50 to areas A and B, and 10% of the rockfish landings at Columbia River ports were apportioned to area A. The remaining 90% of landings at Columbia River ports was assumed to be taken north of the geographic range covered by this assessment. The landings reported for northern California ports were assigned to area C, and the landings reported for the San Francisco and Monterey regions were assigned to area D. The rockfish landings in the southern California region were assumed to not contain any black rockfish. This is consistent with contemporary landings data, which indicate almost no landings of black rockfish south of PMFC Area 1B.

The Fishery Statistics series provides total landings of rockfish and the trawl-caught landings of rockfish each year, as well as a more detailed breakdown by various gear-types for every fifth year. For this assessment trawl-caught rockfish landings were assigned to the TWL gear-type, and the difference between the total rockfish landings and the trawl-caught landings were assigned to the HKL gear-type.

The commercial fishery landings data series for black rockfish prior to 1927 were extended back to zero in 1915, based on linear interpolation.

Foreign Fishery Catches of Black Rockfish

Rogers (2003) developed catch reconstructions for removals by foreign trawlers operating off the US West Coast during the late 1960s to mid 1970s. Although this study reports that Japanese vessels operating in the Columbia and Eureka statistical areas (Oregon and northern California) caught substantial catches of black rockfish, with cumulative catches of more than 500 tons over

10 years, it seems very unlikely that foreign vessels could have operated sufficiently close to shore to catch appreciable quantities of black rockfish. This assessment does not include Rogers' estimates of black rockfish removals.

Assumed Percentages of Black Rockfish in Landings Prior to 1981 (PacFIN)

For the base-run model the rockfish landings were apportioned to black rockfish by applying assumed values for the %Black by area and gear-type that were derived from species composition data from the PacFIN era. For the non-trawl gear the percentages of black rockfish by area were simple ratio estimates of the PacFIN black rockfish landings during 1992-99 over the PacFIN estimates of "speciated" rockfish landings: 26% in area A; 28% in area B; 40% in area C; and 1.2% in area D. For non-trawl gear the estimates of %Black were reasonably stable during this period (Fig. 3). For the trawl gear the percentages of black rockfish by area were declining during the early PacFIN era and were essentially zero during later years in all areas except C (Fig. 3). It seemed inappropriate to use average values from the PacFIN era as available information from prior to 1980 (next section) indicated that the %Black in the trawl rockfish landings were sometimes quite large. The assumed values of %Black for trawl were 0.2% in area A, 2.5% in area B, 7% in area C, and 0.1% in area D.

Alternative Percentages of Black Rockfish in Commercial Landings Prior to 1981

There are few data available to suggest what would be reasonable values for the percentage of black rockfish in the rockfish catch prior to the PacFIN era. Although I could not find any information on the %Black by non-trawl gear, I was able to find three reports on the %Black by trawl. Data from these reports are not used directly in the assessment, but were used to inform my best guess regarding values to use for the %Black.

Nitsos (1965) presented results of species-composition samplings from trawl catches of rockfish landed at major California ports from Eureka to Santa Barbara during 1962 and 1963. Black rockfish comprised 15.1% and 10.4% of the sampled landings at Eureka during 1962 and 1963, and they comprised 2.1% and 0.1% of the sampled landings at San Francisco during 1962 and 1963. No black rockfish were sampled at the other ports. Of the sampled rockfish landings at Eureka the percentage that was black rockfish is 12.3%. Of the rockfish landings at the other sampled ports (excluding Santa Barbara, which is south of the area covered by this assessment), black rockfish comprised 0.4%.

Niska (1976) summarized results of species composition samplings from trawl catches of rockfish landed in Oregon during 1963-71, which were landed as either nominal Pacific ocean perch (POP) or as "other rockfish". Few to no black rockfish were in any of the sampled landings of nominal POP, and very small percentages were present in the sampled landings of other rockfish. Black rockfish were 1.3% of the sampled other rockfish landings during 1963, 0.85% during 1964, 9.74% during 1965, 11.3% during 1966, 16.2% during 1967, 7.3% during 1968, 12.5% during 1969, 21.0% during 1970, and 10.9% during 1971. For those years with the larger reported percentages (1965-71), most of the apparent catches of black rockfish were taken from the area between Cape Elizabeth and Cape Lookout, and would probably have been from north of the current assessment region.

Douglas (1998) revised the analysis of Niska (1976) to apportion catches to PMFC areas and updated the analysis to include information through 1981 on species composition samplings from trawl catches of rockfish landed in Oregon. For the catch regions relevant to the current assessment (PMFC areas 2A, 2B, and 2C), essentially no black rockfish were in any of the sampled landings of nominal POP, and the percentages in the sampled landings of other rockfish were highly erratic, attaining values as high as 58% and 100% for two very lightly sampled strata. The overall ratios by PMFC area of black rockfish over the landings of other rockfish varied from 2.9% to 5.0%.

Oregon Sport Fishery Landings – 1950 to 2006

The Oregon Ocean Recreational Boat Survey (ORBS) provided estimates for 1973 to 2006 of the numbers of black rockfish harvested by recreational anglers fishing from boats in ocean waters off Oregon (Table 8). Estimates of catches from north of Cape Falcon, the northern boundary for the assessment region, were excluded from the tabulation. These were fish landed in Astoria and 28% of the fish landed at Garibaldi. Landings by other segments of the sport fishery (e.g. shore-based or in estuaries) were derived from an estimate of the average percentage of the black rockfish landed in Oregon by the ocean boat fishing modes (96.2%, based on RecFIN estimates of catch by mode). Landings in metric tons for 1980-2006 were derived using the annual estimated average weights of black rockfish landed in Oregon, obtained from RecFIN. For earlier years the tonnage was based on the average weight from 1980-84.

Over 40,000 black rockfish were harvested from each of areas A and B during 1973. To provide for a gradual building of the sport fisheries in these areas, the numbers of fish caught annually during 1950 to 1972 were filled in by linear interpolation, starting from assumed sport harvests of zero in 1949.

California Sport Fishery Landings – 1945 to 2006

Estimates of the numbers of black rockfish caught by sport fishers in California during 1980 to 2006 were obtained from RecFIN, with supplemental information provided by California Department of Fish and Game (CDFG, D. Wilson-Vandenberg) for 1993-96, when the catch of black rockfish by commercial passenger fishing vessels (CPFV) was not included in the RecFIN estimates (Table 9). The estimated black rockfish catches for 1990-92 were derived by linear interpolation from catches during 1989 and 1993. The Marine Recreational Fisheries Statistics Survey, which provides RecFIN with the basic sample data, was unfunded during 1990-92. Landings in metric tons for 1980-2006 were derived using the annual estimated average weights of black rockfish landed in California, obtained from RecFIN. For earlier years the tonnage was based on the average weight from 1980-84.

The CDFG Commercial Passenger Fishing Vessel (CPFV) logbooks for 1957 to 1982 provided the basis for estimating the annual landings of black rockfish during years prior to 1980. Landings for 1957-79 were the rockfish numbers reported in the CPFV logbooks times 0.329, which is the ratio (RecFIN black rockfish, 1980-82) over (CPFV logbook rockfish, 1980-82). The logbook series did not include reported landings of rockfish in the assessment area prior to 1957, but the rockfish landings reported for 1957 were substantial (almost 300,000 fish). To provide for a gradual building of the sport fishery in California, the numbers of black rockfish caught annually were derived by interpolation, starting from assumed sport harvests of zero in 1945.

There is little information with which to evaluate the reconstructed California recreational catch of black rockfish. Miller and Gotshall (1965) sampled the recreational marine fishery during 1958 to 1961 and estimated that the sport fishery during this period landed 64,167 black rockfish annually. In constrast, in the catch reconstruction based on the CPFV logbook data (Table 9) the average annual catch of black rockfish during this period was almost 140,000 fish.

Alternate Historical Landings Series

To evaluate the sensitivity of the assessment results to the catch history reconstructions, alternative values for the percentages of black rockfish were applied to the commercial rockfish landings series to generate high (Table 10) and low catch series (Table 11) by gear type and state. The following table shows the assumed values for %Black that were used with the commercial landings.

	A:OR-N	B:OR-S	C:CA-N	D:CA-Central
Non-trawl				
Low	19.5%	21%	30%	0.9%
Base	26.0%	28%	40%	1.2%
High	32.5%	35%	50%	1.5%
Trawl				
Low	0%	1.2%	3.6%	0%
Base	0.2%	2.5%	7.0%	0.1%
High	0.4%	5.0%	14.0%	0.2%

The percentage values shown above do not represent an exact analysis but instead are meant to reflect some general patterns that seem evident in the available %Black observations and to provide plausible ranges of values.

For each state's sport fishery the alternative landings were generated by multiplying the base-line landings times a fixed percentage: 75% to generate the low alternative landings and 125% to generate the high alternative.

Estimated Discards

Estimates from the Northwest Fisheries Science Center's (NWFSC) West Coast Groundfish Observer Program (provided by J. Hastie, NWFSC) of discards of black rockfish in the commercial fisheries indicated very low levels of discarding (less than 1% in 2004, and 1 to 1.5% in 2005). Estimates from the ORBS program of discards of black rockfish in the Oregon sport fishery, based on data collected by observers on charter boat trips, also indicated low levels of discarding, 2% to 3% in 2002 and 2003 but increasing in more recent years when bag limits were lower. This assessment assumes that there are negligible amounts of dead discards of black rockfish, and applies no adjustment to the landings data for discards or unreported landings. Given the large uncertainty in the %Black values used to generate most of the landings estimates, there seemed little purpose to adjusting for small amounts of discards.

Biological Parameters and Data

Maturity-at-length and Fecundity

This assessment uses the logistic formulation developed in the last assessment for the maturity versus length relationship. The assumed length at 50% maturity is 39.53 cm and the slope coefficient is 0.4103 cm^{-1}. Ralston and Dick (2003) derived this relationship by blending information from Wyllie-Echeverria (1987) on the maturity of black rockfish from northern California with information from Bobko and Berkeley (2003) for fish sampled in Oregon.

Similarly, this assessment, like Ralston and Dick (2003), assumes that weight-specific fecundity is linearly related to female body weight according to the following:

$$larvae / kg = 289{,}406 + 103{,}076 \cdot weight\ (kg)\ .$$

This relationship was derived from laboratory counts of fertilized eggs from several hundred female black rockfish collected in Oregon, as described in Bobko and Berkeley (2003).

Length-weight Relationship

This assessment used the length-weight relationship developed for the 2003 assessment, which was based on length and weight measurements from almost 4,000 individual black rockfish collected by ODFW staff:

$$weight = 0.00001677 \cdot length^{3.00}\ ,$$

where weight is measured in kg and length is fork length in cm. The 2003 assessment reported no statistically significant differences between males and females.

Length-at-age

Length and age data are available for large numbers of black rockfish caught by the sport fishery in Oregon; limited data are also available for fish caught commercially in Oregon. However, as noted in the STAR Panel report for the 2003 assessment, plots of mean length-at-age by year (e.g., Fig. 4) indicate changes that suggest inconsistent age reading. Alternatively, the apparent variations in mean length-at-age could indicate changes in growth.

To investigate this further, average length-at-age data were examined for individual age-readers, including an ANOVA to determine whether there were significant differences among readers in their determinations of length-at-age. All the data examined were from fish captured during 1996-2005. The database does not identify the age-readers prior to 1996. Plots of the data indicate substantial differences among some readers in their average length-at-age measurements (Fig. 5). The ANOVA and subsequent pair-wise comparisons among readers indicated a set of four readers whose measurements were mutually consistent and significantly different from the other four readers. These readers produced length-at-age estimates that were consistent from year to year (Fig. 6). For this assessment only age-readings from this set of standard age-readers were used for developing data series on age composition and mean length-at-age.

The length-at-age data from the set of standard age-readers were used to derive a set of von Bertalanffy growth curve parameters for possible use in the stock assessment model (Fig. 7). Fully separate curves were fitted for each sex using non-linear least-squares, but when the data were fitted instead with a model in which the sexes had the same length at age-3 there was insignificant degradation in fit. The following parameter values were estimated:

Length-at-age-3:	30.00 cm	both sexes
Length-at-age-20:	45.86 cm	females
Growth coefficient, k:	0.2104 yr^{-1}	females

Length-at-age-20:	42.62 cm	males
Growth coefficient, k:	0.2428 yr^{-1}	males

This curve is provided for reference purposes only. In the stock assessment model the growth parameters were freely estimated, but with both sexes having the same length at age-3-yr.

No raw length-at-age data were available from the recent commercial or sport fisheries in California, but data from 186 black rockfish collected off central California between Monterey and Morro Bay during 1978-85, are presented in Lea et al. (1999). The average total length of the 63 age-4-yr fish was 29.6 cm, equivalent to a fork length of about 28.9 cm. The average total length of the four age-11-yr fish was 50.4 cm, equivalent to a fork length of about 49.4 cm. Compared to the length-at-age data from Oregon, the data from California imply that the fish there may not have growth that is comparable to that observed off Oregon. Based on the Oregon length-at-age data an age-4-yr black rockfish (without regard to gender) should have a fork-length of about 33 cm on average, and an age-11-yr fish should have a fork-length of about 42 cm.

Variability in Length-at-age

The length-at-age data from the set of standard age-readers were also used to derive estimates of the variation in length-at-age (Fig. 8). For both males and females the variation in length-at-age tends to decline more or less linearly with either age or length. The preliminary stock assessment model assumed that the coefficient of variation in length-at-age varies linearly with length, from 11% at age-3 to 7% at age-20 for females and to 5% at age-20 for males. During the October STAR meeting this assumption was re-evaluated and the growth model specification for the final base-run model was changed to have a constant 7% coefficient of variation.

Age-reading Error

To help inform this assessment, age-readers at the ODFW were asked to participate in a double-read experiment where both age readers were given the same set of 150 otoliths to read, all of which had previously been read by other readers. These double-reads were used to develop estimates of age-reading error standard deviations by age (Fig. 9), which were fitted by regression through the origin to develop a vector of age-reading error standard deviations for use in the stock assessment model.

Natural Mortality

The previous assessment of black rockfish used different rates of natural mortality on males versus females to account for the lack of older females in fishery samples. The assumed instantaneous rate of natural mortality (M) was 0.12 yr^{-1} and was constant with age for males. For females M was also 0.12 yr^{-1} but only up to age 10, after which there was a step change in M to 0.2 yr^{-1}. This assessment uses a slightly different formulation, which was developed during the May 2007 STAR Panel review. For fish less than 10 years the value of M is 0.16 yr^{-1} for males and females, and remains constant with age for males. For females between 10 and 15 years M increases linearly with age, and for females older than 15 years M is constant at 0.24 yr^{-1}.

The oldest black rockfish from age-readings by the standard set of Oregon age-readers were two 29-year-old males, and the oldest female black rockfish was 26 years old. These maximum age observations suggest that there should not be a large difference in mortality between females and males. The maximum ages are consistent with instantaneous total mortality rates of 0.14 to 0.16 yr^{-1}. However, a plot of the percent female versus age shows the same distinct decline with age in the percentage of females by age, starting from 50% at about age 10, which is a feature noted in the last assessment for southern black rockfish and in the assessment for northern black rockfish.

Size and Age Composition Data

Fish length measurements, primarily from the recreational fishery, are one of the major sources of data for this assessment. Length composition data from the commercial fisheries in Oregon and California were also included, as were some age composition data from the commercial and recreational fisheries in Oregon.

A large proportion of the length composition data were from the Marine Recreational Fishery Statistics Survey (MRFSS), which is a federally funded program operating since 1980 that collects information on the marine sport fisheries. The MRFSS program includes an intercept survey in which sport anglers are interviewed as they return from fishing trips, and where samplers can identify and measure the retained catches. The MRFSS sampling is intended to cover all forms of marine recreational fishing, including shore-based activities from beaches, jetties, and piers. In contrast the ORBS program that operates only in Oregon interviews and samples anglers operating from boats. The MRFSS length data, which are housed in the RecFIN system, generally do not indicate the sex of individual fish that were measured. The length and age data collected by the ORBS program are the only data used in the assessment where gender is recorded.

Processing of the RecFIN length data involved expanding the numbers of fish that were measured to account for fish that were observed and counted during the interviews but not measured. The expanded frequencies were then tabulated by Year, Mode, Wave (bi-monthly period), and State. In the version of the assessment that was reviewed by the late-May STAR panel, these first-stage expanded lengths compositions were further expanded by RecFIN estimates of the numbers of black rockfish landed by Year, Mode, Wave, and State. However, because very small samples from some strata had been expanded to represent very large estimated landings, the expansion process for some years resulted in extremely ragged length composition estimates. For this version of the assessment, strata with less than five fish lengths were excluded from the tabulations and no second-stage expansion was applied to the RecFIN length composition data.

For combining length (or age) data from ORBS and commercial fishery samples the individual sample data from a strata were expanded by the estimated numbers of fish in that strata to produce weighted average estimates of length (or age) composition.

Length and Age Sample Sizes

The level of commercial fishery sampling for black rockfish has been erratic, with almost no samples taken in Oregon until the early 1990s (Table 12). In California there was a shift from trawl to non-trawl samples, which in part reflects the growing importance of hook-and-line fishing in the nearshore and the development of a fishery for live fish. Sampling of the recreational fisheries in Oregon and California by the MRFSS program has been reasonably consistent except for the hiatus during 1990-92 when the program was not funded. The standard MRFSS sampling program stopped in 2003 in Oregon and in 2004 in California, at which time the states assumed larger roles in sampling their recreational fisheries. This resulted in some loss of continuity in the sampling processes.

In the length-composition sample size table for Oregon, the samples listed in the column "Rec-2" were limited to the port of Garibaldi until 1990, at which time ODFW began collecting samples of sport-caught black rockfish from most of the other ports. The average size of the fish sampled prior to 1990 is generally higher than the fish sampled after 1990, probably due to the very limited geographic coverage of the early sample data.

The age-composition data from the set of standard age-readers is limited to the years 1996 to 2005, with most of the age-readings coming from fish collected from the Oregon recreational fishery by the ORBS program (Table 13). Biological sampling by the ORBS program has tended to focus on the charter boat fleet, with the consequence that the age- and length-composition data collected by ORBS probably are not fully representative of fish landed by anglers aboard privately owned boats.

<u>Multinomial Sample Sizes</u>

Initial input values for the multinomial samples sizes determine the relative weights applied in fitting the annual composition data within the set of observations for each fishery. The initial input values in this assessment were based on the following equation developed by I.Stewart and S.Miller (NWFSC), and presented at the 2006 Stock Assessment Data and Modeling workshop.

Effective N = [(0.138*FPS + 1)*NS .... if FPS < 44

Effective N = 7.06 * NS .... if FPS >= 44

where FPS denotes the average number of fish measured per sample and NS denotes the number of samples.

Tuning of the assessment model involved multiplying the input sample sizes for each fishery by an adjustment factor to achieve a better balance between how well the model fit the set of composition data and how well it should have fit the data given the sample sizes underlying the data.

Length Compositions

The length data for the assessment model were tabulated into 2-cm length bins ranging from 20 cm to 60 cm, with accumulator bins at each end (Fig. 10). During the October STAR meeting the data were restructured to include a dummy length bin for fish less than 20 cm. For the data tabulation provided in this document (Table 14), the accumulator bins were extended to compress and simplify display of the data.

The length composition data indicate some general differences between the three fishery types, with the trawl fisheries producing the largest fish, the recreational fisheries producing the smallest fish, and the non-trawl fisheries producing fish of intermediate length. There is little evidence in any of the length-composition data of distinct modes or successions of modes from one year to the next that might represent strong year-classes.

The recreational fishery length-composition data from Oregon are generally quite symmetrically distributed, whereas the recreational fishery length-composition data from California are often quite asymmetric, with an extended shoulder having modest numbers of large fish. However, the data for the first few years of the California series are similar in general shape to the Oregon recreational length-composition data.

Sample length-composition data from the California sport fishery for 1999 and 2000 were excluded from the assessment model because they had very narrow distributions and were extremely different from adjacent years. Close examination of the raw data did not indicate any obvious reason for the odd appearance of these length-compositions.

Age Compositions

The fishery age-composition data for the assessment model consisted of otolith age-readings, mostly from the recreational fishery and only from Oregon (Fig. 11). The age-composition data for the assessment model were tabulated into 1-yr age bins from 1 to 25 years. For the data tabulation provided in this document (Table 15), the accumulator bins were extended to compress and simplify display of the data.

The age-composition data generally do not show much evidence of distinct year-classes that can be easily tracked from one year to the next, which suggests that that there is not much recruitment variability from year-to-year or that age-reading error is sufficient to mask the appearance of strong year-classes.

Mean Weights from Species Composition Sampling Programs

Length- or age-composition data are needed to inform the assessment model about the selection characteristics of the fisheries and surveys. There are very few such data available for the commercial fisheries. To supplement the sparse composition data series, annual average weights were developed from data on sample weights and numbers of black rockfish, information collected routinely as part of the species composition sampling programs in Oregon and California. The data indicate substantial differences in mean weight between the trawl and non-trawl fisheries, with the trawl fisheries landing fish that are about 0.5 kg heavier on average than the fish landed by the non-trawl fisheries (Fig. 12).

Abundance Indices

Age- and length-composition data by themselves do not provide sufficient information to reliably determine trends in stock abundance and biomass. Most assessments of US West Coast groundfish stocks rely on estimates of stock biomass from research trawl surveys to provide information on biomass trends.

Sport Fishery Catch-per-Unit-Effort

Black rockfish mostly occur in nearshore waters, and are rarely taken in the standard National Marine Fisheries Service (NMFS) bottom trawl surveys. The primary tuning indices available for this assessment are ones based on recreational catch-per-unit-effort. This assessment takes an approach similar to that used in the previous assessment for deriving standardized indices of abundance, and uses the same basic data: interview data from RecFIN (Type-3 records) in all areas on catch-per-angler-day; aggregated interview data from ORBS on catch-per-angler-day in Oregon; and data from observers aboard commercial passenger fishing vessels (CPFV) on catch-per-angler-hour off central California.

The RecFIN CPUE Indices

Because sport anglers target a wide variety of species, many fishing trips are very unlikely to ever encounter a black rockfish. The lack of any catch of black rockfish during these trips provides no information on the relative abundance of black rockfish, and these trips should not be included in a catch-rate analysis for black rockfish. To restrict the set of RecFIN data to trips that are likely to have encountered black rockfish, the multispecies analysis developed by Stephens and MacCall (2004) was used to select a subset of the RecFIN data for developing a CPUE index. The analysis applies a logistic regression to trip-level data on the presence or absence of the target species (black rockfish) based on presence or absence data for a suite of other species that occur with reasonable frequency in the catch and effort data set. The resulting logistic regression coefficients for each of the other species provide a measure of the likelihood of catching the target species, given that the other species were caught. Positive coefficients imply a greater likelihood of catching the target species. Separate analyses were done for the data from Oregon and California, and only data from ocean charter boats were used. Data from private boats were excluded because it seemed likely that private anglers would have less consistent fishing patterns than charter boat operators, and would therefore provide noisier information.

For the RecFIN data from Oregon, the logistic regression analysis to select likely black rockfish trips was based on data from 9,120 trips and a suite of 21 species (excluding black rockfish). The analysis generally produced large positive coefficients for shallow-water species that one would expect to co-occur with black rockfish (e.g., tiger rockfish and copper rockfish), and large negative coefficients for deepwater species that one would not expect to co-occur with black rockfish (e.g., Pacific halibut and Chinook salmon) (Table 16). Those trips having an estimated probability of producing a black rockfish that exceeded the cut-off value of 0.68 were selected for the CPUE analysis. This cut-off value was chosen to balance the false-positives against the false-negatives and resulted in 493 trips that were estimated to be false positives, where black rockfish were caught, but should not have been, given the other species caught during those trips. These probably represent trips that fished in multiple locations, and thus caught a mix of shallow- and deepwater species. The screening also resulted in the inclusion of 495 trips (false negatives) that should have caught black rockfish (given the other species), but did not. A total of 5,836 trips were selected for the CPUE analysis.

The analysis for the RecFIN data from California, which was based on 9,089 trips and 29 species, identified that black rockfish are likely to be caught in association with black and yellow rockfish and gopher rockfish, whereas they are unlikely to be caught on trips that land sablefish or chilipepper rockfish (Table 17). Trips were selected for the CPUE analysis if the estimated probability of producing a black rockfish exceeded a cut-off of 0.42, which resulted in the exclusion of 782 trips that were deemed to be false positives, and the inclusion of 779 trips that did not catch any black rockfish. A total of 2,110 trips were selected for the CPUE analysis.

For Oregon, the information collected from Lincoln County dominates the RecFIN catch and effort records selected for the CPUE analysis; the other coastal counties had much lower coverage (Table 18). One notable gap in coverage is the absence prior to 1997 of data from July/August, which generally are months of peak activity for the charter boat fleet in Oregon. Simple tabulations of the raw data indicate that most trips landed black rockfish (Table 19) and that the catch-per-angler-day was quite uniform across counties and seasons, with an overall average catch rate of nearly 6 fish per angler day (Table 20).

For California the RecFIN catch and effort records selected for the CPUE analysis are sparse, with very few data from the northernmost counties (Del Norte and Humboldt) and some gaps in coverage for all counties prior to 1990 (Table 21). Coverage during winter months is light in all years. Because the data are sparse, simple tabulations of the raw data produce quite variable estimates of the percentage of trips that catch black rockfish (Table 22), but it generally appears that trips in northern counties are more likely to catch black rockfish and that summer months are better than winter months. Tabulations of the catch per angler for trips that catch a black rockfish suggest that catch rates are higher in the two northern-most counties (Table 23).

Standardized CPUE indices for Oregon (Fig. 13) and California (Fig. 14) were developed from the selected subsets of the RecFIN catch and effort data using Generalized Linear Models (GLM), with a binomial model to estimate the probability of catching at least one black rockfish and a Gamma or a lognormal model to estimate the magnitude of the positive catches by one angler. In all cases, the structural models had three main effects for the factors Year, Wave (bimonthly period) and County, and there were no interaction terms. The annual index values were derived as the product of two components: predicted values for the probability of catching a black rockfish during a trip, and predicted values for the number of black rockfish caught by an angler given that at least one black rockfish was caught. The predicted values for the two components were based on the same specific levels for Wave and County in order to maintain scales that would be consistent with the observed catch-per-angler data.

The CPUE index for Oregon has a high amount of inter-annual variation, particularly in the early part of the series, but shows no long-term trend. The CPUE index for California has much greater inter-annual variation than the Oregon index, primarily due to some erratic predicted values in the log-normal component in a few early years when the data were few and scattered.

The ORBS CPUE Index

The ORBS data series for most years does not include full species composition information, and therefore was not amenable to a multispecies analysis to select a relevant subset of the data, as was done with the RecFIN data. However, the ORBS samplers classify whether each fishing trip was directed at "bottom fish" (as opposed to trips for salmon, halibut, or albacore tuna). For developing the CPUE index from the ORBS data the analysis was restricted to fishing trips that were identified as "bottom" trips and which were therefore thought to have a consistently high probability of catching black rockfish.

For much of the series the data are not available as records of individual fishing trips but instead are in an aggregated form (e.g., catch and effort by port and month). In this form there were essentially no records in the database where there was effort and no catch of black rockfish. There was also no basis for a formal model of the probability that a single trip catches a black rockfish. To develop a standardized CPUE index from the ORBS series, the CPUE observations (aggregated catch over aggregated effort) were fitted with a gamma model with main effects for Year, Month, Port, and Boat-type (private versus charter) and no interactions. Data from the ports of Astoria, Florence, Bandon, Port Orford, and Gold Beach were excluded from the analysis because of sparse data. The annual index values are the predicted numbers of fish per angler-day for charter boats operating from Newport during the month of July. The index varies between 2.9 and 5.5 fish per angler-day but shows no long-term trend (Fig. 15).

The CDFG CPFV Observer CPUE Index

During 1988 to 1998, observers from CDFG collected data on catch and effort while aboard Commercial Passenger Fishing Vessels (CPFV) operating off Central California. These data provide site-specific fishing rates, which the previous assessment used to develop a CPUE index. The CPFV data series was restricted to observed catch rates at specific fishing locations where black rockfish were caught on at least five occasions during the study period. The index values, which were derived from a delta-gamma GLM with factors for Year, Month, and Location, are used without modification in the current assessment (Fig. 16).

Effects on CPUE of Changes in Bag-Limits

Use of catch-per-effort data as an index of fish abundance is based on numerous assumptions including consistency in the type of gear used and consistency in the spatial pattern of fishing. When fishery management adds constraints to fishing activities, it is likely that fishing patterns will change and distort the relationship between catch-per-effort and fish abundance. Bag-limits, in particular, will tend to constrain catch-rates (all else being equal), and a series of reductions in bag-limits over time will tend to impose a trend on catch-rates, even if stock abundance is increasing. There have been several important changes in bag-limits for black rockfish that might have bearing on the CPUE indices used in this assessment.

In Oregon in 1979, the first year of the CPUE series for California, there was a bag-limit of 15 rockfish, which became more restrictive in 1994 when a sub-limit of 10 black rockfish was added. From 2000 to 2002, there was a rockfish limit of 10 fish in effect, with a sub-limit of three canary rockfish during 2000, one canary rockfish during 2001, and one canary rockfish plus one yelloweye rockfish during 2002. Beginning in 2003 the 10-fish bag-limit applied to all marine fish species rather than just to rockfish. In July 2005 the marine fish bag-limit was reduced to 5 fish; for 2006 it was 6 marine fish.

In California in 1980, which is the first year of the CPUE series for California, there was a bag-limit of 15 rockfish in any combination. In 2000 the bag limit for rockfish was reduced to 10 fish.

To determine whether catch rates for black rockfish in the recreational fishery were being constrained by bag-limits, the RecFIN data on catch-per-angler were tabulated and plotted as frequency histograms (Fig. 17). The plots for both regions of Oregon and for the northern portion of California indicate truncation of the frequency histograms at 10 fish-per-angler, starting in the years when the 10-fish bag limits went into effect, which strongly suggests that the CPUE index would be influenced by the bag-limit changes.

When the late-May STAR Panel reviewed an earlier version of this assessment, it was agreed that the CPUE indices in Oregon should be broken into separate sections corresponding to changes in the bag-limits, with the breaks occurring between 1993 and 1994, and between 1999 and 2000. For California, a single break should be placed between 1999 and 2000. Further, broken series should be rejoined if the assessment model's fit to the series implied a reduction in the effective catch rate (catchability). An increase in the effective catch rate would imply that the reduced bag-limit was not constraining the fishing operations.

PIT-Tagging Study Estimates of Black Rockfish Abundance off Newport, Oregon

Beginning in 2002, ODFW has used Passive Integrated Transponder (PIT) tags to mark 2,500 to 3,000 black rockfish annually off Newport, Oregon. Marked fish are recovered from recreational fishery landings, with sampling focused on the charter vessel fleet. Approximately 80% of the annual landings are sampled for marked fish, resulting in the recovery of 976 marked fish to date. The multi-stage mark-recovery model described in Brownie et al. (1985) as Model 0 was used to estimate annual survival and recovery rates for the black rockfish population off Newport (Table 24). Model 0 was selected because it was the only classic Brownie model that adequately fit the data. Model 0 allows direct (first-year) recovery rates to differ from recovery rates of previously marked cohorts, which appeared to be the case in the black rockfish mark-recovery data. Model 0 parameters were then used to calculate annual exploitation rates, which were then applied to the annual landings to estimate annual abundance.

The mark-recovery study only covers the black rockfish off Newport, Oregon, and this population is an unknown fraction (q) of the much larger stock of black rockfish residing in the waters off Oregon. To provide some idea of what fraction the Newport population represents of the larger Oregon stock south of Cape Falcon, recreational and commercial observer data were used to estimate the proportion of habitat occurring inside the mark-recovery study area in relation to the amount of habitat occurring in the larger areas used in the stock assessment (Table 25). Assuming that abundance is proportional to available habitat, which seems reasonable given observed catch-rates of black rockfish, these habitat proportions provide a reasonable range of estimates of q for the Newport population abundance estimates (from 9% to 21% with a best estimate of 16%). With regard to how much of the black rockfish stock resides in waters off Oregon versus California, the Council apportions optimum yields for Oregon plus California based on 58% to Oregon and 42% to California, implying that the Newport population comprises approximately 10% of the exploitable black rockfish in the assessment region.

Details for the tagging study are available in Buell et al. (2007), which is included as Appendix A to this assessment.

SWFSC Juvenile Rockfish Survey Index

Since 2001, the NMFS Southwest Fisheries Science Center, in conjunction with the Pacific Whiting Conservation Cooperative, has conducted a coast-wide, mid-water trawl survey of pre-recruit pelagic juvenile rockfish and Pacific hake. Using data for the juvenile black rockfish caught during the surveys, S. Ralston (SWFSC) developed three different indices of black rockfish recruitment strength for 2001-2006. Although the three indices differ in their underlying statistical models, they show similar patterns (Fig. 18). For this assessment, the index based on the ANOVA model was used, but the estimated coefficients of variation (CVs) for the index values were inflated by a factor of 10 when input to the stock assessment model because the CVs seemed extraordinarily low.

HISTORY OF MODELING APPROACHES

The first stock assessment of black rockfish off Oregon (Stewart 1993), which was limited in geographic scope to the northern portion of Oregon, was a Cohort Analysis based on age composition data collected from fish landed at Garibaldi. The first comprehensive analysis of the black rockfish stock off Oregon and California was by Ralston and Dick (2003), who developed a statistical catch-at-age model using Stock Synthesis. Their model configuration and approach were very similar to the current assessment, with a few notable exceptions that are described in more detail below. The stock of black rockfish off Washington has been assessed three times: by Wallace and Tagart (1994), Wallace et al. (1999), and Wallace et al. (2007). The assessments in 1994 and 2007 used the then-current versions of Stock Synthesis and the 1999 assessment used a purpose-built model (running under the AD Model Builder software) that directly incorporated tag-recapture data.

Response to 2003 STAR Panel Recommendations

The current assessment was partially successful at responding to the recommendations outlined in the 2003 STAR panel report.

Fishery independent surveys and biological data collection programs

The new assessment used data from two surveys that were not used by the 2003 assessment and that potentially provided indices for tuning the assessment. The juvenile rockfish survey is a fishery independent survey that provides information on recruitment strength of black rockfish. The ODFW tagging study, while not fishery-independent, provides a new data source that should be much less prone to the biases inherent in fishery catch-per-unit-effort data. There remains a general need for expanded data collection systems for nearshore rockfish species.

Pre-assessment meetings to evaluate data.

The STAT participated in the Recreational CPUE Statistics and Stock Assessment Data Workshops that were held during 2004 to exchange information about available data sources and suitable methods for analysis of these data. Also, the STAT was in repeated contact with personnel at ODFW, CDFG, PacFIN, and NMFS regarding the data sources during the data compilation phase of the assessment.

Consistent methods and data sources to estimate catch histories.

The assessment teams for southern and northern black rockfish shared catch history information to avoid overlap and double counting, but there was no coordination with other rockfish assessment teams to develop a comprehensive historical analysis of rockfish catches.

Investigate possible causes of changes in mean length at age

The STAT conducted analyses of the mean length-at-age data available from Oregon and concluded that the apparent changes in length-at-age were due to differences in age-reading over time because of changes in age-readers.

Evaluate the use of recreational fishery CPUE indices as an index of abundance.

The STAT did not conduct any analyses to confirm that the CPUE indices were valid indices of black rockfish abundance. Such an evaluation requires independent information on stock abundance with which to compare the CPUE indices, but no such data are available.

Investigate stock separation or a stock model with two spatial regions.

An assessment model for black rockfish that included four explicit spatial areas was developed for the late-May STAR Panel but this model did not produce stable results. The data available for black rockfish do not appear to be sufficient to support a finer spatial scale for the assessment.

Response to May 2007 STAR Panel Recommendations

An initial version of the new assessment for black rockfish was reviewed by a STAR Panel during May 2007, but the STAT was unable to develop an acceptable base-model during the May STAR meeting. The STAR Panel made a number of suggestions concerning how the black rockfish assessment model should be revised. Many of these suggestions were incorporated into the assessment model that was subsequently reviewed during the October STAR.

Include the Oregon tagging study abundance estimates as an index with an informed prior probability distribution for the index's catchability coefficient.

The revised assessment model includes the Oregon tagging study abundance estimates. ODFW personnel developed estimates of the expected value for the catchability coefficient (Tag-Q) for this new index with respect to the portion of the stock residing off Oregon, but the STAT was unable to develop a formal prior probability distribution for the Tag-Q parameter because of the general lack of information on how black rockfish are spatially distributed between California and Oregon.

Fully capture the effect of uncertainty in the catch history.

The revised assessment includes an analysis that explores the sensitivity of the model results to alternative assumptions about the catch histories.

Include a descriptive analysis of CPUE and justify the use of CPUE as indices of abundance

The revised assessment document includes expanded descriptions of the catch and effort data sources and tabulations indicating the degree of sampling coverage.

Provide better GLM diagnostics.

The revised assessment document includes separate binomial and positive-catch indices. Residual plots for the indices were presented during the October STAR meeting.

Explore alternative stock hypotheses.

Subsequent to the May STAR meeting the STAT explored at length a two-area model configured with Oregon data only, but the STAT was unable to find model configurations that produced stable results.

Continue exploration of using multiple areas.

The STAT explored a series of area-based model configurations subsequent to the May STAR meeting. None of the configurations produced results that seemed stable or adequate to use as a base-model. No area-based model configurations were brought to the October STAR meeting.

Consultations with the GAP and with Fishers

Prior to developing a working stock assessment model, staff from ODFW organized a series of five public workshops that the STAT attended, and to which interested fishers were invited: in Oregon at Newport, North Bend, Port Orford, Pacific City, and Brookings; and in California at

Eureka. Attendance at these workshops ranged from five (in Eureka) to more than 30 participants (in Brookings). Each workshop lasted from two to three hours, and every workshop produced lively and informative discussions between the audience and the STAT.

CURRENT MODELING APPROACH

The current assessment builds on the basic model structure and approach developed in Ralston and Dick (2003). The data are organized into three basic gear-types (HKL, TWL, and REC), the data from Oregon and California are kept separate, and the tuning indices are recreational angler CPUE series based on the same data sources (RecFIN for both states, ORBS for Oregon, and CPFV for California). In most cases the data series were re-developed for the current assessment, rather than simply updating the old series with information for later years. This was done initially because the original version of this assessment had four explicit spatial areas, each of which required its own sets of data. Also, re-developing all the data series meant greater assurance that the data were treated in a consistent manner across all years of the series.

The landings data series in the current assessment differ quite substantially from the series developed by Ralston and Dick for the previous assessment (Fig. 19). This is especially noticeable in the non-trawl fishery in California, the trawl fishery in Oregon, and the recreational fishery in Oregon. In small part, the differences arise because the current assessment starts reconstructing catch histories earlier than 1945, which was the starting year for the catch histories in the last assessment. For example, in the case of the non-trawl fishery in California, the current assessment assumes that black rockfish are a fairly large percentage of the non-trawl landings of rockfish, which began well before 1945. For the trawl fishery in Oregon the previous assessment mistakenly assumed that all the trawl landings of black rockfish in Oregon were taken from south of the Columbia River. However, most of the landings into Astoria, near the mouth of the Columbia River, are likely to have been taken from north of the Columbia River, and almost certainly from north of Cape Falcon, the northern boundary for the current assessment. Based on PacFIN data, landings into Astoria account for about one third of the black rockfish landings in Oregon. For the recreational fishery in Oregon, the current and previous assessments used the same estimates for the numbers of black rockfish landed, but the assessments differ considerably in the value assumed for the average weight of a black rockfish. The previous assessment derived its average weight value by applying a length-to-weight relationship to length-frequency data from fish sampled in Garibaldi, where the fish tend to be larger than the state-wide average. The current assessment used an average weight based on RecFIN, which has more broadly based sampling.

The new assessment took a slightly different approach in its use of the Stephens and MacCall procedures for developing the RecFIN CPUE indices. The current assessment used the technique to select a subset of data for the CPUE analysis, whereas the previous assessment used the probability values predicted by the method as weights in the GLM analyses of the full sets of RecFIN data.

The new assessment has a more complete CPUE series from the ORBS program, which in the previous assessment was missing data for 1987 to 1998, due to changed procedures for estimating rockfish species compositions. In connection with the 2006 assessment of yelloweye rockfish, a consistent and complete series of species composition proportions was developed, which also allowed black rockfish catches to be estimated for the years that were lacking estimates in the 2003 black rockfish assessment.

The new assessment uses the ODFW PIT tag estimates of black rockfish abundance off Newport as an abundance index. These data were unavailable for the previous assessment. The new assessment also uses the juvenile rockfish pre-recruit index, which was unavailable for the previous assessment.

New Approaches

The new assessment uses the Stock Synthesis 2 software (SS2, version 2.00g), which provided additional modeling features that were unavailable in the Stock Synthesis software used for the previous assessment.

Definitions of Fisheries and Surveys

Oregon and California each have a non-trawl, trawl, and recreational fishery, for a total of six fisheries. The model is structured as a single area with all fisheries (and surveys) simultaneously accessing the same population of fish. Oregon has a CPUE abundance index based on RecFIN data from Oregon that is associated for its selection curve with the Oregon recreational fishery. California has a similar RecFIN abundance index associated with the California recreational fishery. The two additional CPUE abundance indices, based on ORBS and the CPFV Observer data, are treated as independent surveys, each with its own separate length composition data. There are also age composition data and mean length-at-age data associated with the ORBS survey. Finally, there are two additional indices: one for the abundance estimates from the Newport tagging study, and one for the pre-recruit index.

Likelihood Components

The SS2 model for this assessment has 24 non-zero likelihood components: survey fit components for six indices (with some CPUE indices broken into two or three segments to account for changes in bag-limits), length composition components for six fisheries and two surveys; age composition components for one fishery (Oregon non-trawl) and one survey (ORBS), and one component each for length-at-age, mean body weight, recruitment, and the forecast recruitment.

Structural Assumptions

- The fisheries begin from an unfished state in 1915.
- The assessment model is configured for separate sexes.
- Growth differs between the sexes and is estimated within the model.
- Spawning output is measured as millions of larvae rather than as female spawning biomass.
- A Beverton and Holt curve was used to define the relationship between average recruitment and spawning output (larvae).
- Selection is by length, not by age, and does not differ by gender.
- Selection curves for all fisheries use the double-normal configuration, except for the two trawl fisheries, which are linked to a simple logistic curve.
- All six parameters for each of the double-normal selection curves are estimated.
- Breaks allowed in the CPUE indices for bag-limit changes are not accompanied by changes in selection.
- Deviations in recruitment begin in 1970 and extend through 2006.

- All active likelihood components have relative weights (lambda values) of 1.0 in the total likelihood.

Assumed Values and Constraints for Parameters

- Natural mortality is fixed for males at 0.16 and is constant with age.
- Natural mortality for females is 0.16 for females less than age-10-yr, ramps to 0.24 over the ages 10 to 15 yr, and then remains constant at 0.24.
- The CV for length-at-age is a function of length and is constant at 7%.
- Growth and maturity are assumed to be time-invariant.
- Steepness is fixed at 0.6.
- The input value for the log-scale standard deviation in recruitment (sigma-R) is 0.5.
- No estimated parameters are assigned prior probability distributions.

MODEL SELECTION AND EVALUATION

Developing the base model for southern black rockfish involved exploring a wide variety of model configurations, ranging from the suite of complex models with area-based fisheries that was examined during the May 2007 STAR meeting, to the much simpler single-area model that was brought to the October STAR meeting. During the process of model selection the STAT was guided by changes in goodness-of-fit and by subjective examination of the observed versus predicted values. The STAT also used the estimated catchability coefficient for the Newport tagging study (Tag-Q) as an informal diagnostic. It was the STAT's opinion that the tagging study's estimates of abundance and exploitation rate provided more reliable indications of stock size and status than any of the CPUE-based indices, although for a very limited geographic range. Constraints on the Tag-Q parameter were not formally included in the model fitting because the STAT was unable to develop a prior probability distribution for this parameter.

Changes to the Model during the October STAR Meeting

The October STAR Panel made a number of requests for additional information and model runs. The STAR Panel Report contains the full list of requests and the STAT responses. Described below are those that resulted in changes to the preliminary base model and thus lead to the final base-run model.

When developing a response to the request for a plot of age-readings versus average-age for the standard set of age-readers (Request D), the STAT found a mistake in its analysis of the coefficient that defines the vector of standard deviations of age-reading errors. Data from some non-standard age-readers had been mistakenly included in the original analysis. The analysis was redone using only data from the standard set of age-readers. This resulted in slight changes to the vector of standard deviations of age-reading errors that was input to the model.

The recreational CPUE time series for the Oregon ORBS survey was broken into segments between 2004 and 2005 to reflect the bag-limit reduction that occurred mid-year during 2005 (Request E).

Explorations of the sensitivity to alternative values for the parameters that define the variation in length-at-age (Request F) resulted in improved fit to the data and the decision to change the growth model configuration so that the coefficient of variation (CV) in length-at-age was constant at 7%. In the preliminary base model the CV was 11% at age-3-yr for females and males, but was 7% at age-20-yr for females and 5% at age-20-yr for males.

When exploring why the model provided poor fits to the pre-recruit times series (Request I), the STAT determined that the model was constrained by the absence of small fish in the California recreational fishery. The large pre-recruit index value for 2004 should have appeared as a shoulder of small fish in the 2006 length composition data, but it did not. The STAT was concerned that the growth curve in the preliminary base model was predicting young fish that were unrealistically large because of the structure of the smallest length bin. The STAT modified the structure of the length bins to include a dummy length category representing 5-15 cm fish, and changed the growth model specification so that the model estimated length for age-1 rather than age-3 fish. These changes produced growth curves that appeared reasonable, but the changes did not lessen the poor model fit to the pre-recruit time series.

The STAR Panel was concerned that the mean length-at-age data were very influential in the likelihood profile over the virgin-recruitment parameter (R0). To remove any possible influence of a time-trend in the length-at-age data, the STAR panel suggested fitting only one year of mean length-at-age data (rather than three years) (Request K). For the final base model the mean length-at-age data from 2003 through 2005 were combined into a single composite set of mean length-at-age data that was assigned to the year 2004.

To explore candidates for a new base model (Request L) the STAT ran the model with the recruitment deviations starting in 1950. The plot of the estimated standard deviations of recruitment against year suggested that 1970 would be an appropriate starting year for the recruitment deviations. A series of one-step tuning runs for the input sigma-R parameter indicated that it would be appropriate to specify a sigma-R value of 0.5, which was approximately the output sigma-R value obtained from an input sigma-R of 1.0.

Input Variance Adjustments

The preliminary base-run model that was brought to the STAR meeting seemed to be fully "tuned". The effective sample sizes estimated by the model were almost equivalent on average to the multinomial samples sizes that were input to the model, the root mean square error (rmse) that the model estimated for each survey was almost equivalent to average standard error that was input for the survey, and the rmse that the model estimated for the recruitment deviations was almost equivalent to the sigma-R parameter that was input to the model. The change in the CV for length-at-age that occurred during the STAR meeting, however, resulted in changes to the model's estimates of variability in the data, particularly for the mean length-at-age data.

Prior to exploring dimensions of uncertainty for building the decision table, the STAT developed a tuned version of the working base model in which the variance adjustment for the mean length-at-age data was greatly reduced relative to the preliminary base model. A likelihood profile over R0 with this tuned model indicated that the revised model had considerably less tension between the likelihood component for mean length-at-age and the other components. However, the tuned model provided a very poor fit to the mean length-at-age data because those data had been so greatly down-weighted by the tuning process. Given that mean length-at-age data should provide a more reliable basis for estimating growth than the other sources of data that were input to the model, the STAT argued that an earlier partially tuned version of the model should be used as the final base model. The STAR Panel agreed.

The input variance adjustments for the final base-run model are in Table 26.

Likelihood Profiles

Likelihood profiles were conducted at all stages of model development and exploration to identify sources of tension among different data sources and model components. For the final base-run model the likelihood profile over the R0 parameter illustrates a fundamental conflict between the age-composition data and the mean length-at-age data (Fig. 20). The age composition data strongly favor lower values of R0, which corresponds to a more depleted stock and lower values for MSY, whereas the length-at-age data strongly favor higher values of R0. There is also considerable tension within a given type of likelihood component. For example, the Oregon recreational fishery length-composition data favor low values of R0, whereas the California recreational fishery length-composition data favor high values of R0. Most individual components tend to favor extreme rather than intermediate values of R0 (Table 27).

The likelihood profile over the spawner-recruit steepness parameter indicates that the available data provide very little information regarding the value of steepness. Most of the individual likelihood components are consistent with a wide range of steepness values (Table 28). The value of steepness assumed for the final base model (0.6) is essentially the same as the 0.58 value obtained from a meta-analysis of available steepness parameter estimates for West Coast rockfish (M.Dorn, Alaska Fisheries Science Center, personal communication).

Model Diagnostics

The final base model had a Hessian matrix that could be inverted and the maximum gradient component was 0.00015. To confirm that the final base-run model had fully converged, a series of 100 runs were conducted with randomized initial parameter values that were randomly "jittered" by 0.1. Many of the runs produced ridiculously high negative log-likelihood values and clearly had failed to converge to a sensible set of parameter values. Of the 69 runs that produced reasonable results, none had a lower negative log-likelihood than the base-run model, and 38 had converged to the same value negative log-likelihood as the base-run model. This supports the conclusion that the final base-run model had fully converged.

The base-run model's selection curves for the different fisheries and surveys generally seem plausible (Fig. 21), and were reasonably similar to the curves estimated by the previous assessment. The curves are all highly domed except for the selection curve for the two trawl fisheries, which were linked and forced to be asymptotic.

Plots of the observed versus predicted fits to the abundance indices generally indicate reasonable fits with essentially all predicted values lying within the confidence bands around the observed values (Fig. 22).

Plots of observed versus expected values for the length composition data often were not very good with strong indications of lack of fit (Fig. 23), particularly with the smaller size classes. Plots of observed versus expected values for the age composition data also showed trajectories with lack of fit (Fig. 24), with the model generally predicting smaller peaks than were apparent in the observed data. Plots of observed versus expected values for the mean length-at-age data indicated a tendency to over-estimate the size-at-age of older fish, particularly for males (Fig. 25).

Plots of the length-composition residuals (Fig. 26) and age-composition residuals (Fig. 27) showed evidence of systematic lack of fit to the data. Fixing this, however, would have required a much more complex model that allowed year-to-year variation in the selection curves to accommodate the year-to-year variations in the length- and age-composition data.

BASE-RUN MODEL RESULTS

Parameter Values

The final base-run model had 92 estimated parameters, including five growth curve parameters, 38 selection curve parameters, and 37 annual recruitment deviation parameters (Table 29). Nine of the estimated selection curve parameters (for the initial or final selection) were at their lower bounds and could have been fixed at those values. Doing so had no effect on the values of the other estimated parameters or on the likelihood values.

Time-Trajectories of Population Estimates

The base-run model estimated that the unexploited stock had total biomass of over 29,300 mt, spawning output of about 4,600 million larvae, and annual recruitment of about 7.8 million age-0 fish (Table 30). The model estimated the spawning output at the start of 2007 to be about 3,200 million larvae, equivalent to 70% of the unexploited level. The model's estimates of spawning output (Fig. 28) and age 2+ biomass (Fig. 29) reached their lowest points in the mid-1990s and have been rising steadily since. The estimated increases in spawning output and biomass since the mid-1990s have been driven by above-average recruitment throughout the 1990s and very strong year-classes in 1994 and 1999 (Fig. 30). The greatest level of spawning depletion occurred in the mid-1990s when spawning output dropped to 35% of the unexploited level (Fig. 31). The fisheries exerted a fairly high and sustained total rate of exploitation on the stock during the 1980s and early 1990s, and the total exploitation rate reached its peak in 1992 and has declined more or less steadily ever since (Fig. 32).

Estimated Population Numbers-at-Age

The final base-run model estimates of the numbers of fish alive at the start of each year by sex are given in Table 31.

UNCERTAINTY AND SENSITIVITY ANALYSES

The final base-run model was fully converged and the Stock Synthesis program used the inverse of the Hessian matrix to produce approximate standard deviations for many of the estimated parameters and for the series of derived spawning outputs and recruitments (Table 32). The coefficients of variation (CV) for the estimates of spawning output (S) ranged from a low of 8.8% for S(0) to a high of 18.5% for S(2007). The estimates of annual recruitment were more variable, with the CVs ranging from a low of 8.9% for R(0) to a high of 51% for R(2007). These measures of variability based on the Hessian matrix reflect the model's lack of fit to the input data, but they do not include numerous other sources of uncertainty, such as the values for the steepness and natural mortality parameters, which are highly uncertain but were fixed in the model. Confidence limits derived from the standard deviations estimated from the model will be narrower than they should be for any stated confidence level.

Sensitivity Analyses

The first two sensitivity analyses described below (for catch history and natural mortality) were conducted with the preliminary base-run model and were not repeated with the final base-run model. Although the preliminary and final base models differ in the absolute scale of the results (Fig. 33), the preliminary base model should provide a reasonable view of the general pattern of sensitivity to catch history or natural mortality.

Catch History

Catch histories are an important source of uncertainty in many stock assessments, and that seems to be especially so in this assessment where the scale of the catches is driven by assumed and largely unverified values for the percentages of black rockfish in landings of general rockfish. To evaluate whether uncertainty in the landings of black rockfish propagates into significant uncertainty in the assessment results, a sensitivity analysis was conducted with the preliminary base-run model using a series of eight runs with different levels for the three fishery classes (trawl, non-trawl, and recreational) (Table 33). The results generally indicated that the estimated levels of spawning depletion was quite insensitive to the levels of catch, with the greatest difference showing in the run with high levels for all three fishery classes versus the run with low levels for all three fishery classes. In contrast, the magnitude of the estimated MSY (calculated from F50%) was very sensitive to the catch history, varying by over 300 t in the run with high levels for the three fishery classes versus the run with low levels for the three fishery classes. Comparing the high versus low levels of recreational catch shows a change in MSY of almost 250 t.

Natural Mortality

At the September meeting of the PFMC's Scientific and Statistical Committee (SSC), the stock assessment for black rockfish off Washington was reviewed and the SSC agreed to accept a modified formulation for the natural mortality schedule for female black rockfish. In this formulation, M for females age-15-yr and older is 0.24^{-yr} rather than 0.20^{-yr}, as was agreed during the late-May STAR meeting. Although the preliminary base-run model for black rockfish off Oregon and Washington uses the formulation from the September SSC meeting, there remains considerable uncertainty in how best to model natural mortality for black rockfish. To explore this issue, an analysis was conducted that explored the sensitivity of the model's goodness-of-fit to alternative parameter values for M on young fish (males and females) and M on old fish (females only) (Table 34). The best overall fit occurred with a young-M value of 0.14^{-yr} and an old-Fem-M-offset of 0.5, corresponding to an old-Fem-M of 0.231^{-yr}. An even better fit might have been obtained with a higher value for the Old-M-offset. The difference in total log-likelihood between the best-fit value and the preliminary base-run model value was about 5.4 units.

Mean Length-at-Age Data

During the October STAR meeting the Panel expressed concern that the likelihood component for the mean length-at-age data appeared to have a great deal of influence on the base-run model's estimate of R0. To explore this the STAR Panel requested a sensitivity analysis with the final base model in which the prior weight (lambda) for the mean length-at-age likelihood component was reduced from 1.0 to 0.1. Results from this analysis indicated that reducing the prior weight on the mean length-at-age data resulted in improved fits to the age- and length-composition data, but degraded the fit to the indices (Table 35). For the model with reduced weight on the mean length-at-age data the stock was more depleted than in the base-run model and was less productive in terms of the maximum sustainable yield that it could support.

Comparison with Previous Assessments

The base-run model produced estimates of stock size and recruitment that differ substantially from the 2003 assessment (Fig. 34). The absolute scales of biomass and recruitment in the new assessment are much larger than in the 2003 assessment. The differing scales can largely be attributed to the higher rate of natural mortality in the new assessment. When the base-run model was re-done using the same natural mortality formulation and parameter values as in the 2003 assessment, the biomass and recruitment trajectories were much more similar (Fig. 34).

REBUILDING PARAMETERS AND REFERENCE POINTS

For rockfish species managed by the Pacific Fishery Management Council (PFMC) the default target rate of fishing is F50%, which is the fishing rate that reduces the spawning potential ratio (SPR) to 50% of the level experienced in the absence of fishing. The F50% fishing rate is considered to be a proxy for F(MSY), which is the rate of fishing mortality that produces the maximum sustainable yield (MSY). The Council's default harvest control rule for groundfish stocks specifies that a stock is overfished if the stock's spawning output, generally measured in terms of spawning biomass (SB), drops below 25% of the unexploited level, SB(0). In this assessment spawning output was measured in terms of millions of black rockfish larvae. The Council's target level for spawning output is 40% of the unexploited level, denoted SB40%. The SB40% level of spawning output is considered to be a proxy for SB(MSY), which is the level of spawning output that has surplus annual production equal to MSY.

In this assessment the steepness parameter was fixed at 0.6. When steepness is 0.6, fishing at F50% results in equilibrium spawning output that is 40% of the unexploited level, and F50% and SB40% are equivalent proxies for MSY conditions. The yield produced by fishing at F50%, which is the proxy value for MSY, was estimated to be 1,035 mt annually.

The MSY and SB(MSY) values were estimated within the SS2 software based on the Beverton and Holt stock-recruit relationship with an assumed steepness parameter of 0.6. The estimated MSY value, 1,064 mt annually, was very similar to the proxy MSY value. The estimated SB(MSY) was 31.6% of SB(0).

The mean generation time for the stock was estimated to be 13.5 years.

	Point estimate	Uncertainty in estimates (approx. 95% confidence limits)	
Unfished Spawning Output (SB_0) (millions of larvae)	4578.5	3772.3	5384.7
Unfished Recruitment (R_0) at age-0 (1000s of fish)	7852.0	6459.2	9244.8
Reference points based on $SB_{40\%}$ or F50%			
Spawning Output at $SB_{40\%}$ (millions of larvae)	1831.4	1508.9	2153.9
SPR resulting in $SB_{40\%}$ ($SPR_{SB40\%}$)	0.5	none because steepness was fixed	
Exploitation rate resulting in $SB_{40\%}$	0.07227	na	na
Yield with $SPR_{SB40\%}$ at $SB_{40\%}$ (mt)	1035.4	853.1	1217.7
Reference points based on estimated MSY values			
Spawning Output at MSY (SB_{MSY}) (mill. larvae)	1444.6	1189.7	1699.5
SPR_{MSY}	0.4296	0.4288	0.4304
Exploitation Rate corresponding to SPR_{MSY}	0.08864	na	na
MSY (mt)	1064.6	877.1	1251.9

HARVEST PROJECTIONS AND DECISION TABLES

Catch Forecasts

Projections of future catches through 2016 (Table 36) were made based on an F50% target rate of fishing mortality and the following assumptions:

- catches during 2007 and 2008 would be at the Optimum Yield (OY) levels specified by the Council (722 mt each year less an adjustment of 26 mt to account for catches from North of Cape Falcon);
- fishery selection curves estimated for 2006 and earlier years would continue unchanged into the future;
- 58% of each annual catch would be taken by Oregon fisheries, of which the Oregon recreational fishery would take 76% and the Oregon non-trawl fishery would take 26% (leaving Oregon trawl with no catch); and
- 42% of each annual catch would be taken by California fisheries, of which the California recreational fishery would take 55% and the California non-trawl fishery would take 45% (leaving California trawl with no catch).

Because the projected spawning output values for the projection period were always greater than the management target (40% of the unexploited level), the 40:10 harvest control rule adjustments did not apply, and the OY values were all equivalent to the Acceptable Biological Catch (ABC) values.

Decision Table

The decision table (Table 37) was developed with assistance from the STAR Panel. Although there are numerous dimensions of uncertainty regarding the results of this stock assessment, it was agreed that combining uncertainty in the formulation of natural mortality with uncertainty in the historical catch series could adequately capture the axis of uncertainty for the decision table. The three alternative states of nature were defined as follows.

- The least productive state of nature had a natural mortality coefficient (M) of 0.14 $^{-yr}$ for males and young females to age-10-yr, an M of 0.21 $^{-yr}$ for females age-15-yr and older, and the catch history prior to 1981 for the trawl fisheries was based on low assumed values for the percentages of black rockfish in the landings of rockfish (0% in northern OR, 1.2% in southern OR, 3.6% in northern CA, and 0% in southern CA).
- The most productive state of nature had an M of 0.18 $^{-yr}$ for males and young females to age-10-yr, an M of 0.27 $^{-yr}$ for females age-15-yr and older, and the catch history prior to 1981 for the trawl fisheries was based on high assumed values for the percentages of black rockfish in the landings of rockfish (0.4% in northern OR, 5.0% in southern OR, 14.0% in northern CA, and 0.2% in southern CA).
- The base-run state of nature had a natural mortality coefficient (M) of 0.16 $^{-yr}$ for males and young females to age-10-yr, an M of 0.24 $^{-yr}$ for females age-15-yr and older, and the catch history prior to 1981 for the trawl fisheries was based on the base-run assumed values for the percentage of black rockfish in the landings of rockfish (0.2% in northern OR, 2.5% in southern OR, 7.0% in northern CA, and 0.1% in southern CA).

The STAR and STAT agreed that the base-run state of nature could be viewed as being twice as likely as the two alternative states of nature, and that the low-productivity and high-productivity states were equally likely.

Three alternative management actions were defined in terms of the stream of OY catches projected from each of the three alternative states of nature. The low productivity state of nature produced a stream of low catches, the high productivity state of nature produced a stream of high catches, and the base-model state of nature produced a stream of intermediate catches. The OY catch streams considered in the management actions of the decision table all have an abrupt increase in catch from 2009 to 2010 when the new stock assessment results first have an influence on the OY.

PRIORITIZED RESEARCH AND DATA NEEDS

- A comprehensive analysis of historic rockfish landings is needed to further refine the landings series for black rockfish and other rockfish species. The analysis should make consistent use of available species composition data and documented historical developments, such as the directed fisheries for Pacific ocean perch and widow rockfish.
- The ODFW tagging study off Newport should be continued and expanded to other areas. To provide better prior information on the spatial distribution of the black rockfish stock, further work should be conducted to map the extent of black rockfish habitat and the densities of black rockfish residing there.
- Age composition data should be developed for black rockfish caught commercially in California, and the data should be entered into the California commercial fishery database (CALCOM).
- If otoliths are available for black rockfish from the recreational fishery in California, they should be identified and read in a manner consistent with the processing of commercial fishery samples.
- A program should be established that routinely collects otoliths from black rockfish and other species harvested by the recreational fishery in California.

- Growth of black rockfish in California should be examined. The current assessment model assumes that black rockfish in California have the same growth curve as black rockfish in Oregon, but differences in growth could be an alternative explanation for the large differences in the length composition data between Oregon and California. Except for some published growth curves based on limited data, no length-at-age data are currently available for California.
- Additional age-reader comparisons should be conducted to resolve the apparent differences in mean length-at-age measurements between readers. Cross-validation experiments should be conducted with age-readers from Washington and California to confirm consistency in age-reading results.
- If otoliths are available from the older Oregon samples that were excluded from the current assessment, they should be re-read to extend the series of age composition data farther back in time.
- Length composition data, including gender, should be collected from the California fisheries to help better define the selection curves and the sex-specific natural mortality process. Currently all the length composition data from the California fisheries are combined-sex samples. Sex-specific length composition samples from the commercial fisheries in California would be particularly informative because these fisheries tend to catch larger black rockfish than the recreational fishery. The apparent lack of older females, which is evident in the age composition data from the Oregon recreational fishery, could be an artifact of the highly domed length-selection by the Oregon recreational fishery.

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Table 1. Summary of regulations for West Coast black rockfish off Oregon and California.

Date	Regulatory Action
01/83	40,000 lb trip limit *Sebastes* complex coastwide; recreational: California and Oregon 15 rockfish per angler.
01/84	30,000 lb trip limit for *Sebastes* complex north of Cape Blanco with a 1 trip per week restriction, no change south.
05/84	15,000 lb trip limit for *Sebastes* complex once per week north of Cape Blanco.
08/84	7,500 lb/trip per week or 15,000 lb/trip per 2 weeks for *Sebastes* complex north of Cape Blanco.
01/85	30,000 lb weekly trip limit for *Sebastes* complex north of Cape Blanco, no change south.
04/85	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.
01/86	25,000 lbs per weekly trip or 50,000 lbs per biweekly trip for *Sebastes* complex north of Cape Blanco, no change south.
09/86	30,000 lbs per weekly trip or 60,000 lbs per biweekly trip north of Cape Blanco for *Sebastes* complex.
01/87	25,000 lbs per weekly trip or 50,000 lbs per biweekly trip north of Cape Blanco for *Sebastes* complex, no change south.
01/88	No change for *Sebastes* complex.
01/89	No change for *Sebastes* complex.
01/90	No change for *Sebastes* complex.
01/91	25,000 lbs per trip south of Cape Blanco for *Sebastes* complex, no change north.
01/92	50,000 lbs cumulative *Sebastes* complex per 2 weeks coastwide.
01/93	No change for *Sebastes* complex.
01/94	Limited entry: 80,000 lbs cumulative *Sebastes* complex per month. Coastwide open access: 10,000 lbs per trip not to exceed 40,000 lbs per month. Recreational: 10 black rockfish in 15 rockfish bag per angler for Oregon.
09/94	Limited entry south of Cape Mendocino raised to 100,000 lbs cumulative per month.
01/95	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.
01/96	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.
01/97	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.
01/98	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.
07/98	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.
01/99	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.
04/99	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.
05/99	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.
08/99	Limited entry north of Cape Mendocino: 10,000 lbs cumulative bimonthly limit for all *Sebastes* other than canary and yellowtail rockfish.

Table 1. Summary of regulations (continued).

Date	Regulatory Action
01/00	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 coastwide 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.
05/00	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.
07/00	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.
01/01	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.
05/01	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.
01/02	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.
01/03	Limited Entry trawl: 300 lbs per month coastwide. 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. Landings of black rockfish from South of Cape Falcon, as used in the base model.

Area =	Oregon			California			
Type =	HKL	TWL	REC	HKL	TWL	REC	ALL
Year	MTs	MTs	MTs	MTs	MTs	MTs	MTs
1915	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1916	0.2	0.0	0.0	2.7	0.1	0.0	2.9
1917	0.4	0.0	0.0	5.3	0.1	0.0	5.9
1918	0.6	0.0	0.0	8.0	0.2	0.0	8.8
1919	0.9	0.0	0.0	10.6	0.2	0.0	11.7
1920	1.1	0.0	0.0	13.3	0.3	0.0	14.7
1921	1.3	0.0	0.0	16.0	0.4	0.0	17.6
1922	1.5	0.0	0.0	18.6	0.4	0.0	20.5
1923	1.7	0.0	0.0	21.3	0.5	0.0	23.5
1924	1.9	0.0	0.0	23.9	0.6	0.0	26.4
1925	2.1	0.0	0.0	26.6	0.6	0.0	29.3
1926	2.3	0.0	0.0	29.3	0.7	0.0	32.3
1927	2.6	0.0	0.0	31.9	0.7	0.0	35.2
1928	2.7	0.0	0.0	30.8	0.9	0.0	34.4
1929	7.8	0.0	0.0	54.3	0.9	0.0	63.1
1930	11.6	0.0	0.0	47.7	3.1	0.0	62.5
1931	8.1	0.0	0.0	36.1	11.2	0.0	55.5
1932	2.2	0.0	0.0	29.9	9.6	0.0	41.7
1933	4.3	0.0	0.0	16.4	14.6	0.0	35.4
1934	2.6	0.0	0.0	34.1	8.8	0.0	45.5
1935	1.6	0.0	0.0	41.9	9.8	0.0	53.3
1936	7.9	0.0	0.0	47.9	4.7	0.0	60.5
1937	5.7	0.0	0.0	37.7	10.4	0.0	53.7
1938	2.7	0.0	0.0	39.7	12.6	0.0	55.0
1939	3.8	0.0	0.0	46.7	17.4	0.0	67.9
1940	10.9	0.3	0.0	39.0	13.7	0.0	64.0
1941	18.6	0.9	0.0	30.7	10.9	0.0	61.0
1942	18.4	2.2	0.0	23.6	14.6	0.0	58.7
1943	66.1	9.1	0.0	46.0	36.5	0.0	157.7
1944	23.2	21.7	0.0	34.2	170.1	0.0	249.2
1945	18.9	36.4	0.0	36.4	367.0	0.0	458.7
1946	19.6	26.0	0.0	49.9	293.4	8.1	396.9
1947	10.8	8.0	0.0	47.5	194.8	16.1	277.3
1948	19.9	4.7	0.0	34.1	121.0	24.2	204.0
1949	16.3	9.9	0.0	29.2	100.1	32.2	187.8
1950	10.3	13.1	1.7	40.5	114.6	40.3	220.4
1951	8.1	10.3	3.3	46.4	140.7	48.4	257.2
1952	7.7	12.0	5.0	39.0	81.5	56.4	201.7
1953	3.0	5.8	6.7	27.3	98.5	64.5	205.8
1954	4.3	8.7	8.3	49.4	98.3	72.6	241.6
1955	5.3	16.6	10.0	43.1	90.8	80.6	246.3
1956	2.2	10.8	11.7	5.7	64.6	88.7	183.6
1957	4.6	9.3	13.4	10.7	76.1	96.7	210.7
1958	1.4	11.2	15.0	0.4	79.0	179.7	286.8
1959	3.7	24.2	16.7	12.1	69.6	146.2	272.5
1960	2.5	23.4	18.4	9.3	77.7	133.2	264.6
1961	5.6	19.0	20.0	7.1	43.4	95.9	191.0

Table 2. Landings of black rockfish in the base model (continued).

Area =	Oregon			California			
Type =	HKL	TWL	REC	HKL	TWL	REC	ALL
Year	MTs	MTs	MTs	MTs	MTs	MTs	MTs
1962	6.0	21.2	21.7	9.1	44.6	101.9	204.6
1963	5.0	30.9	23.4	15.0	71.6	112.2	258.1
1964	5.5	40.7	25.0	8.1	40.0	83.3	202.7
1965	18.6	40.7	26.7	11.8	56.7	131.2	285.7
1966	6.0	20.4	28.4	13.9	42.7	154.0	265.5
1967	16.3	9.4	30.1	13.9	40.1	187.0	296.7
1968	16.4	12.5	31.7	13.0	54.4	177.3	305.3
1969	40.8	31.2	33.4	35.4	65.9	192.8	399.5
1970	18.6	20.9	35.1	35.7	85.9	274.4	470.6
1971	0.7	23.7	36.7	3.6	111.3	193.7	369.7
1972	0.8	31.6	38.4	28.3	124.9	246.9	470.9
1973	0.1	25.7	40.1	8.2	94.6	311.7	480.4
1974	0.0	19.9	75.6	32.1	108.9	353.2	589.6
1975	0.5	20.3	37.6	12.3	74.5	334.3	479.6
1976	0.2	23.7	113.1	14.1	88.5	403.1	642.6
1977	62.9	24.7	113.4	10.6	64.4	361.9	637.8
1978	55.2	47.9	148.4	11.1	69.1	327.4	659.0
1979	89.7	100.9	289.0	20.0	126.1	341.3	967.1
1980	46.6	138.5	236.0	27.9	179.5	270.2	898.7
1981	80.6	0.0	362.9	22.4	457.6	421.5	1345.0
1982	123.1	159.7	386.6	118.5	232.9	434.5	1455.3
1983	216.6	95.7	373.8	299.8	120.1	197.5	1303.5
1984	126.8	2.3	486.8	193.4	37.8	359.8	1206.9
1985	139.3	0.3	194.1	320.4	81.4	399.3	1134.8
1986	214.9	0.0	193.8	21.5	0.8	336.4	767.4
1987	92.5	0.4	202.5	21.4	67.3	207.3	591.4
1988	105.6	0.0	217.6	25.9	58.0	209.7	616.8
1989	137.2	0.0	308.6	106.6	26.6	219.8	798.8
1990	192.4	0.3	312.3	145.8	0.3	231.0	882.1
1991	413.2	0.0	156.3	125.0	21.9	246.0	962.5
1992	431.8	0.0	308.8	217.5	50.2	261.0	1269.3
1993	126.8	0.2	341.9	146.5	2.3	251.2	868.9
1994	149.9	35.9	280.8	147.9	0.3	228.1	842.9
1995	128.8	2.0	350.8	186.8	2.3	176.5	847.3
1996	191.2	0.2	376.8	128.7	10.4	143.2	850.5
1997	217.8	1.7	343.6	144.1	12.2	94.9	814.3
1998	206.4	0.4	339.6	94.0	5.5	108.7	754.7
1999	196.6	0.0	282.5	65.6	3.8	154.7	703.2
2000	159.8	0.0	308.2	55.1	1.3	131.0	655.4
2001	192.5	0.0	329.3	112.4	1.3	240.4	876.0
2002	163.5	0.0	270.2	100.6	2.0	152.7	689.1
2003	150.7	0.0	341.2	68.1	0.5	500.4	1060.9
2004	160.7	0.2	330.8	76.3	1.2	117.3	686.5
2005	138.9	0.2	309.6	85.7	0.0	183.3	717.7
2006	112.2	0.0	259.8	71.7	0.0	183.5	627.2
ALL	5319	1268	9483	4758	5208	11931	37967
Percent:	14.0%	3.3%	25.0%	12.5%	13.7%	31.4%	100%
	HKL =	26.5%	TWL =	17.1%	Rec =	56.4%	

Table 3. PacFIN reported landings "specified" as black rockfish.

Area =	A:OR-N		B:OR-S		C:CA-N		D:CA-Central		ALL
Type =	HKL	TWL	HKL	TWL	HKL	TWL	HKL	TWL	ALL
Year	MTs	MTs	MTs	MTs	MTs	MTs	MTs	MTs	MTs
1981		0.0		0.0	0.0	446.2	0.0	0.0	446.2
1982	0.0	0.0	0.0	104.2	54.7	166.6	20.9	0.0	346.4
1983		3.1		79.4	241.5	114.1	39.6	0.0	477.6
1984	0.0	2.1		0.1	155.8	36.7	19.6	0.0	214.2
1985	0.0	0.1	0.5	0.2	193.4	27.1	85.0	1.9	308.1
1986	93.3	0.0	4.7	0.0	1.5	0.7	0.1	0.0	100.3
1987	0.0	0.4	0.0	0.0	5.3	66.3	0.1	0.2	72.4
1988	0.0	0.0	0.0	0.0	0.9	56.4	0.2	0.0	57.5
1989	0.0	0.0	0.0	0.0	1.1	24.9	1.9	0.6	28.4
1990		0.0	0.5	0.3	31.1	0.0	1.5	0.0	33.4
1991		0.0	104.5	0.0	0.0	20.7	0.1	0.0	125.4
1992	169.7	0.0	132.5	0.0	189.3	49.7	10.6	0.0	551.8
1993	0.1	0.0	65.3	0.2	112.6	0.0	12.3	0.0	190.4
1994	0.3	0.0	48.6	31.2	99.7	0.0	27.9	0.0	207.7
1995	0.0	0.0	49.1	0.0	148.5	0.1	12.9	0.0	210.6
1996	0.0	0.0	70.5	0.0	74.5	0.7	16.0	0.0	161.8
1997	0.0	0.0	102.8	1.1	82.6	10.9	16.7	0.0	214.1
1998	31.0	0.0	63.7	0.0	52.7	1.8	11.7	0.0	160.9
1999	0.0	0.0	58.6	0.0	39.7	3.1	7.9	0.0	109.3
2000		0.0	58.2	0.0	35.9	0.3	4.9	0.0	99.3
2001	0.0	0.0	110.9	0.0	73.9	1.0	17.3	0.0	203.1
2002	8.6	0.0	78.2	0.0	83.4	0.0	5.3	0.0	175.5
2003	11.2	0.0	70.2	0.0	50.1	0.0	0.4	0.0	132.0
2004	0.0	0.0	72.0	0.0	60.8	1.0	2.7	0.0	136.4
2005	0.3	0.0	65.0	0.1	69.2	0.0	1.0	0.0	135.7
2006	18.1	0.0	59.6	0.0	57.1	0.0	2.5	0.0	137.4
	332.5	5.7	1215.4	216.8	1915.3	1028.3	319.2	2.7	5035.9
Percent:	6.6%	0.1%	24.1%	4.3%	38.0%	20.4%	6.3%	0.1%	100%

Table 4. Landings of black rockfish at Washington ports, 1981-2006. Data from WDFW.

Area =	A:OR-N		B:OR-S		C:CA-N		D:CA-Central		ALL
Gear =	HKL	TWL	HKL	TWL	HKL	TWL	HKL	TWL	ALL
Year									
1981		0.0	0.2	0.0		0.0		0.0	0.2
1982		0.0	0.1	0.0	0.0	0.0		0.0	0.1
1983		0.0	0.3	0.0	0.0	0.0		0.0	0.3
1984		0.0	0.0	0.0		0.0		0.0	0.0
1985		0.0	0.1	0.0		0.0		0.0	0.1
1986		0.0	0.0	0.0		0.0		0.0	0.0
1987		0.0	0.3	0.0	0.0	0.0		0.0	0.3
1988		0.0	0.0	0.0	0.0	0.0		0.0	0.0
1989		0.0	0.1	0.0		0.0		0.0	0.1
1990		0.0	0.0	0.0		0.0		0.0	0.0
1991		0.0	0.0	0.0		0.0		0.0	0.0
1992		0.0	0.0	0.0		0.0		0.0	0.0
1993		0.0	0.1	0.0		0.0		0.0	0.1
1994		0.0	1.3	0.0		0.0		0.0	1.3
1995		0.0	0.0	0.0		0.0		0.0	0.0
1996		0.0	0.0	0.0		0.0		0.0	0.0
1997		0.1	0.0	0.0		0.0		0.0	0.1
1998		0.2	0.0	0.0		0.0		0.0	0.2
1999		0.0	0.0	0.0		0.0		0.0	0.0
2000		0.0	0.8	0.0		0.0		0.0	0.8
2001		0.0	0.1	0.0		0.0		0.0	0.1
2002		0.0	0.0	0.0		0.0		0.0	0.0
2003		0.0	0.0	0.0		0.0		0.0	0.0
2004		0.0	0.0	0.0		0.0		0.0	0.0
2005		0.0	0.0	0.0		0.0		0.0	0.0
2006		0.0	0.0	0.0		0.0		0.0	0.0
	0.0	0.3	3.2	0.0	0.0	0.0	0.0	0.0	3.5

Table 5. Landings of black rockfish derived from "unspecified" rockfish plus nominal black rockfish, 1981-2006, from PacFIN data.

Area =	A:OR-N		B:OR-S		C:CA-N		D:CA-Central		ALL
Type =	HKL	TWL	HKL	TWL	HKL	TWL	HKL	TWL	ALL
Year	MTs	MTs	MTs	MTs	MTs	MTs	MTs	MTs	MTs
1981	38.5	0.0	41.9	0.0	18.4	9.4	3.9	2.0	114.0
1982	54.7	0.0	68.3	55.5	27.3	66.3	15.6	0.1	287.8
1983	125.9	0.3	90.5	13.0	5.6	5.5	13.1	0.5	254.3
1984	84.8	0.1	42.0	0.0	14.0	0.2	4.0	0.9	146.0
1985	74.3	0.0	64.4	0.0	32.1	52.4	9.9	0.0	233.2
1986	47.3	0.0	69.7	0.0	2.6	0.0	17.3	0.0	136.9
1987	19.7	0.0	72.5	0.0	8.3	0.7	7.7	0.0	108.9
1988	76.9	0.0	28.7	0.0	23.7	0.5	1.2	1.0	132.0
1989	84.2	0.0	52.9	0.0	97.7	1.2	6.0	0.0	242.0
1990	74.0	0.0	117.9	0.0	104.4	0.1	8.9	0.2	305.4
1991	154.1	0.0	154.7	0.0	115.0	1.0	9.9	0.2	434.8
1992	75.8	0.0	53.9	0.0	6.4	0.5	11.1	0.0	147.7
1993	54.2	0.0	7.1	0.0	10.6	1.8	11.0	0.5	85.2
1994	19.9	1.7	79.8	3.0	7.6	0.3	12.7	0.0	125.0
1995	56.9	0.6	22.9	1.4	16.8	2.0	8.6	0.2	109.3
1996	55.9	0.2	64.8	0.0	13.0	9.7	25.1	0.0	168.8
1997	57.1	0.0	57.9	0.5	18.6	1.2	26.3	0.1	161.6
1998	29.2	0.2	82.5	0.0	9.6	3.6	20.0	0.2	145.3
1999	55.7	0.0	82.3	0.0	11.7	0.4	6.3	0.3	156.8
2000	62.1	0.0	38.8	0.0	9.2	0.0	5.1	1.0	116.1
2001	50.8	0.0	30.7	0.0	3.7	0.0	17.5	0.2	103.0
2002	62.2	0.0	14.6	0.0	6.4	0.6	5.5	1.5	90.7
2003	62.5	0.0	6.8	0.0	14.3	0.1	3.3	0.4	87.3
2004	83.7	0.0	5.0	0.2	8.3	0.2	4.5	0.0	102.0
2005	60.0	0.0	13.6	0.0	11.9	0.0	3.6	0.0	89.2
2006	20.5	0.0	14.0	0.0	8.6	0.0	3.4	0.0	46.6
	1640.7	3.1	1377.9	73.8	605.8	157.8	261.4	9.2	4129.8

Table 6. Rockfish landings by area and gear type, 1956-1980, from Pacific Marine Fisheries Commission (PMFC) reports.

Area =	A:OR-N		B:OR-S		C:CA-N		D:CA-Central		ALL
Type =	HKL	TWL	HKL	TWL	HKL	TWL	HKL	TWL	ALL
Year	MTs	MTs	MTs	MTs	MTs	MTs	MTs	MTs	MTs
1956	6.0	1069.8	2.2	347.9	2.7	866.8	381.0	3923.2	6599.7
1957	10.8	774.1	6.3	309.4	13.8	1030.3	427.6	3968.1	6540.4
1958	3.3	861.6	2.0	379.7	0.0	1069.8	33.3	4132.9	6482.6
1959	6.0	848.9	7.5	900.4	7.3	937.8	762.7	3967.6	7438.2
1960	5.6	1390.5	3.9	826.5	10.9	1068.4	415.2	2923.2	6644.2
1961	15.4	1860.2	5.7	609.4	7.1	585.6	353.5	2417.2	5854.2
1962	15.1	1844.3	7.6	702.2	12.9	608.7	328.9	2024.9	5544.6
1963	11.5	2024.4	7.0	1075.9	28.5	991.6	294.9	2209.9	6643.8
1964	10.6	1993.6	9.7	1469.7	15.3	545.7	166.3	1827.1	6037.9
1965	51.2	4722.4	18.8	1249.7	21.7	782.0	261.6	1979.5	9086.9
1966	14.2	1433.8	8.3	700.8	20.8	577.0	463.2	2351.4	5569.6
1967	37.6	686.7	23.2	321.6	24.1	545.7	357.4	1873.8	3870.1
1968	17.7	294.8	42.0	477.2	24.6	752.5	268.2	1705.1	3582.0
1969	27.1	319.3	120.7	1222.4	82.4	919.9	204.7	1482.8	4379.4
1970	15.2	299.8	52.4	813.3	82.7	1198.9	215.8	2011.7	4689.7
1971	1.8	266.7	0.7	926.7	7.4	1562.6	56.8	1882.0	4704.7
1972	2.7	342.5	0.2	1237.1	59.9	1740.5	366.5	3085.8	6835.1
1973	0.3	441.3	0.1	992.9	14.1	1278.2	211.4	5152.9	8091.3
1974	0.0	252.7	0.0	773.8	69.9	1493.2	347.5	4386.3	7323.3
1975	1.4	314.3	0.5	788.8	*25.6*	*1028.8*	*169.4*	*2501.8*	4830.6
1976	0.1	747.5	0.5	886.8	*30.7*	*1233.2*	*149.1*	*2202.6*	5250.5
1977	84.0	381.0	146.5	956.2	*22.2*	*890.4*	*141.0*	*2082.0*	4703.3
1978	*108.7*	*1984.6*	*96.1*	*1755.4*	*23.9*	*961.5*	*124.1*	*1832.3*	6886.7
1979	*172.3*	*3989.0*	*160.5*	*3715.1*	*43.8*	*1758.3*	*207.7*	*3067.2*	13113.8
1980	*92.3*	*5792.2*	*80.9*	*5075.5*	*62.6*	*2514.3*	*237.8*	*3512.6*	17368.1

Notes: HKL landings for 1956-70 (grey-shaded above) were derived using the ratio of non-trawl to trawl reported in the US Fishery Statistics series for the corresponding years and areas.

Some of the PMFC landings statistics for Oregon during 1978-80 seemed unusal. Values in italics above for Oregon areas were derived from landings data in various "Pounds and Values" reports.

The PMFC landings statistics were incomplete for California during 1975-80. Values in italics above were derived from landings data in various Cal. Fishery Bulletins.

Table 7. Rockfish landings by area and gear type, 1927-1955, from the Fishery Statistics of the United States series.

Area =	Columbia River		Coastal Ports		A:OR-N		B:OR-S		C:CA-N		D:CA-Central		ALL
Type =	HKL	TWL	HKL	TWL	HKL	TWL	HKL	TWL	HKL	TWL	HKL	TWL	ALL
Year	MTs	MTs	MTs	MTs	MTs	MTs	MTs	MTs	MTs	MTs	MTs	MTs	MTs
1927	11.7	0.0	8.3	0.0	5.3	0.0	4.2	0.0	48.4	8.0	1046.4	178.3	1290.7
1928	25.8	0.0	7.6	0.0	6.4	0.0	3.8	0.0	39.6	9.1	1249.2	240.7	1548.8
1929	32.4	0.0	25.7	0.0	16.1	0.0	12.9	0.0	107.7	9.1	937.1	294.5	1377.4
1930	11.8	0.0	42.0	0.0	22.2	0.0	21.0	0.0	74.8	40.2	1482.8	265.2	1906.2
1931	12.2	0.0	28.9	0.0	15.7	0.0	14.5	0.0	47.9	158.8	1417.1	59.6	1713.5
1932	5.9	0.0	7.5	1.8	4.3	0.9	3.7	0.9	40.5	136.4	1139.6	100.7	1427.0
1933	5.4	0.0	15.6	1.1	8.3	0.5	7.8	0.5	14.1	206.5	898.9	143.7	1280.5
1934	15.8	0.0	8.2	0.0	5.7	0.0	4.1	0.0	58.1	123.5	902.0	150.0	1243.4
1935	16.8	0.1	4.5	0.7	3.9	0.4	2.2	0.4	71.2	138.1	1115.3	124.2	1455.6
1936	24.9	2.8	26.9	0.4	15.9	0.5	13.4	0.2	79.9	64.3	1328.1	190.4	1692.8
1937	47.2	5.9	16.4	0.3	12.9	0.7	8.2	0.1	60.6	145.7	1120.8	158.8	1507.8
1938	59.1	0.0	4.2	0.0	8.0	0.0	2.1	0.0	70.0	178.8	973.0	121.5	1353.4
1939	26.9	6.8	11.5	1.9	8.4	1.6	5.7	1.0	95.2	247.1	722.3	59.0	1140.3
1940	44.3	178.5	36.2	21.8	22.6	28.8	18.1	10.9	70.4	194.4	903.9	54.6	1303.6
1941	89.0	380.3	60.2	60.8	39.0	68.4	30.1	30.4	51.6	155.3	836.3	31.4	1242.6
1942	81.2	567.3	60.2	152.4	38.2	132.9	30.1	76.2	47.6	207.7	377.6	12.8	923.1
1943	285.4	2235.1	217.5	641.6	137.3	544.3	108.7	320.8	103.1	520.7	392.5	10.1	2137.6
1944	56.4	3489.7	80.5	1558.8	45.9	1128.4	40.2	779.4	79.0	2427.6	217.3	145.9	4863.6
1945	34.8	5217.0	66.7	2621.5	36.8	1832.4	33.3	1310.7	73.8	5241.8	574.2	44.0	9147.1
1946	57.3	2978.0	66.9	1879.1	39.2	1237.4	33.5	939.6	107.8	4190.9	565.2	43.1	7156.5
1947	18.2	2482.1	38.3	555.6	21.0	526.0	19.2	277.8	104.6	2779.0	475.5	310.5	4513.5
1948	20.0	1711.7	71.9	325.8	38.0	334.1	35.9	162.9	67.4	1725.3	591.9	279.3	3234.8
1949	22.4	1372.6	58.3	712.1	31.4	493.3	29.2	356.1	55.7	1426.2	575.8	271.7	3239.4
1950	18.5	1597.6	36.5	943.8	20.1	631.7	18.3	471.9	67.8	1630.5	1113.8	439.5	4393.6
1951	13.7	1736.6	28.5	739.1	15.6	543.2	14.3	369.6	85.1	1989.4	1030.2	1410.4	5457.9
1952	16.0	2977.8	27.0	844.4	15.1	720.0	13.5	422.2	59.8	1135.5	1254.5	2046.5	5667.2
1953	11.5	2247.8	9.9	397.5	6.1	423.6	5.0	198.8	24.5	1373.0	1461.8	2385.2	5877.9
1954	9.3	2961.0	14.9	600.2	8.4	596.2	7.4	300.1	72.4	1376.0	1701.8	2000.5	6062.8
1955	13.7	1909.3	18.1	1198.5	10.4	790.2	9.1	599.3	67.3	1278.9	1344.5	1251.2	5350.9

Notes: 10% of the reported landings at Columbia River ports were assigned to Area A (OR-North). 50% of the reported landings at coastal ports were assigned to Area A and 50% to Area B (OR-South). Landings reported for Northern California district were assigned to Area C (CA-North). Landings reported for the San Francisco and Monterey districts were assigned to Area D (CA-central).

Table 8. Sport fishery landings of black rockfish in Oregon (excluding North of Cape Falcon).

Area =	A:OR-N	B:OR-S	A	B		A	B	ALL
Type =	Ocean Boat		REC	REC		REC	REC	REC
Year	n fish	n fish	n fish	n fish	av wt (kg)	MTs	MTs	MTs
1949	0	0	0	0	0.948	0.0	0.0	0.0
1950	680	1014	707	1054	0.948	0.7	1.0	1.7
1951	1360	2028	1414	2108	0.948	1.3	2.0	3.3
1952	2040	3041	2121	3162	0.948	2.0	3.0	5.0
1953	2721	4055	2828	4216	0.948	2.7	4.0	6.7
1954	3401	5069	3536	5270	0.948	3.4	5.0	8.3
1955	4081	6083	4243	6324	0.948	4.0	6.0	10.0
1956	4761	7097	4950	7378	0.948	4.7	7.0	11.7
1957	5441	8110	5657	8432	0.948	5.4	8.0	13.4
1958	6121	9124	6364	9486	0.948	6.0	9.0	15.0
1959	6802	10138	7071	10540	0.948	6.7	10.0	16.7
1960	7482	11152	7778	11594	0.948	7.4	11.0	18.4
1961	8162	12166	8485	12648	0.948	8.0	12.0	20.0
1962	8842	13179	9193	13702	0.948	8.7	13.0	21.7
1963	9522	14193	9900	14756	0.948	9.4	14.0	23.4
1964	10202	15207	10607	15810	0.948	10.1	15.0	25.0
1965	10882	16221	11314	16864	0.948	10.7	16.0	26.7
1966	11563	17235	12021	17918	0.948	11.4	17.0	28.4
1967	12243	18248	12728	18972	0.948	12.1	18.0	30.1
1968	12923	19262	13435	20026	0.948	12.7	19.0	31.7
1969	13603	20276	14142	21080	0.948	13.4	20.0	33.4
1970	14283	21290	14849	22134	0.948	14.1	21.0	35.1
1971	14963	22303	15557	23188	0.948	14.7	22.0	36.7
1972	15643	23317	16264	24242	0.948	15.4	23.0	38.4
1973	16324	24331	16971	25296	0.948	16.1	24.0	40.1
1974	25915	50779	26943	52793	0.948	25.5	50.1	75.6
1975	15236	22955	15840	23865	0.948	15.0	22.6	37.6
1976	38033	76716	39541	79758	0.948	37.5	75.6	113.1
1977	40368	74637	41968	77596	0.948	39.8	73.6	113.4
1978	66042	84514	68660	87865	0.948	65.1	83.3	148.4
1979	118328	174913	123019	181848	0.948	116.6	172.4	289.0
1980	117007	94344	121646	98085	1.074	130.6	105.3	236.0
1981	200179	158485	208115	164768	0.973	202.6	160.4	362.9
1982	267831	191327	278450	198912	0.810	225.5	161.1	386.6
1983	263063	155851	273492	162030	0.858	234.7	139.1	373.8
1984	296506	160294	308262	166650	1.025	316.0	170.8	486.8
1985	108676	122404	112984	127257	0.808	91.3	102.8	194.1
1986	110821	88436	115215	91942	0.936	107.8	86.0	193.8
1987	102560	111113	106627	115518	0.912	97.2	105.3	202.5
1988	172603	64526	179446	67084	0.883	158.4	59.2	217.6
1989	224238	103393	233128	107493	0.906	211.2	97.4	308.6
1990	230892	89790	240046	93350	0.937	224.9	87.4	312.3

Table 8. Sport fishery landings of black rockfish in Oregon (continued).

Area =	A:OR-N	B:OR-S	A	B		A	B	ALL
Type =	Ocean Boat		REC	REC		REC	REC	REC
Year	n fish	n fish	n fish	n fish	av wt (kg)	MTs	MTs	MTs
1991	106052	54470	110256	56629	0.937	103.3	53.0	156.3
1992	208575	108446	216845	112745	0.937	203.1	105.6	308.8
1993	216807	118086	225402	122768	0.982	221.3	120.6	341.9
1994	152754	123849	158810	128759	0.977	155.1	125.7	280.8
1995	227867	138249	236901	143730	0.922	218.4	132.5	350.8
1996	284495	119053	295774	123773	0.898	265.6	111.2	376.8
1997	233850	132915	243121	138185	0.901	219.1	124.5	343.6
1998	253412	115104	263459	119668	0.887	233.6	106.1	339.6
1999	189125	118860	196623	123572	0.882	173.5	109.0	282.5
2000	196206	133621	203985	138919	0.899	183.3	124.8	308.2
2001	142953	131337	148621	136544	1.155	171.6	157.7	329.3
2002	138458	86560	143947	89992	1.155	166.2	103.9	270.2
2003	152900	134256	158961	139579	1.143	181.7	159.5	341.2
2004	154482	118509	160606	123207	1.166	187.2	143.6	330.8
2005	157867	110601	164126	114986	1.109	182.1	127.5	309.6
2006	132803	101235	138068	105249	1.068	147.4	112.4	259.8

Notes: ODFW estimates of rockfish landed by the ocean boat sport fishery begin in 1973. Landings for 1949-72 (grey-shaded above) were derived from a linear trend, zero in 1949. Landings by other segments of the sport fishery (e.g. shore-based or in estuaries) were derived from an estimate of the average percentage of the black rockfish landed in Oregon by the ocean boat fishing mode (96.2%), from RecFIN estimates of catch by mode. Average weight of a black rockfish for 1949-1979 was from the average weight observed during 1980-84.

Table 9. Sport fishery landings of black rockfish in California.

Area =	CA: N+Central			
Type =	CPFV-logs			
Year	n rock	n blck	av wt (kg)	MTs
1945		0		0.0
1946		8125		8.1
1947		16249		16.1
1948		24374		24.2
1949		32498		32.2
1950		40623		40.3
1951		48747		48.4
1952		56872		56.4
1953		64997		64.5
1954		73121		72.6
1955		81246		80.6
1956		89370		88.7
1957	296231	97495		96.7
1958	550353	181131		179.7
1959	447844	147393		146.2
1960	407924	134255		133.2
1961	293667	96651		95.9
1962	311989	102681		101.9
1963	343604	113086		112.2
1964	255148	83974		83.3
1965	401686	132202		131.2
1966	471643	155226		154.0
1967	572549	188436		187.0
1968	542978	178704		177.3
1969	590326	194287		192.8
1970	840170	276515		274.4
1971	593203	195234		193.7
1972	755944	248795		246.9
1973	954378	314103		311.7
1974	1081444	355922		353.2
1975	1023759	336937		334.3
1976	1234293	406228		403.1
1977	1108181	364722		361.9
1978	1002538	329953		327.4
1979	1045083	343955		341.3
1980	1033982	279829	0.966	270.2
1981	1175173	429089	0.982	421.5
1982	1147534	395828	1.098	434.5
1983		191272	1.032	197.5
1984		407423	0.883	359.8
1985		521117	0.766	399.3

Table 9. Sport fishery landings of black rockfish in California (continued).

Area =	CA: N+Central	Source =	RecFIN	
Year		n fish	av wt (kg)	MTs
1986		389800	0.863	336.4
1987		261235	0.794	207.3
1988		288920	0.726	209.7
1989		315858	0.696	219.8
1990		337836	0.684	231.0
1991		359814	0.684	246.0
1992		381792	0.684	261.0
1993		403770	0.622	251.2
1994		330100	0.691	228.1
1995		239336	0.737	176.5
1996		185730	0.771	143.2
1997		152601	0.622	94.9
1998		161313	0.674	108.7
1999		274359	0.564	154.7
2000		230214	0.569	131.0
2001		341512	0.704	240.4
2002		175119	0.872	152.7
2003		568824	0.880	500.4
2004		165100	0.710	117.3
2005		218818	0.838	183.3
2006		225833	0.813	183.5

Notes: RecFIN estimates of black rockfish landings began in 1980. Landings for 1957-79 (grey-shaded above) were derived from CPFV logbook reported rockfish times 0.329, which is the ratio (RecFIN black rockfish, 1980-82) over (CPFV logbook rockfish, 1980-82). Landings for 1990-92, when there was no MRFSS sampling, were derived by linear interpolation from adjacent years. Landings by commercial passenger fishing vessels (CPFV) during 1993-96, when CPFV catches were not included in the RecFIN estimates, were provided by CDFG. Average weight of a black rockfish for 1945-1979 was from the average weight observed during 1980-84.

Table 10. Low alternative landings history for black rockfish.

Area =	Oregon			California			
Type =	HKL	TWL	REC	HKL	TWL	REC	ALL
Year	MTs	MTs	MTs	MTs	MTs	MTs	MTs
1915	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1916	0.2	0.0	0.0	2.0	0.0	0.0	2.2
1917	0.3	0.0	0.0	4.0	0.0	0.0	4.4
1918	0.5	0.0	0.0	6.0	0.1	0.0	6.5
1919	0.6	0.0	0.0	8.0	0.1	0.0	8.7
1920	0.8	0.0	0.0	10.0	0.1	0.0	10.9
1921	1.0	0.0	0.0	12.0	0.1	0.0	13.1
1922	1.1	0.0	0.0	14.0	0.2	0.0	15.2
1923	1.3	0.0	0.0	16.0	0.2	0.0	17.4
1924	1.4	0.0	0.0	18.0	0.2	0.0	19.6
1925	1.6	0.0	0.0	19.9	0.2	0.0	21.8
1926	1.8	0.0	0.0	21.9	0.3	0.0	24.0
1927	1.9	0.0	0.0	23.9	0.3	0.0	26.1
1928	2.0	0.0	0.0	23.1	0.3	0.0	25.5
1929	5.8	0.0	0.0	40.8	0.3	0.0	46.9
1930	8.7	0.0	0.0	35.8	1.4	0.0	46.0
1931	6.1	0.0	0.0	27.1	5.7	0.0	38.9
1932	1.6	0.0	0.0	22.4	4.9	0.0	28.9
1933	3.3	0.0	0.0	12.3	7.4	0.0	23.0
1934	2.0	0.0	0.0	25.5	4.4	0.0	32.0
1935	1.2	0.0	0.0	31.4	5.0	0.0	37.6
1936	5.9	0.0	0.0	35.9	2.3	0.0	44.2
1937	4.2	0.0	0.0	28.3	5.2	0.0	37.7
1938	2.0	0.0	0.0	29.8	6.4	0.0	38.2
1939	2.8	0.0	0.0	35.0	8.9	0.0	46.8
1940	8.2	0.1	0.0	29.3	7.0	0.0	44.6
1941	13.9	0.4	0.0	23.0	5.6	0.0	42.9
1942	13.8	0.9	0.0	17.7	7.5	0.0	39.8
1943	49.6	3.8	0.0	34.5	18.7	0.0	106.7
1944	17.4	9.4	0.0	25.6	87.4	0.0	139.8
1945	14.2	15.7	0.0	27.3	188.7	0.0	245.9
1946	14.7	11.3	0.0	37.4	150.9	6.0	220.3
1947	8.1	3.3	0.0	35.6	100.0	12.1	159.2
1948	14.9	2.0	0.0	25.6	62.1	18.1	122.7
1949	12.2	4.3	0.0	21.9	51.3	24.2	114.0
1950	7.8	5.7	1.3	30.4	58.7	30.2	134.0
1951	6.0	4.4	2.5	34.8	71.6	36.3	155.7
1952	5.8	5.1	3.8	29.2	40.9	42.3	127.0
1953	2.2	2.4	5.0	20.5	49.4	48.4	127.9
1954	3.2	3.6	6.3	37.0	49.5	54.4	154.1
1955	3.9	7.2	7.5	32.3	46.0	60.5	157.4
1956	1.6	4.2	8.8	4.2	31.2	66.5	116.5
1957	3.4	3.7	10.0	8.0	37.1	72.6	134.8
1958	1.1	4.6	11.3	0.3	38.5	134.8	190.5
1959	2.8	10.8	12.5	9.1	33.8	109.7	178.6
1960	1.9	9.9	13.8	7.0	38.5	99.9	171.0
1961	4.2	7.3	15.0	5.3	21.1	71.9	124.9

Table 10. Low alternative landings history for black rockfish (continued).

Area =	Oregon			California			
Type =	HKL	TWL	REC	HKL	TWL	REC	ALL
Year	MTs	MTs	MTs	MTs	MTs	MTs	MTs
1962	4.5	8.4	16.3	6.8	21.9	76.4	134.4
1963	3.7	12.9	17.5	11.2	35.7	84.2	165.2
1964	4.1	17.6	18.8	6.1	19.6	62.5	128.8
1965	13.9	15.0	20.0	8.9	28.2	98.4	184.4
1966	4.5	8.4	21.3	10.4	20.8	115.5	180.9
1967	12.2	3.9	22.5	10.4	19.6	140.2	208.9
1968	12.3	5.7	23.8	9.8	27.1	133.0	211.6
1969	30.6	14.7	25.0	26.6	33.1	144.6	274.6
1970	14.0	9.8	26.3	26.7	43.2	205.8	325.7
1971	0.5	11.1	27.6	2.7	56.3	145.3	243.4
1972	0.6	14.8	28.8	21.3	62.7	185.1	313.3
1973	0.1	11.9	30.1	6.1	46.0	233.7	327.9
1974	0.0	9.3	56.7	24.1	53.8	264.9	408.7
1975	0.4	9.5	28.2	9.2	37.0	250.7	335.0
1976	0.1	10.6	84.8	10.5	44.4	302.3	452.8
1977	47.2	11.5	85.0	7.9	32.1	271.4	455.0
1978	41.4	21.1	111.3	8.3	34.6	245.5	462.2
1979	67.3	44.6	216.8	15.0	63.3	256.0	662.9
1980	35.0	60.9	177.0	20.9	90.5	202.6	586.9
1981	80.6	0.0	272.2	22.4	457.6	316.1	1148.8
1982	123.1	159.7	289.9	118.5	232.9	325.9	1250.0
1983	216.6	95.7	280.4	299.8	120.1	148.1	1160.7
1984	126.8	2.3	365.1	193.4	37.8	269.8	995.2
1985	139.3	0.3	145.6	320.4	81.4	299.4	986.4
1986	214.9	0.0	145.4	21.5	0.8	252.3	634.9
1987	92.5	0.4	151.9	21.4	67.3	155.5	489.0
1988	105.6	0.0	163.2	25.9	58.0	157.3	510.0
1989	137.2	0.0	231.5	106.6	26.6	164.8	666.7
1990	192.4	0.3	234.2	145.8	0.3	173.2	746.3
1991	413.2	0.0	117.3	125.0	21.9	184.5	861.9
1992	431.8	0.0	231.6	217.5	50.2	195.8	1126.9
1993	126.8	0.2	256.4	146.5	2.3	188.4	720.6
1994	149.9	35.9	210.6	147.9	0.3	171.0	715.7
1995	128.8	2.0	263.1	186.8	2.3	132.4	715.4
1996	191.2	0.2	282.6	128.7	10.4	107.4	720.5
1997	217.8	1.7	257.7	144.1	12.2	71.2	704.7
1998	206.4	0.4	254.7	94.0	5.5	81.5	642.6
1999	196.6	0.0	211.9	65.6	3.8	116.0	593.9
2000	159.8	0.0	231.1	55.1	1.3	98.3	545.6
2001	192.5	0.0	247.0	112.4	1.3	180.3	733.5
2002	163.5	0.0	202.6	100.6	2.0	114.5	583.4
2003	150.7	0.0	255.9	68.1	0.5	375.3	850.5
2004	160.7	0.2	248.1	76.3	1.2	88.0	574.5
2005	138.9	0.2	232.2	85.7	0.0	137.5	594.5
2006	112.2	0.0	194.9	71.7	0.0	137.6	516.4
ALL	5132	721	7113	4344	3218	8948	29475
Percent:	17.4%	2.4%	24.1%	14.7%	10.9%	30.4%	100%
	HKL =	32.1%	TWL =	13.4%	Rec =	54.5%	

Table 11. High alternative landings history for black rockfish.

Area =	Oregon			California			
Type =	HKL	TWL	REC	HKL	TWL	REC	ALL
Year	MTs	MTs	MTs	MTs	MTs	MTs	MTs
1915	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1916	0.3	0.0	0.0	3.3	0.1	0.0	3.7
1917	0.5	0.0	0.0	6.6	0.2	0.0	7.4
1918	0.8	0.0	0.0	10.0	0.4	0.0	11.1
1919	1.1	0.0	0.0	13.3	0.5	0.0	14.9
1920	1.3	0.0	0.0	16.6	0.6	0.0	18.6
1921	1.6	0.0	0.0	19.9	0.7	0.0	22.3
1922	1.9	0.0	0.0	23.3	0.9	0.0	26.0
1923	2.1	0.0	0.0	26.6	1.0	0.0	29.7
1924	2.4	0.0	0.0	29.9	1.1	0.0	33.4
1925	2.7	0.0	0.0	33.2	1.2	0.0	37.1
1926	2.9	0.0	0.0	36.6	1.4	0.0	40.9
1927	3.2	0.0	0.0	39.9	1.5	0.0	44.6
1928	3.4	0.0	0.0	38.5	1.8	0.0	43.7
1929	9.7	0.0	0.0	67.9	1.9	0.0	79.5
1930	14.6	0.0	0.0	59.7	6.2	0.0	80.4
1931	10.2	0.0	0.0	45.2	22.4	0.0	77.7
1932	2.7	0.0	0.0	37.3	19.3	0.0	59.4
1933	5.4	0.0	0.0	20.5	29.2	0.0	55.2
1934	3.3	0.0	0.0	42.6	17.6	0.0	63.4
1935	2.1	0.0	0.0	52.3	19.6	0.0	74.0
1936	9.9	0.0	0.0	59.9	9.4	0.0	79.2
1937	7.1	0.0	0.0	47.1	20.7	0.0	74.9
1938	3.3	0.0	0.0	49.6	25.3	0.0	78.2
1939	4.7	0.1	0.0	58.4	34.7	0.0	97.9
1940	13.7	0.7	0.0	48.8	27.3	0.0	90.4
1941	23.2	1.8	0.0	38.4	21.8	0.0	85.2
1942	23.0	4.3	0.0	29.4	29.1	0.0	85.9
1943	82.7	18.2	0.0	57.5	72.9	0.0	231.3
1944	29.0	43.5	0.0	42.7	340.2	0.0	455.4
1945	23.6	72.9	0.0	45.5	733.9	0.0	876.0
1946	24.4	51.9	0.0	62.4	586.8	10.1	735.6
1947	13.5	16.0	0.0	59.4	389.7	20.2	498.8
1948	24.9	9.5	0.0	42.6	242.1	30.2	349.3
1949	20.4	19.8	0.0	36.5	200.2	40.3	317.2
1950	12.9	26.1	2.1	50.6	229.2	50.4	371.3
1951	10.1	20.7	4.2	58.0	281.3	60.5	434.7
1952	9.6	24.0	6.3	48.7	163.1	70.5	322.2
1953	3.7	11.6	8.3	34.2	197.0	80.6	335.5
1954	5.3	17.4	10.4	61.7	196.6	90.7	382.2
1955	6.6	33.1	12.5	53.8	181.5	100.8	388.4
1956	2.7	21.7	14.6	7.1	129.2	110.8	286.1
1957	5.7	18.6	16.7	13.3	152.2	120.9	327.4
1958	1.8	22.4	18.8	0.5	158.0	224.7	426.2
1959	4.6	48.4	20.9	15.1	139.2	182.8	411.0
1960	3.2	46.9	23.0	11.7	155.4	166.5	406.7
1961	7.0	37.9	25.0	8.9	86.8	119.9	285.5

Table 11. High alternative landings history for black rockfish (continued).

Area =	Oregon			California			
Type =	HKL	TWL	REC	HKL	TWL	REC	ALL
Year	MTs	MTs	MTs	MTs	MTs	MTs	MTs
1962	7.6	42.5	27.1	11.4	89.3	127.4	305.2
1963	6.2	61.9	29.2	18.7	143.2	140.3	399.5
1964	6.8	81.5	31.3	10.2	80.0	104.2	314.0
1965	23.2	81.4	33.4	14.8	113.4	164.0	430.2
1966	7.5	40.8	35.5	17.4	85.5	192.5	379.2
1967	20.3	18.8	37.6	17.4	80.1	233.7	408.0
1968	20.4	25.0	39.7	16.3	108.8	221.6	431.8
1969	51.1	62.4	41.7	44.3	131.8	241.0	572.2
1970	23.3	41.9	43.8	44.6	171.9	343.0	668.4
1971	0.8	47.4	45.9	4.5	222.5	242.1	563.4
1972	1.0	63.2	48.0	35.4	249.8	308.6	706.0
1973	0.2	51.4	50.1	10.2	189.3	389.6	690.7
1974	0.0	39.7	94.5	40.1	217.8	441.4	833.6
1975	0.6	40.7	47.1	15.3	149.0	417.9	670.6
1976	0.2	47.3	141.4	17.6	177.1	503.8	887.4
1977	78.6	49.3	141.7	13.2	128.8	452.4	864.0
1978	69.0	95.7	185.5	13.8	138.3	409.2	911.5
1979	112.2	201.7	361.3	25.0	252.3	426.6	1379.1
1980	58.3	276.9	295.0	34.9	359.0	337.7	1361.8
1981	80.6	0.0	453.7	22.4	457.6	526.9	1541.1
1982	123.1	159.7	483.2	118.5	232.9	543.1	1660.6
1983	216.6	95.7	467.3	299.8	120.1	246.8	1446.3
1984	126.8	2.3	608.5	193.4	37.8	449.7	1418.5
1985	139.3	0.3	242.6	320.4	81.4	499.1	1283.1
1986	214.9	0.0	242.3	21.5	0.8	420.4	900.0
1987	92.5	0.4	253.2	21.4	67.3	259.1	693.9
1988	105.6	0.0	272.0	25.9	58.0	262.1	723.6
1989	137.2	0.0	385.8	106.6	26.6	274.7	930.9
1990	192.4	0.3	390.4	145.8	0.3	288.7	1017.9
1991	413.2	0.0	195.4	125.0	21.9	307.5	1063.0
1992	431.8	0.0	385.9	217.5	50.2	326.3	1411.8
1993	126.8	0.2	427.4	146.5	2.3	314.0	1017.2
1994	149.9	35.9	351.0	147.9	0.3	285.1	970.1
1995	128.8	2.0	438.5	186.8	2.3	220.6	979.1
1996	191.2	0.2	471.0	128.7	10.4	179.0	980.5
1997	217.8	1.7	429.4	144.1	12.2	118.6	923.9
1998	206.4	0.4	424.6	94.0	5.5	135.9	866.8
1999	196.6	0.0	353.1	65.6	3.8	193.3	812.4
2000	159.8	0.0	385.2	55.1	1.3	163.8	765.2
2001	192.5	0.0	411.6	112.4	1.3	300.5	1018.4
2002	163.5	0.0	337.7	100.6	2.0	190.9	794.8
2003	150.7	0.0	426.5	68.1	0.5	625.5	1271.3
2004	160.7	0.2	413.5	76.3	1.2	146.6	798.5
2005	138.9	0.2	387.0	85.7	0.0	229.1	840.9
2006	112.2	0.0	324.8	71.7	0.0	229.4	738.1
ALL	5506	2237	11854	5172	9217	14914	48900
Percent:	11.3%	4.6%	24.2%	10.6%	18.8%	30.5%	100%
	HKL =	21.8%	TWL =	23.4%	Rec =	54.7%	

Table 12. Black rockfish length composition sample sizes.

Oregon	Number of trips or interviews						Number of fish length measurements					
Year	HKL	TWL	REC	REC-2	REC-3	Total	HKL	TWL	REC	REC-2	REC-3	Total
1974		1				1		100				100
1978				7.4*		7				259		259
1979				3.6*		4				126		126
1980			121	1.4*		122			781	50		831
1981			70	2*		72			472	69		541
1982			151	5.3*		156			949	187		1136
1983			56	2.9*		59			298	101		399
1984			217	22.3*		239			1347	781		2128
1985			296	13.9*		310			1785	487		2272
1986			196	22.7*		219			1299	794		2093
1987			185	18*		203			865	629		1494
1988			276	14.3*		290			1364	502		1866
1989			143	22.8*		166			917	798		1715
1990				60*		60				2099		2099
1991				36.3*		36				1270		1270
1992	9			54.1*		63	216			1894		2110
1993			322	37.6*		360			1869	1315		3184
1994		1	451	90.9*		543		41	2175	3182		5398
1995	14		349	57.3*		420	404		2156	2004		4564
1996	6		326	46.9*		379	228		2171	1643		4042
1997	9	2	452	55		518	246	65	3054	1847		5212
1998	12		757	57		826	278		3905	1584		5767
1999	7		795	123		925	152		5083	3247		8482
2000	30		673	174		877	603		4229	4624		9456
2001	67	1	405	20	508	1001	1029	20	2249	440	5613	9351
2002	93		450	114	607	1264	1216		2235	3696	3682	10829
2003	123			116	680	919	1314			3416	3443	8173
2004	221			79	457	757	3510			3260	2572	9342
2005	100	1		146	668	915	2217	36		3082	3589	8924
2006	161				1126	1287	4695				7084	11779
All	852	6	6691	972	4046	12998.714	16108	262	39203	43386	25983	124942

Notes: REC = Data from RecFIN, collected by the Marine Recreational Fishery Statistics Survey.
REC-2 = Data collected by ODFW's Ocean Recreational Boat Survey (ORBS) program.
* Trip details unavailable. Estimate based on 35 fish per sample.
REC-3 = Extra data collected by ORBS.

Table 12. Black rockfish length composition sample sizes (continued).

California	Number of trips or interviews						Number of fish length measurements					
Year	HKL	TWL	REC	REC-2	REC-3	Total	HKL	TWL	REC	REC-2	REC-3	Total
1978		6				6		52				52
1980		16	108			124		132	478			610
1981		16	102			118		130	439			569
1982	3	25	126			154	55	313	558			926
1983	3	17	80			100	71	212	368			651
1984	2	10	152			164	57	176	590			823
1985	1	9	328			338	31	157	1318			1506
1986		3	254			257		27	1012			1039
1987		8	99	2		109		184	402	48		634
1988		3	90	20		113		63	313	888		1264
1989		8	97	20		125		80	364	948		1392
1990		1		7		8		5		261		266
1991		2		17		19		36		521		557
1992	49	3		24		76	948	65		384		1397
1993	143		386	31		560	2413		1253	711		4377
1994	134		227	35		396	2823		900	1024		4747
1995	82		196	21		299	2145		658	840		3643
1996	68	1	351	30		450	1953	25	1516	1088		4582
1997	46	3	121	49		219	967	82	1422	1798		4269
1998	20	1	178	33		232	300	6	769	450		1525
1999	172	1	371			544	4720	25	1426			6171
2000	36	1	272			309	571	25	901			1497
2001	50	4	244			298	952	47	983			1982
2002	33		338			371	601		1247			1848
2003	5	1	660			666	123	19	2345			2487
2004	14	1			1006	1021	257	9			3332	3598
2005	11				1578	1589	220				5259	5479
2006	31				1784	1815	641				5223	5864
All	903	140	4780	289	4368	10480	19848	1870	19262	8961	13814	63755

Notes: REC = Data from RecFIN, collected by the Marine Recreational Fishery Statistics Survey.
REC-2 = Data collected by CDFG's CPFV Observer Program.
REC-3 = Data collected by CDFG's California Recreational Fishery Survey (CRFS).

Table 13. Sample sizes for black rockfish age composition data (standard age-readers).

	Number of trips or interviews.			Number of fish with age-readings.		
Year	HKL	REC-2	Total	HKL	REC-2	Total
Oregon						
1996		17.8*	17.8		624	624
1997		13	13		457	457
1998		22	22		522	522
1999		61	61		1607	1607
2000		91	91		2320	2320
2002	22	103	125	316	3397	3713
2003	27	115	142	462	2230	2692
2004	19	79	98	385	2311	2696
2005	13	111	124	310	1446	1756
California	No ages available.					
All	81	604	693.8	1473	14914	16387

* Trip details unavailable. Estimate based on 35 fish per sample.

Table 14. Black rockfish fishery length composition data - sexed.

	Length in cm			Females													
Year	<=24	24	26	28	30	32	34	36	38	40	42	44	46	48	50	52	54	56+
OR-HKL																		
1992	0.0%	0.0%	0.0%	0.0%	0.3%	2.2%	2.4%	2.3%	6.8%	5.6%	7.3%	5.3%	3.0%	2.0%	3.8%	0.1%	0.0%	0.0%
1995	0.0%	0.0%	0.0%	0.0%	1.7%	2.8%	6.8%	4.8%	7.2%	8.1%	3.9%	7.0%	5.4%	1.6%	1.8%	0.3%	0.0%	0.0%
1996	0.0%	0.0%	0.0%	0.0%	0.0%	0.4%	3.4%	4.7%	8.5%	4.8%	4.7%	4.7%	1.1%	2.0%	0.0%	0.0%	0.0%	0.0%
1997	0.0%	0.1%	0.0%	0.3%	0.6%	2.3%	2.5%	6.6%	7.6%	4.2%	4.8%	5.6%	1.5%	0.5%	0.4%	0.0%	0.0%	0.0%
1998	0.0%	0.0%	0.0%	0.4%	0.4%	1.8%	3.3%	4.0%	5.2%	5.7%	3.2%	2.9%	2.1%	0.1%	0.4%	0.0%	1.0%	0.0%
1999	0.0%	1.4%	0.0%	0.0%	2.5%	6.7%	6.5%	7.5%	2.8%	5.9%	4.7%	0.4%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
2000	0.0%	0.0%	0.1%	0.4%	2.3%	1.9%	7.6%	9.5%	8.9%	5.7%	6.7%	2.3%	1.7%	0.3%	0.3%	0.7%	0.0%	0.0%
2001	0.0%	0.0%	0.0%	0.0%	0.6%	2.9%	4.9%	8.7%	10.7%	12.0%	8.9%	2.9%	2.9%	0.9%	0.0%	0.0%	0.0%	0.0%
2002*	0.0%	0.0%	0.0%	0.1%	0.9%	2.3%	4.4%	6.0%	9.7%	9.2%	8.9%	7.6%	3.2%	2.1%	0.8%	0.0%	0.0%	0.0%
2003*	0.2%	0.0%	0.2%	0.2%	1.4%	3.0%	5.0%	3.8%	7.4%	8.1%	8.6%	5.7%	2.4%	0.9%	0.2%	0.0%	0.0%	0.0%
2004*	0.0%	0.0%	0.0%	0.2%	1.8%	4.8%	6.9%	7.3%	5.3%	5.4%	6.9%	6.2%	3.8%	1.1%	0.4%	0.0%	0.0%	0.0%
2005*	0.0%	0.0%	0.0%	0.0%	1.1%	4.6%	7.9%	7.9%	5.9%	4.7%	5.0%	5.4%	2.3%	1.1%	0.2%	0.0%	0.0%	0.0%
2006	0.0%	0.0%	0.3%	0.2%	1.6%	3.3%	5.6%	7.6%	7.0%	5.5%	6.0%	6.2%	3.8%	1.2%	0.6%	0.2%	0.1%	0.0%
	* Sample age composition data used; length composition data not used.																	
OR-Rec-ORBS																		
1990	0.0%	0.0%	0.2%	0.8%	1.1%	2.1%	6.0%	9.1%	8.2%	7.9%	6.5%	4.8%	3.2%	1.8%	0.7%	0.2%	0.0%	0.0%
1991	0.0%	0.0%	0.0%	1.7%	3.8%	3.0%	4.0%	9.6%	11.8%	7.5%	9.1%	2.0%	1.8%	0.5%	0.0%	0.1%	0.0%	0.0%
1992	0.0%	0.1%	0.3%	0.9%	0.9%	1.8%	4.6%	6.9%	9.1%	9.6%	6.0%	4.5%	1.8%	1.4%	0.1%	0.0%	0.0%	0.0%
1993	0.2%	0.2%	0.7%	1.2%	2.0%	2.7%	4.5%	5.7%	6.9%	6.3%	6.2%	4.4%	2.9%	0.9%	0.2%	0.1%	0.0%	0.0%
1994	0.1%	0.1%	0.4%	0.9%	2.1%	4.7%	4.4%	6.0%	7.8%	7.8%	5.7%	4.0%	2.4%	1.5%	0.3%	0.1%	0.0%	0.0%
1995	0.1%	0.2%	0.3%	1.3%	2.9%	4.9%	6.0%	6.5%	8.1%	7.9%	4.8%	3.1%	1.8%	0.8%	0.2%	0.0%	0.1%	0.0%
1996	0.0%	0.2%	0.5%	1.3%	2.0%	4.3%	6.6%	8.1%	8.3%	6.3%	3.7%	3.1%	0.9%	0.4%	0.1%	0.0%	0.0%	0.0%
1997	0.0%	0.3%	0.2%	2.1%	3.8%	4.3%	7.4%	8.0%	8.3%	7.0%	4.7%	2.8%	1.8%	1.1%	0.3%	0.0%	0.1%	0.0%
1998	0.2%	0.6%	0.7%	1.5%	2.3%	5.4%	8.3%	9.4%	6.5%	4.5%	4.1%	2.5%	1.6%	0.6%	0.3%	0.1%	0.1%	0.0%
1999	0.2%	0.0%	0.2%	0.8%	2.8%	5.5%	7.8%	8.8%	9.6%	6.1%	4.1%	1.9%	1.3%	0.8%	0.2%	0.1%	0.0%	0.0%
2000	0.0%	0.2%	0.3%	0.4%	2.2%	4.2%	7.5%	10.7%	10.4%	6.3%	4.1%	1.7%	0.8%	0.3%	0.1%	0.0%	0.0%	0.0%
2001	0.0%	0.0%	0.2%	0.1%	0.1%	2.4%	6.8%	10.9%	9.1%	6.4%	6.3%	3.5%	1.9%	0.0%	0.2%	0.2%	0.0%	0.0%
2002	0.1%	0.2%	0.6%	1.2%	1.2%	2.5%	3.7%	5.7%	10.1%	11.6%	8.2%	4.3%	2.3%	0.6%	0.2%	0.0%	0.0%	0.0%
2003	0.0%	0.1%	0.2%	0.6%	1.8%	2.9%	4.1%	6.0%	8.2%	9.0%	7.8%	5.1%	2.6%	0.9%	0.3%	0.2%	0.1%	0.0%
2004	0.0%	0.1%	0.5%	0.8%	2.3%	3.3%	6.7%	6.6%	7.3%	8.0%	8.1%	4.3%	1.5%	0.8%	0.3%	0.0%	0.1%	0.0%
2005	0.1%	0.0%	0.0%	0.2%	1.2%	3.6%	7.7%	8.5%	8.1%	7.4%	6.5%	3.9%	1.3%	1.0%	0.1%	0.1%	0.1%	0.0%

Table 14. Black rockfish fishery length composition data – sexed (continued).

	Length in cm			Males													
Year	<=24	24	26	28	30	32	34	36	38	40	42	44	46	48	50	52	54	56+
OR-HKL																		
1992	0.0%	0.0%	0.0%	0.0%	2.0%	0.1%	0.6%	2.7%	7.7%	9.2%	12.2%	12.5%	5.7%	5.0%	0.3%	1.2%	0.0%	0.0%
1995	0.0%	0.0%	0.0%	0.4%	1.1%	2.4%	4.7%	4.1%	8.5%	8.2%	10.9%	6.3%	1.3%	0.7%	0.1%	0.0%	0.0%	0.0%
1996	0.0%	0.0%	0.0%	0.0%	0.4%	2.0%	3.3%	7.1%	9.7%	18.6%	15.2%	7.7%	1.6%	0.0%	0.0%	0.0%	0.0%	0.0%
1997	0.0%	0.2%	0.3%	0.9%	1.7%	3.5%	7.3%	3.7%	10.3%	14.0%	12.5%	6.1%	2.1%	0.1%	0.1%	0.0%	0.0%	0.0%
1998	0.0%	0.0%	0.4%	1.0%	2.1%	4.8%	6.9%	11.7%	11.1%	15.9%	10.1%	4.9%	0.2%	0.4%	0.0%	0.0%	0.0%	0.0%
1999	0.0%	0.0%	0.0%	1.4%	1.6%	6.1%	7.4%	13.6%	9.2%	12.7%	4.0%	1.4%	4.2%	0.0%	0.0%	0.0%	0.0%	0.0%
2000	0.0%	0.0%	0.1%	0.3%	0.5%	2.6%	8.4%	8.7%	10.4%	7.4%	5.6%	3.3%	3.6%	0.4%	0.4%	0.0%	0.0%	0.0%
2001	0.0%	0.0%	0.0%	0.0%	0.2%	0.7%	3.2%	5.6%	10.5%	11.7%	7.3%	3.3%	1.0%	0.7%	0.0%	0.0%	0.0%	0.1%
2002*	0.0%	0.0%	0.0%	0.0%	0.3%	1.3%	2.2%	5.2%	9.0%	12.3%	9.3%	3.7%	1.4%	0.1%	0.0%	0.0%	0.0%	0.0%
2003*	0.0%	0.0%	0.0%	0.7%	2.2%	2.4%	2.7%	7.0%	13.5%	11.6%	7.9%	3.0%	1.2%	0.9%	0.0%	0.0%	0.0%	0.0%
2004*	0.0%	0.0%	0.0%	0.1%	0.9%	3.1%	5.9%	6.9%	8.2%	11.0%	9.2%	3.0%	1.0%	0.4%	0.0%	0.0%	0.0%	0.0%
2005*	0.0%	0.0%	0.0%	0.2%	1.0%	4.5%	9.4%	6.8%	8.4%	12.5%	7.8%	2.6%	0.7%	0.1%	0.0%	0.0%	0.0%	0.0%
2006	0.0%	0.0%	0.0%	0.3%	0.6%	1.7%	4.9%	7.6%	9.2%	11.6%	8.5%	4.2%	1.3%	0.5%	0.1%	0.0%	0.0%	0.0%
	* Sample age composition data used; length composition data not used.																	
OR-Rec-ORBS																		
1990	0.0%	0.0%	0.8%	0.3%	1.7%	2.4%	6.2%	7.9%	7.7%	9.0%	5.7%	3.6%	1.0%	1.0%	0.1%	0.0%	0.0%	0.0%
1991	0.0%	0.0%	0.8%	0.0%	1.2%	5.8%	9.2%	8.6%	5.8%	7.5%	3.3%	2.1%	0.7%	0.2%	0.0%	0.0%	0.0%	0.0%
1992	0.0%	0.1%	0.1%	1.0%	1.9%	2.7%	5.4%	9.5%	10.4%	9.8%	7.0%	3.2%	0.7%	0.2%	0.0%	0.1%	0.0%	0.0%
1993	0.1%	0.2%	0.8%	1.9%	2.3%	3.2%	4.6%	7.6%	12.1%	10.2%	8.5%	2.1%	0.9%	0.2%	0.0%	0.0%	0.0%	0.0%
1994	0.0%	0.0%	0.4%	0.8%	1.8%	3.2%	5.0%	6.1%	9.1%	8.7%	8.3%	5.4%	2.4%	0.3%	0.1%	0.0%	0.0%	0.0%
1995	0.0%	0.0%	0.2%	1.1%	2.8%	4.7%	8.2%	9.3%	8.8%	6.6%	5.3%	2.4%	1.1%	0.2%	0.3%	0.1%	0.0%	0.0%
1996	0.3%	0.7%	0.8%	1.4%	2.6%	5.1%	9.3%	8.8%	10.3%	8.3%	5.5%	1.1%	0.3%	0.0%	0.0%	0.0%	0.0%	0.0%
1997	0.0%	0.1%	0.2%	0.9%	1.8%	4.9%	7.6%	6.8%	8.9%	7.1%	4.0%	2.4%	2.3%	0.8%	0.2%	0.0%	0.0%	0.0%
1998	0.3%	0.4%	0.9%	0.9%	2.1%	5.3%	9.1%	9.0%	8.0%	7.5%	3.9%	2.0%	1.1%	0.7%	0.2%	0.0%	0.0%	0.0%
1999	0.1%	0.2%	0.1%	0.6%	2.6%	5.3%	7.8%	9.7%	8.3%	6.2%	4.7%	2.3%	1.1%	0.7%	0.2%	0.0%	0.0%	0.0%
2000	0.1%	0.2%	0.2%	0.9%	2.8%	4.7%	10.2%	11.6%	9.1%	6.0%	3.4%	1.2%	0.4%	0.1%	0.0%	0.0%	0.0%	0.0%
2001	0.0%	0.0%	0.2%	0.0%	1.6%	2.7%	10.4%	13.2%	7.6%	8.1%	5.0%	2.0%	1.1%	0.0%	0.2%	0.0%	0.0%	0.0%
2002	0.0%	0.3%	0.8%	1.4%	1.3%	2.5%	5.1%	10.6%	12.3%	8.3%	3.4%	1.1%	0.2%	0.1%	0.0%	0.0%	0.0%	0.0%
2003	0.1%	0.1%	0.5%	0.6%	2.3%	4.0%	5.9%	8.3%	12.2%	9.0%	4.0%	2.0%	0.9%	0.3%	0.0%	0.0%	0.0%	0.0%
2004	0.1%	0.1%	0.3%	0.6%	1.6%	4.7%	7.9%	9.6%	11.3%	7.9%	3.3%	1.4%	0.4%	0.2%	0.0%	0.0%	0.0%	0.0%
2005	0.0%	0.0%	0.0%	0.3%	0.9%	3.1%	6.0%	9.4%	11.8%	10.2%	5.4%	2.2%	0.6%	0.2%	0.0%	0.0%	0.0%	0.0%

Table 14. Black rockfish fishery length composition data - unsexed.

	Length in cm			Both sexes													
Year	<=24	24	26	28	30	32	34	36	38	40	42	44	46	48	50	52	54	56+
OR-TWL																		
1974	0.0%	0.0%	1.0%	0.0%	0.0%	0.0%	0.0%	0.0%	2.0%	5.0%	16.0%	16.0%	18.0%	14.0%	11.0%	10.0%	6.0%	1.0%
1994	0.0%	0.0%	0.0%	4.9%	0.0%	0.0%	12.2%	4.9%	17.1%	9.8%	22.0%	17.1%	9.8%	2.4%	0.0%	0.0%	0.0%	0.0%
1997	0.0%	0.0%	0.0%	1.7%	1.7%	0.0%	0.0%	0.0%	1.3%	6.1%	18.4%	33.1%	26.6%	5.7%	5.3%	0.0%	0.0%	0.0%
2001	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	10.0%	35.0%	10.0%	20.0%	0.0%	5.0%	15.0%	5.0%	0.0%	0.0%
2005	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	2.8%	22.2%	19.5%	11.1%	22.2%	8.3%	5.6%	0.0%	8.3%	0.0%	0.0%
OR-REC																		
1980	0.3%	0.6%	1.9%	7.0%	5.8%	7.2%	9.8%	12.9%	10.4%	10.7%	9.3%	8.4%	6.3%	5.5%	2.6%	1.2%	0.1%	0.0%
1981	0.6%	0.1%	3.4%	2.6%	7.8%	11.5%	11.1%	10.1%	11.3%	12.5%	8.0%	7.9%	7.0%	4.1%	0.9%	0.6%	0.1%	0.3%
1982	0.1%	0.2%	0.7%	2.7%	5.1%	10.0%	10.9%	13.4%	13.0%	12.9%	12.8%	7.3%	6.3%	2.9%	1.2%	0.1%	0.4%	0.0%
1983	0.0%	0.2%	2.3%	1.9%	6.7%	7.3%	16.8%	15.2%	13.5%	11.3%	10.4%	7.2%	3.7%	1.9%	0.0%	0.0%	1.1%	0.6%
1984	0.3%	0.3%	1.3%	2.4%	3.0%	8.8%	12.9%	18.6%	13.6%	12.9%	11.7%	7.0%	4.0%	2.0%	1.0%	0.3%	0.1%	0.0%
1985	0.7%	2.9%	1.7%	4.3%	7.8%	7.2%	10.7%	16.6%	14.1%	14.8%	9.3%	5.0%	2.5%	1.6%	0.4%	0.2%	0.2%	0.1%
1986	0.0%	0.9%	1.0%	3.2%	6.2%	6.5%	11.5%	15.7%	16.6%	18.9%	10.5%	5.8%	1.6%	1.1%	0.4%	0.0%	0.1%	0.0%
1987	1.4%	2.7%	3.4%	6.0%	8.1%	7.5%	8.7%	13.3%	8.1%	14.3%	9.8%	8.3%	4.0%	3.2%	0.6%	0.4%	0.0%	0.2%
1988	2.7%	2.7%	3.2%	5.4%	7.6%	10.6%	13.3%	15.7%	12.7%	10.6%	6.7%	3.8%	2.8%	1.7%	0.5%	0.1%	0.0%	0.0%
1989	0.6%	0.8%	1.0%	3.0%	4.6%	10.8%	12.3%	15.4%	12.9%	14.4%	11.0%	6.3%	3.8%	1.5%	0.3%	0.7%	0.1%	0.4%
1993	0.2%	0.2%	1.1%	2.7%	4.4%	10.2%	10.4%	17.3%	17.2%	14.2%	10.0%	7.2%	3.2%	1.3%	0.2%	0.1%	0.1%	0.0%
1994	0.5%	0.6%	1.0%	2.3%	4.9%	8.6%	12.0%	15.9%	14.4%	16.0%	10.8%	6.6%	3.1%	1.6%	0.6%	0.8%	0.3%	0.0%
1995	0.0%	0.3%	0.8%	2.7%	4.7%	11.1%	14.8%	17.0%	16.7%	15.1%	8.9%	4.0%	2.3%	1.4%	0.2%	0.0%	0.0%	0.0%
1996	0.0%	0.1%	1.6%	2.5%	4.6%	11.1%	12.7%	15.1%	17.0%	15.3%	11.3%	5.2%	2.0%	0.9%	0.3%	0.0%	0.0%	0.2%
1997	0.2%	0.2%	1.1%	2.8%	5.1%	11.4%	17.4%	17.0%	14.8%	12.6%	9.2%	5.3%	1.8%	0.9%	0.2%	0.2%	0.0%	0.0%
1998	0.1%	0.3%	1.4%	3.2%	5.5%	9.1%	13.2%	17.0%	17.7%	12.9%	10.0%	5.3%	2.5%	1.5%	0.2%	0.0%	0.0%	0.0%
1999	0.0%	0.1%	0.9%	3.1%	7.1%	13.1%	17.3%	18.9%	15.3%	11.7%	7.5%	2.8%	1.6%	0.4%	0.2%	0.0%	0.0%	0.0%
2000	0.2%	0.2%	1.1%	2.2%	5.3%	10.8%	17.6%	19.5%	17.6%	12.2%	7.8%	3.8%	0.9%	0.3%	0.1%	0.1%	0.0%	0.2%
2001	0.1%	0.2%	0.9%	2.0%	3.1%	6.3%	14.4%	21.8%	20.9%	15.1%	8.2%	4.3%	1.3%	0.6%	0.6%	0.2%	0.0%	0.0%
2002	0.0%	0.1%	0.8%	1.4%	3.6%	4.6%	9.8%	16.7%	22.1%	18.5%	12.3%	6.0%	2.6%	0.9%	0.5%	0.1%	0.1%	0.1%
OR-ORBS																		
1978	0.0%	0.0%	3.1%	5.4%	7.0%	6.6%	11.2%	10.4%	14.3%	12.7%	5.4%	8.5%	7.0%	5.4%	2.7%	0.4%	0.0%	0.0%
1979	0.0%	0.0%	0.0%	0.0%	0.0%	1.6%	6.4%	11.9%	14.3%	22.2%	22.2%	8.7%	7.9%	2.4%	0.8%	0.8%	0.8%	0.0%

Table 14. Black rockfish fishery length composition data – unsexed (continued).

	Length in cm			Both sexes														
Year	<=24	24	26	28	30	32	34	36	38	40	42	44	46	48	50	52	54	56+
OR-ORBS (cont.)																		
1980	0.0%	0.0%	0.0%	0.0%	2.0%	2.0%	12.0%	10.0%	16.0%	16.0%	32.0%	2.0%	6.0%	2.0%	0.0%	0.0%	0.0%	0.0%
1981	0.0%	0.0%	0.0%	0.0%	1.5%	4.4%	7.3%	8.7%	13.0%	17.4%	24.6%	14.5%	5.8%	2.9%	0.0%	0.0%	0.0%	0.0%
1982	0.0%	0.0%	0.0%	0.5%	0.0%	3.2%	5.3%	11.8%	8.6%	17.1%	18.2%	13.9%	8.6%	5.9%	4.8%	2.1%	0.0%	0.0%
1983	0.0%	0.0%	0.0%	1.0%	2.0%	9.9%	13.9%	18.8%	23.8%	16.8%	6.9%	3.0%	2.0%	2.0%	0.0%	0.0%	0.0%	0.0%
1984	0.0%	0.1%	0.0%	0.5%	1.4%	5.3%	11.4%	14.9%	16.9%	15.6%	11.8%	10.8%	4.7%	4.0%	1.5%	0.8%	0.4%	0.0%
1985	0.0%	0.0%	0.2%	0.2%	0.2%	3.3%	5.8%	15.2%	21.4%	14.6%	16.0%	10.7%	7.6%	3.9%	0.8%	0.2%	0.0%	0.0%
1986	0.0%	0.0%	0.3%	0.3%	1.8%	1.5%	5.0%	11.2%	17.4%	17.8%	12.9%	11.7%	9.8%	5.3%	3.2%	1.0%	0.8%	0.3%
1987	0.0%	0.3%	0.5%	0.8%	1.4%	1.7%	5.4%	10.3%	15.3%	18.8%	16.4%	12.3%	8.4%	5.2%	2.4%	0.6%	0.2%	0.0%
1988	0.0%	0.0%	0.0%	0.0%	0.6%	2.2%	4.2%	5.2%	9.0%	13.9%	18.3%	16.3%	14.0%	10.4%	3.6%	2.0%	0.4%	0.0%
1989	0.0%	0.0%	0.0%	0.0%	0.4%	1.1%	3.6%	8.0%	11.0%	13.2%	18.7%	17.5%	11.0%	7.8%	4.6%	2.1%	0.9%	0.0%
OR-ORBS-2																		
2001	0.2%	0.2%	0.6%	1.1%	2.8%	4.6%	8.6%	19.4%	22.4%	18.4%	10.5%	6.2%	3.1%	1.0%	0.6%	0.1%	0.1%	0.0%
2002	0.0%	0.9%	0.9%	1.5%	3.0%	4.0%	6.3%	13.2%	22.2%	20.0%	13.2%	8.2%	3.1%	2.0%	0.8%	0.4%	0.2%	0.2%
2003	0.0%	0.5%	0.2%	1.7%	3.6%	6.5%	8.0%	12.5%	15.6%	17.3%	14.7%	9.6%	4.7%	2.5%	1.2%	0.7%	0.6%	0.2%
2004	0.0%	0.0%	0.4%	0.9%	2.5%	5.7%	12.5%	13.1%	16.0%	17.1%	13.1%	9.9%	4.5%	2.8%	1.1%	0.2%	0.1%	0.0%
2005	0.0%	0.0%	0.2%	0.4%	2.1%	4.0%	11.6%	13.5%	19.8%	19.4%	13.5%	7.7%	4.8%	1.5%	0.7%	0.8%	0.0%	0.1%
2006	0.0%	0.0%	0.1%	0.7%	1.7%	5.9%	11.3%	15.6%	17.5%	18.2%	13.7%	7.9%	4.0%	1.4%	0.9%	0.6%	0.3%	0.2%
CA-HKL																		
1982	0.0%	0.0%	0.0%	1.8%	1.8%	3.6%	3.6%	14.5%	3.6%	14.5%	12.7%	18.2%	10.9%	7.3%	3.6%	1.8%	0.0%	1.8%
1983	0.0%	0.0%	0.0%	1.4%	0.0%	0.0%	4.2%	1.4%	9.9%	16.9%	26.8%	14.1%	12.7%	9.9%	2.8%	0.0%	0.0%	0.0%
1984	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	10.5%	1.8%	7.0%	29.8%	22.8%	17.5%	8.8%	1.8%	0.0%	0.0%	0.0%
1985	0.0%	0.0%	0.0%	3.2%	3.2%	0.0%	6.5%	9.7%	9.7%	16.1%	19.4%	19.4%	6.5%	6.5%	0.0%	0.0%	0.0%	0.0%
1992	0.4%	1.6%	3.5%	2.8%	5.9%	6.6%	7.8%	10.0%	15.1%	16.9%	10.5%	8.8%	5.5%	3.7%	0.5%	0.1%	0.2%	0.0%
1993	0.2%	1.3%	3.5%	5.1%	6.3%	8.9%	10.2%	15.1%	16.2%	13.7%	9.5%	5.5%	2.2%	1.5%	0.3%	0.2%	0.0%	0.1%
1994	0.7%	1.0%	2.7%	5.2%	7.7%	10.9%	11.2%	12.6%	12.2%	12.7%	9.5%	6.8%	3.5%	1.7%	1.1%	0.2%	0.2%	0.0%
1995	0.1%	0.2%	1.4%	4.7%	9.7%	12.0%	13.3%	12.6%	14.5%	12.3%	8.3%	5.5%	3.5%	0.7%	0.6%	0.1%	0.3%	0.0%
1996	0.7%	0.7%	1.1%	3.6%	8.4%	11.5%	13.5%	13.5%	13.5%	12.0%	10.0%	6.2%	3.5%	1.0%	0.5%	0.3%	0.0%	0.0%
1997	0.1%	0.8%	1.4%	3.6%	7.1%	12.8%	18.0%	15.1%	12.8%	10.8%	7.9%	5.5%	2.3%	1.6%	0.2%	0.0%	0.0%	0.0%
1998	0.0%	0.0%	0.3%	3.0%	7.0%	12.0%	13.0%	14.7%	14.3%	15.7%	11.0%	4.3%	2.3%	2.0%	0.3%	0.0%	0.0%	0.0%

Table 14. Black rockfish fishery length composition data – unsexed (continued).

Year	Length in cm <=24	24	26	Both sexes 28	30	32	34	36	38	40	42	44	46	48	50	52	54	56+
CA-HKL (cont.)																		
1999	0.0%	0.2%	0.3%	1.3%	4.5%	10.3%	18.6%	18.6%	17.0%	12.8%	8.0%	4.1%	2.3%	1.4%	0.5%	0.1%	0.0%	0.0%
1999	0.0%	0.2%	0.3%	1.3%	4.5%	10.3%	18.6%	18.6%	17.0%	12.8%	8.0%	4.1%	2.3%	1.4%	0.5%	0.1%	0.0%	0.0%
2000	0.0%	0.0%	0.9%	2.3%	4.2%	11.7%	14.4%	17.7%	16.6%	14.4%	9.1%	4.9%	2.5%	0.7%	0.4%	0.4%	0.0%	0.0%
2001	0.0%	0.0%	0.3%	0.8%	2.7%	7.4%	12.0%	20.4%	20.3%	16.8%	9.9%	4.5%	2.9%	1.3%	0.6%	0.1%	0.0%	0.0%
2002	0.0%	0.0%	1.0%	2.0%	3.2%	7.3%	10.0%	17.1%	16.0%	13.8%	12.0%	8.0%	5.5%	2.7%	0.7%	0.8%	0.0%	0.0%
2003	0.0%	1.6%	2.4%	8.1%	6.5%	5.7%	6.5%	11.4%	12.2%	18.7%	13.0%	5.7%	4.9%	1.6%	0.0%	1.6%	0.0%	0.0%
2004	0.0%	0.4%	1.9%	3.1%	14.0%	11.7%	14.8%	10.9%	10.5%	10.1%	6.6%	8.6%	4.7%	1.6%	0.4%	0.8%	0.0%	0.0%
2005	0.0%	0.5%	4.1%	2.7%	9.1%	13.6%	19.1%	17.3%	10.5%	9.1%	6.8%	3.6%	1.8%	1.4%	0.5%	0.0%	0.0%	0.0%
2006	0.0%	0.0%	1.2%	3.3%	6.7%	13.4%	15.0%	15.4%	14.0%	10.6%	9.2%	5.5%	3.6%	1.4%	0.2%	0.2%	0.3%	0.0%
CA-TWL																		
1978	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	5.8%	9.6%	15.4%	15.4%	15.4%	7.7%	11.5%	3.8%	5.8%	1.9%	7.7%
1980	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.8%	1.5%	5.3%	8.3%	13.6%	16.7%	22.0%	12.1%	3.8%	7.6%	5.3%	3.0%
1981	0.0%	0.0%	0.0%	0.0%	1.5%	2.3%	2.3%	4.6%	6.2%	6.9%	12.3%	12.3%	16.2%	16.9%	8.5%	3.1%	4.6%	2.3%
1982	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.3%	3.8%	5.1%	11.8%	10.5%	22.4%	13.4%	11.5%	11.8%	5.1%	3.2%	1.0%
1983	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.5%	0.0%	2.8%	8.0%	16.5%	17.5%	17.9%	14.6%	9.0%	7.1%	3.8%	2.4%
1984	0.0%	0.0%	0.0%	0.0%	0.0%	0.6%	1.7%	0.0%	0.0%	7.4%	25.0%	19.3%	19.9%	11.9%	6.8%	4.0%	1.7%	1.7%
1985	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.6%	4.5%	10.8%	24.8%	22.9%	16.6%	9.6%	5.1%	5.1%	0.0%
1986	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	3.7%	18.5%	22.2%	22.2%	11.1%	14.8%	7.4%	0.0%	0.0%
1987	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	2.2%	3.8%	6.5%	15.2%	21.2%	25.0%	12.5%	6.5%	4.3%	2.7%
1988	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	1.6%	4.8%	9.5%	14.3%	17.5%	15.9%	22.2%	11.1%	3.2%
1989	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	1.3%	0.0%	5.0%	8.8%	5.0%	15.0%	26.3%	17.5%	11.3%	7.5%	2.5%
1990*	0.0%	0.0%	0.0%	20.0%	0.0%	0.0%	20.0%	60.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
1991	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	5.6%	0.0%	5.6%	13.9%	8.3%	22.2%	30.6%	8.3%	5.6%	0.0%	0.0%	0.0%
1992	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	9.2%	4.6%	24.6%	20.0%	18.5%	16.9%	3.1%	1.5%	0.0%	1.5%
1996	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	12.0%	4.0%	16.0%	20.0%	20.0%	12.0%	0.0%	8.0%	8.0%
1997	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	1.2%	7.3%	8.5%	9.8%	9.8%	15.9%	17.1%	15.9%	6.1%	3.7%	4.9%	0.0%
1998*	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	16.7%	50.0%	16.7%	0.0%	16.7%	0.0%	0.0%
1999	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	4.0%	0.0%	0.0%	4.0%	12.0%	16.0%	24.0%	8.0%	16.0%	8.0%	0.0%	8.0%
2000	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	4.0%	0.0%	0.0%	8.0%	20.0%	28.0%	24.0%	12.0%	4.0%	0.0%	0.0%
2001	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	6.4%	4.3%	6.4%	8.5%	12.8%	17.0%	21.3%	4.3%	12.8%	2.1%	4.3%

Table 14. Black rockfish fishery length composition data – unsexed (continued).

Year	Length in cm <=24	24	26	Both sexes 28	30	32	34	36	38	40	42	44	46	48	50	52	54	56+
CA-TWL (cont.)																		
2003	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	5.3%	0.0%	21.1%	15.8%	21.1%	5.3%	15.8%	5.3%	10.5%	0.0%
2004*	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	22.2%	0.0%	33.3%	0.0%	33.3%	0.0%	0.0%	11.1%

* Very small sample; excluded from model.

Year	<=24	24	26	28	30	32	34	36	38	40	42	44	46	48	50	52	54	56+
CA-REC																		
1980	0.1%	1.0%	1.3%	4.3%	6.7%	9.0%	10.2%	8.9%	10.8%	8.8%	10.5%	11.6%	5.8%	6.6%	2.4%	1.8%	0.0%	0.1%
1981	0.4%	0.6%	0.9%	2.0%	2.2%	6.7%	10.6%	13.2%	7.8%	11.1%	13.0%	10.3%	11.5%	5.9%	2.2%	1.3%	0.0%	0.3%
1982	0.2%	0.3%	0.4%	3.3%	6.8%	10.4%	9.3%	7.3%	10.2%	11.5%	9.8%	8.6%	9.5%	6.6%	3.2%	1.7%	0.4%	0.4%
1983	0.5%	0.0%	0.6%	2.3%	6.2%	8.8%	7.9%	9.0%	11.8%	11.1%	10.7%	9.1%	11.6%	8.4%	0.8%	0.6%	0.2%	0.4%
1984	1.4%	1.4%	4.6%	4.1%	7.8%	7.0%	8.0%	6.7%	11.2%	10.1%	12.9%	11.2%	5.7%	3.8%	1.4%	1.3%	0.9%	0.4%
1985	1.1%	1.9%	4.5%	9.5%	12.3%	11.5%	8.5%	8.1%	9.0%	7.6%	8.1%	6.0%	4.7%	4.7%	1.5%	0.9%	0.2%	0.0%
1986	0.4%	1.4%	2.4%	4.2%	8.3%	11.0%	10.6%	11.0%	10.3%	11.1%	9.7%	5.8%	7.1%	3.2%	2.2%	0.6%	0.5%	0.3%
1987	2.3%	3.8%	6.6%	8.0%	12.6%	11.2%	13.5%	11.3%	7.3%	3.4%	2.2%	5.9%	5.5%	3.9%	1.1%	0.7%	0.2%	0.4%
1988	2.7%	3.2%	6.1%	8.6%	12.8%	9.2%	16.0%	9.4%	9.1%	5.4%	3.1%	3.8%	5.1%	2.8%	1.5%	0.9%	0.0%	0.3%
1989	2.5%	4.3%	8.6%	12.3%	13.3%	15.4%	16.7%	8.6%	5.1%	3.9%	1.8%	3.4%	2.1%	1.8%	0.0%	0.0%	0.0%	0.2%
1993	2.2%	4.2%	7.1%	10.0%	14.6%	11.8%	9.3%	8.4%	7.4%	7.7%	6.7%	4.9%	3.1%	1.1%	1.0%	0.0%	0.0%	0.4%
1994	1.1%	2.3%	3.8%	11.1%	14.5%	15.4%	13.6%	9.9%	7.2%	7.4%	5.6%	4.1%	3.0%	0.8%	0.4%	0.1%	0.0%	0.1%
1995	1.8%	3.4%	5.5%	13.3%	19.8%	10.8%	8.8%	10.5%	7.8%	5.0%	4.5%	2.9%	2.3%	0.9%	0.9%	0.9%	0.3%	0.5%
1996	1.6%	1.0%	4.1%	8.4%	13.0%	13.1%	11.9%	7.9%	10.0%	9.3%	7.5%	6.0%	3.7%	1.6%	0.4%	0.1%	0.3%	0.1%
1997	4.1%	9.1%	12.9%	16.9%	17.4%	12.5%	8.4%	7.0%	3.3%	3.2%	2.0%	2.1%	0.7%	0.3%	0.1%	0.0%	0.0%	0.0%
1998	1.3%	2.8%	10.9%	17.3%	17.4%	11.7%	5.0%	7.3%	6.3%	9.8%	3.2%	2.0%	1.7%	0.5%	0.8%	1.8%	0.1%	0.0%
1999*	1.6%	3.5%	7.6%	15.9%	28.5%	22.8%	12.5%	4.5%	1.2%	0.9%	0.6%	0.2%	0.1%	0.1%	0.1%	0.0%	0.0%	0.0%
2000*	0.9%	3.1%	6.6%	18.7%	31.4%	22.1%	11.4%	2.0%	0.8%	0.7%	0.7%	0.5%	1.0%	0.1%	0.0%	0.0%	0.0%	0.0%
2001	1.9%	1.8%	5.5%	9.7%	16.6%	20.4%	17.2%	8.3%	7.9%	4.3%	3.0%	0.1%	1.2%	2.0%	0.2%	0.0%	0.1%	0.1%
2002	3.4%	5.8%	10.3%	9.1%	13.6%	17.0%	19.1%	9.6%	4.5%	2.2%	2.2%	1.2%	0.9%	0.7%	0.3%	0.2%	0.0%	0.1%
2003	1.4%	3.3%	10.6%	16.4%	20.3%	12.0%	7.0%	4.4%	4.9%	5.4%	4.8%	3.7%	3.1%	1.5%	0.8%	0.3%	0.0%	0.2%
2004	3.6%	4.9%	6.5%	13.0%	17.7%	17.2%	12.2%	6.1%	3.5%	4.5%	1.7%	3.3%	2.0%	1.7%	1.1%	0.3%	0.2%	0.3%
2005	0.8%	1.8%	3.6%	7.1%	12.3%	12.0%	10.8%	9.6%	8.7%	11.1%	8.6%	5.9%	3.5%	2.4%	0.7%	0.6%	0.2%	0.2%
2006	0.4%	1.2%	3.2%	6.9%	11.7%	13.4%	11.5%	8.2%	9.5%	8.6%	8.6%	6.8%	4.6%	3.0%	1.2%	0.7%	0.3%	0.2%

* Extremely narrow distribution; excluded from model.

Table 14. Black rockfish fishery length composition data – unsexed (continued).

Year	Length in cm <=24	24	26	Both sexes 28	30	32	34	36	38	40	42	44	46	48	50	52	54	56+
CA-CPFV																		
1987*	2.1%	6.3%	10.4%	14.6%	10.4%	18.8%	16.7%	16.7%	2.1%	0.0%	0.0%	2.1%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
1988	1.4%	4.8%	12.2%	6.6%	6.5%	9.7%	13.1%	8.3%	6.4%	3.0%	3.6%	5.7%	5.9%	6.6%	3.4%	1.6%	0.7%	0.5%
1989	0.5%	1.5%	2.6%	6.6%	13.7%	18.5%	15.4%	10.1%	4.3%	4.4%	5.0%	4.2%	5.7%	3.6%	1.8%	1.3%	0.7%	0.0%
1990	1.1%	6.1%	8.4%	8.4%	22.2%	27.6%	17.2%	5.7%	1.9%	1.1%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
1991	3.8%	3.8%	14.2%	19.6%	18.2%	17.9%	12.9%	6.7%	1.9%	0.0%	0.4%	0.2%	0.2%	0.0%	0.0%	0.0%	0.0%	0.2%
1992	0.5%	1.0%	5.5%	13.0%	12.0%	21.1%	13.8%	10.4%	5.7%	4.4%	3.6%	2.6%	3.6%	1.6%	0.8%	0.3%	0.0%	0.0%
1993	0.6%	3.7%	9.1%	12.8%	15.0%	11.8%	9.3%	5.2%	4.5%	5.9%	7.3%	5.2%	4.2%	3.0%	1.3%	0.7%	0.4%	0.0%
1994	2.7%	4.7%	10.4%	15.7%	22.0%	18.6%	9.5%	6.4%	1.9%	1.4%	1.9%	1.8%	1.4%	1.4%	0.3%	0.1%	0.1%	0.0%
1995	1.7%	9.5%	21.2%	26.5%	24.6%	12.4%	2.5%	1.0%	0.1%	0.1%	0.0%	0.2%	0.1%	0.0%	0.1%	0.0%	0.0%	0.0%
1996	1.7%	3.1%	10.0%	18.8%	22.2%	17.4%	11.2%	5.4%	2.6%	1.8%	1.7%	1.5%	1.0%	1.1%	0.1%	0.0%	0.4%	0.0%
1997	2.4%	6.0%	15.3%	19.3%	22.2%	14.8%	10.1%	5.5%	1.8%	1.0%	0.4%	0.6%	0.4%	0.1%	0.1%	0.0%	0.0%	0.0%
1998	1.1%	4.7%	10.9%	23.3%	23.1%	14.2%	6.4%	2.2%	1.1%	2.2%	1.8%	4.2%	2.7%	1.3%	0.4%	0.2%	0.0%	0.0%

* Very small sample; excluded from model.

Table 15. Black rockfish fishery age composition data – sexed.

	Age in years.			Females														
Year	<4	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20+
OR-HKL																		
2002	0.0%	0.8%	3.4%	12.1%	5.4%	15.2%	6.1%	3.3%	3.0%	3.0%	0.7%	1.4%	0.5%	0.0%	0.0%	0.0%	0.0%	0.0%
2003	0.1%	1.4%	4.5%	7.8%	4.9%	9.0%	7.8%	4.2%	2.9%	1.9%	0.3%	0.2%	0.1%	0.3%	0.0%	0.0%	0.0%	0.0%
2004	0.0%	1.6%	9.1%	8.0%	6.4%	5.6%	3.1%	5.4%	5.1%	1.3%	0.9%	0.7%	0.7%	0.0%	0.0%	0.0%	0.0%	0.0%
2005	0.0%	0.0%	13.0%	12.7%	6.0%	3.1%	7.3%	0.4%	2.0%	0.2%	0.5%	0.4%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
OR-REC																		
1996	5.8%	9.4%	10.0%	8.9%	4.8%	2.3%	1.1%	0.9%	0.8%	0.3%	0.3%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
1997	1.4%	6.9%	13.0%	10.8%	7.4%	4.7%	3.7%	1.9%	1.4%	0.4%	0.3%	0.1%	0.1%	0.0%	0.0%	0.1%	0.0%	0.0%
1998	3.2%	14.3%	13.7%	9.4%	6.6%	4.9%	0.9%	1.3%	0.2%	0.0%	0.3%	0.0%	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%
1999	0.4%	7.7%	11.6%	11.3%	7.4%	5.9%	2.4%	2.5%	0.8%	0.4%	0.4%	0.1%	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%
2000	0.8%	4.0%	13.4%	12.1%	7.9%	5.2%	2.8%	1.9%	0.9%	0.6%	0.3%	0.3%	0.2%	0.0%	0.2%	0.1%	0.0%	0.0%
2002	1.1%	1.6%	4.3%	8.7%	10.8%	9.8%	5.3%	3.4%	2.9%	1.7%	1.3%	0.4%	0.4%	0.4%	0.3%	0.2%	0.0%	0.3%
2003	0.2%	2.5%	6.5%	7.3%	10.1%	9.3%	5.3%	3.5%	2.3%	1.0%	0.9%	0.4%	0.0%	0.1%	0.0%	0.0%	0.0%	0.0%
2004	0.2%	3.0%	9.3%	8.3%	6.8%	6.9%	6.7%	3.8%	2.7%	1.6%	0.8%	0.4%	0.2%	0.1%	0.1%	0.0%	0.0%	0.0%
2005	0.0%	0.4%	7.9%	15.8%	6.2%	3.7%	6.9%	2.3%	2.1%	0.5%	1.4%	0.6%	0.3%	0.1%	0.3%	0.0%	0.0%	0.0%

Table 15. Black rockfish fishery age composition data – sexed (continued).

Age in years.			Males															
Year	<4	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20+
OR-HKL																		
2002	0.0%	0.4%	4.2%	6.1%	6.6%	9.2%	6.7%	2.2%	3.7%	1.5%	1.5%	1.6%	0.8%	0.0%	0.0%	0.0%	0.1%	0.5%
2003	0.0%	0.7%	2.1%	5.6%	5.3%	8.6%	12.4%	5.5%	3.3%	6.0%	1.9%	1.3%	1.1%	0.3%	0.1%	0.4%	0.0%	0.1%
2004	0.0%	1.2%	5.9%	3.8%	4.8%	3.2%	9.9%	8.5%	4.5%	5.2%	0.9%	1.7%	0.4%	0.2%	0.1%	0.3%	0.8%	0.8%
2005	0.4%	2.7%	12.0%	10.2%	5.1%	4.1%	5.1%	5.2%	2.7%	2.8%	1.9%	1.1%	0.9%	0.0%	0.4%	0.0%	0.0%	0.0%
OR-REC																		
1996	3.1%	7.7%	11.9%	11.4%	4.6%	3.4%	3.4%	2.2%	2.1%	1.1%	0.9%	1.3%	0.5%	0.0%	0.3%	0.4%	0.2%	0.6%
1997	1.4%	1.8%	6.8%	11.6%	9.0%	6.6%	1.4%	1.8%	3.1%	0.3%	0.3%	1.7%	0.9%	0.1%	0.2%	0.1%	0.0%	0.8%
1998	3.0%	4.6%	10.3%	11.4%	5.5%	3.8%	3.3%	1.5%	0.8%	0.6%	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
1999	0.7%	4.8%	10.3%	7.1%	7.9%	6.5%	3.9%	1.7%	1.9%	1.2%	0.9%	0.7%	0.1%	0.1%	0.2%	0.1%	0.2%	0.5%
2000	0.6%	4.7%	13.5%	11.5%	5.5%	3.8%	2.6%	2.0%	1.5%	1.1%	0.3%	0.5%	0.3%	0.6%	0.2%	0.2%	0.1%	0.2%
2002	1.3%	2.0%	5.5%	7.3%	9.4%	6.7%	4.1%	2.6%	2.4%	1.3%	0.9%	0.6%	0.8%	0.5%	0.7%	0.3%	0.2%	0.6%
2003	0.2%	2.1%	7.1%	8.5%	8.9%	7.1%	4.8%	3.9%	2.5%	2.5%	1.0%	0.8%	0.7%	0.3%	0.1%	0.0%	0.0%	0.0%
2004	0.0%	2.3%	10.3%	7.8%	6.6%	5.3%	5.9%	4.0%	1.8%	1.9%	1.1%	0.8%	0.5%	0.3%	0.1%	0.1%	0.1%	0.2%
2005	0.1%	0.7%	6.4%	11.0%	7.5%	5.5%	3.7%	3.9%	2.7%	3.5%	1.3%	1.9%	1.2%	0.4%	0.1%	0.7%	0.3%	0.7%

Table 16. Selecting black rockfish trips from RecFIN catch and effort data – Oregon.

Logistic regression coefficients for species co-caught with black rockfish, ocean charter/party boat trips only (N trips = 9120).

Species	Coeff	N trips	Trips w Blck
tiger rockfish	4.375	125	104
copper rockfish	2.898	523	495
dungeness crab	2.132	439	350
kelp greenling	1.481	1504	1408
vermilion rockfish	1.474	476	433
blue rockfish	1.374	3699	3277
cabezon	1.349	1479	1380
China rockfish	1.052	935	857
quillback rockfish	0.878	762	668
lingcod	0.568	3652	2970
bocaccio	-0.114	94	7
canary rockfish	-0.504	2041	1400
yellowtail rockfish	-0.633	1997	1329
rosethorn rockfish	-0.857	191	19
greenstriped rockfish	-0.873	175	5
yelloweye rockfish	-1.779	814	368
widow rockfish	-1.919	290	74
coho salmon	-2.346	1038	120
albacore	-2.521	153	3
chinook salmon	-2.585	1258	157
Pacific halibut	-3.448	661	41

Cut-off probability for selection = 0.68

Table 17. Selecting black rockfish trips from RecFIN catch and effort data – California.

Logistic regression coefficients for species co-caught with black rockfish, ocean charter/party boat trips only (N trips = 9089).

Species	Coeff	N trips	Trips w Blck
black and yellow rockfish	1.344	129	107
gopher rockfish	0.926	1492	932
cabezon	0.784	326	226
kelp greenling	0.709	363	230
vermilion rockfish	0.451	1410	650
China rockfish	0.401	930	513
lingcod	0.224	1776	642
blue rockfish	0.064	3370	1333
brown rockfish	-0.083	1134	478
yelloweye rockfish	-0.129	374	33
quillback rockfish	-0.178	183	49
olive rockfish	-0.192	798	234
copper rockfish	-0.216	812	184
canary rockfish	-0.337	1786	238
starry rockfish	-0.621	539	26
Pacific sanddab	-0.736	272	23
yellowtail rockfish	-0.764	2980	415
speckled rockfish	-0.791	203	6
chub (Pacific) mackerel	-0.810	119	10
widow rockfish	-0.820	737	41
greenstriped rockfish	-1.121	479	5
rosy rockfish	-1.179	835	52
flag rockfish	-1.291	161	2
bocaccio rockfish	-1.395	1028	27
greenspotted rockfish	-1.747	928	11
chinook salmon	-3.356	1877	39
rockfish genus	-3.650	436	7
chilipepper rockfish	-3.993	714	2
sablefish	-4.163	83	0

Cut-off probability for selection = 0.42

Table 18. Summary of RecFIN catch-per-angler data used for the CPUE analysis – Oregon.

Number of trips interviewed.

Year	Tillamook	Lincoln	Coos	Curry	Jan/Feb	Mar/Apr	May/Jun	Jul/Aug	Sep/Oct	Nov/Dec	Total
1980	6	63	5	1	25	17			27	6	75
1981		47	2		7	13			23	6	49
1982	3	58	1		13	14	13		14	8	62
1983	7	52		1	1	31	22			6	60
1984	14	65	27	7	9	14	60		28	5	116
1985	13	90	33	7	21	9	46		53	14	143
1986	8	50	54	1	1	19	66		24	3	113
1987	8	118	16	2	24	21	37		38	24	144
1988	4	170	7	20	48	60	22		44	28	202
1989		212	10	2	25	63	30		103	8	229
1990											
1991											
1992											
1993	12	238	66	23	28	70	142		69	31	340
1994	16	234	53	57		81	120		159		360
1995	16	153	48	62		68	143		62	6	279
1996	7	205	48	21	29	66	95		78	13	281
1997	38	322	85	54	19	76	88	222	63	31	499
1998	30	220	63	65	2	43	117	126	86	4	378
1999	54	315	64	65	18	62	131	133	149	5	498
2000	24	229	12	48	27	77	80	56	54	19	313
2001	26	98	54	28	22	37	66	40	20	21	206
2002	18	152	48	43	15	83	51	58	46	8	261
2003		49		6	14	41					55
Total	490	3785	888	658	348	1222	1777	1081	1162	246	5836

Table 19. Summary of RecFIN catch-per-angler data – Oregon (continued).

Percentage of trips catching black rockfish.

Year	Tillamook	Lincoln	Coos	Curry	Jan/Feb	Mar/Apr	May/Jun	Jul/Aug	Sep/Oct	Nov/Dec	Total
1980	33.3%	79.4%	20.0%	100.0%	56.0%	52.9%			96.3%	83.3%	72.0%
1981		93.6%	100.0%		85.7%	100.0%			91.3%	100.0%	93.9%
1982	100.0%	91.4%	0.0%		100.0%	92.9%	76.9%		92.9%	87.5%	90.3%
1983	85.7%	82.7%		100.0%	100.0%	87.1%	72.7%			100.0%	83.3%
1984	100.0%	80.0%	81.5%	100.0%	88.9%	71.4%	96.7%		64.3%	80.0%	84.5%
1985	100.0%	85.6%	93.9%	85.7%	57.1%	100.0%	93.5%		92.5%	100.0%	88.8%
1986	100.0%	96.0%	100.0%	100.0%	100.0%	100.0%	100.0%		91.7%	100.0%	98.2%
1987	100.0%	65.3%	75.0%	100.0%	83.3%	66.7%	59.5%		76.3%	58.3%	68.8%
1988	100.0%	77.1%	14.3%	90.0%	70.8%	78.3%	95.5%		79.5%	60.7%	76.2%
1989		85.4%	100.0%	50.0%	72.0%	98.4%	96.7%		82.5%	37.5%	86.0%
1990											
1991											
1992											
1993	100.0%	87.4%	74.2%	95.7%	67.9%	88.6%	83.8%		92.8%	90.3%	85.9%
1994	100.0%	90.2%	83.0%	96.5%		92.6%	92.5%		88.1%		90.6%
1995	100.0%	93.5%	83.3%	100.0%		95.6%	94.4%		90.3%	83.3%	93.5%
1996	85.7%	89.8%	77.1%	100.0%	93.1%	90.9%	87.4%		89.7%	61.5%	88.3%
1997	94.7%	95.7%	98.8%	94.4%	100.0%	98.7%	93.2%	96.4%	93.7%	96.8%	96.0%
1998	93.3%	95.5%	90.5%	100.0%	100.0%	100.0%	97.4%	94.4%	90.7%	100.0%	95.2%
1999	92.6%	92.1%	79.7%	93.8%	77.8%	98.4%	96.2%	91.0%	83.9%	100.0%	90.8%
2000	95.8%	93.0%	66.7%	100.0%	100.0%	96.1%	86.3%	91.1%	98.1%	94.7%	93.3%
2001	100.0%	96.9%	98.1%	100.0%	95.5%	97.3%	100.0%	97.5%	100.0%	95.2%	98.1%
2002	88.9%	94.7%	100.0%	95.3%	100.0%	95.2%	94.1%	93.1%	97.8%	100.0%	95.4%
2003		100.0%		100.0%	100.0%	100.0%					100.0%
Total	94.5%	90.8%	89.4%	97.6%	81.9%	93.8%	93.5%	95.3%	87.3%	83.3%	91.6%

Table 20. Summary of RecFIN catch-per-angler data – Oregon (continued).

Catch per angler-day for trips catching black rockfish.

Year	Tillamook	Lincoln	Coos	Curry	Jan/Feb	Mar/Apr	May/Jun	Jul/Aug	Sep/Oct	Nov/Dec	Total
1980	9.71	5.10	2.50		6.89	7.13			3.59	5.35	5.23
1981		7.36	3.50		6.54	8.11			7.17	5.83	7.18
1982	7.50	6.71			8.52	8.53	3.76		7.08	2.73	6.73
1983	9.33	3.74		5.00	3.50	4.71	4.82			1.33	4.50
1984	8.81	3.07	6.24	8.63	1.91	2.03	6.25		4.05	1.22	4.64
1985	9.83	4.55	4.12	5.60	2.40	4.16	6.88		4.14	5.51	5.06
1986	5.82	4.18	7.41	4.00	13.00	2.52	7.14		3.16	7.83	5.65
1987	9.88	3.61	4.02	6.10	4.21	4.62	4.54		3.03	4.53	4.10
1988	13.50	4.02	0.50	2.67	4.68	3.13	3.79		4.45	4.17	4.00
1989		6.54	8.33	8.50	5.07	7.89	8.47		5.25	1.29	6.63
1990											
1991											
1992											
1993	9.31	5.21	5.35	6.77	7.41	6.56	4.82		6.94	1.90	5.46
1994	7.07	4.33	5.41	6.62		5.72	4.59		4.76		4.94
1995	7.64	5.41	5.75	7.98		8.09	6.40		3.74	2.28	6.24
1996	10.11	5.46	7.58	5.28	3.90	6.49	6.35		5.96	2.85	5.87
1997	7.25	4.92	6.67	6.65	5.20	6.63	6.85	5.40	4.22	4.80	5.63
1998	5.96	6.16	6.77	7.08	8.25	6.90	6.64	6.68	5.38	6.75	6.41
1999	5.68	5.23	7.25	5.24	5.05	7.52	5.80	5.18	4.46	10.30	5.56
2000	6.99	5.59	4.38	5.67	5.35	6.66	5.42	4.71	6.28	4.38	5.68
2001	6.66	4.42	6.37	6.81	4.83	6.47	6.60	5.47	4.53	2.92	5.57
2002	7.09	5.94	7.94	4.20	4.71	7.65	6.57	4.06	5.51	5.11	5.97
2003		6.19		5.10	5.48	6.34					6.08
Total	6.81	5.35	6.45	6.26	5.12	6.43	6.14	5.59	5.00	4.05	5.75

Table 21. Summary of RecFIN catch-per-angler data used for the CPUE analysis – California.

Number of trips interviewed.

Year	Del Norte	Humboldt	Mendocino	Sonoma	San Mateo	Santa Cruz	Jan/Feb	Mar/Apr	May/Jun	Jul/Aug	Sep/Oct	Nov/Dec	Total
1980				2	4		1	1	2		2		6
1981	1		3						1	2	1		4
1982		1	3						1	1		2	4
1983			2		1	5			2	5	1		8
1984			1	3	1	4			3		6		9
1985	2		3	4	23	3	2	4	4	12	9	4	35
1986			5	1	9	14			13	10	4	2	29
1987				6	9				2		9	4	15
1988		1		1	23	1	1	1	4	9	11		26
1989		1	5			15				18	3		21
1990													
1991													
1992													
1993													
1994													
1995	3	4	9	3	1					19		1	20
1996	8	8	18	26	14	38	1		17	42	50	2	112
1997				14	3	6			2	11	6	4	23
1998		3	1	4	18	6				10	12	10	32
1999		3	12	10	28	25	7	4	10	38	18	1	78
2000				11	30	14			30	14	2	9	55
2001		8	2	8	128	32	1		65	72	34	6	178
2002			6	39	71	56	1		9	114	48		172
2003	8	20	38	92	132	89	6		2	197	112	62	379
2004	6	11	28	72	87	133	53		6	130	148		337
2005	1	26	13	21	82	90			1	86	105	41	233
2006	12	61		35	129	97			14	154	136	30	334
Total	41	147	149	352	793	628	73	10	188	944	717	178	2110

Table 22. Summary of RecFIN catch-per-angler data – California (continued).

Percentage of trips catching black rockfish.

Year	Del Norte	Humboldt	Mendocino	Sonoma	San Mateo	Santa Cruz	Jan/Feb	Mar/Apr	May/Jun	Jul/Aug	Sep/Oct	Nov/Dec	Total
1980				50.0%	25.0%		0.0%	0.0%	50.0%		50.0%		33.3%
1981	100.0%		33.3%						0.0%	100.0%	0.0%		50.0%
1982		100.0%	33.3%						100.0%	0.0%		50.0%	50.0%
1983			0.0%		0.0%	0.0%			0.0%	0.0%	0.0%		0.0%
1984			0.0%	100.0%	0.0%	25.0%			100.0%		16.7%		44.4%
1985	50.0%		0.0%	25.0%	91.3%	0.0%	0.0%	25.0%	50.0%	100.0%	44.4%	100.0%	65.7%
1986			20.0%	0.0%	11.1%	64.3%			30.8%	70.0%	0.0%	0.0%	37.9%
1987				16.7%	44.4%				50.0%		33.3%	25.0%	33.3%
1988		100.0%		0.0%	52.2%	100.0%	100.0%	0.0%	0.0%	77.8%	54.5%		53.8%
1989		0.0%	40.0%			0.0%				0.0%	66.7%		9.5%
1990													
1991													
1992													
1993													
1994													
1995	100.0%	75.0%	100.0%	33.3%	0.0%					84.2%		0.0%	80.0%
1996	100.0%	87.5%	44.4%	69.2%	21.4%	63.2%	0.0%		58.8%	54.8%	68.0%	50.0%	60.7%
1997				100.0%	100.0%	100.0%			100.0%	100.0%	100.0%	100.0%	100.0%
1998		66.7%	100.0%	100.0%	27.8%	50.0%				60.0%	58.3%	20.0%	46.9%
1999		66.7%	50.0%	0.0%	57.1%	96.0%	0.0%	50.0%	40.0%	71.1%	83.3%	0.0%	61.5%
2000				90.9%	93.3%	71.4%			90.0%	85.7%	0.0%	100.0%	87.3%
2001		100.0%	0.0%	62.5%	78.1%	40.6%	0.0%		70.8%	77.8%	55.9%	83.3%	70.8%
2002			16.7%	64.1%	93.0%	89.3%	0.0%		66.7%	81.6%	89.6%		82.6%
2003	100.0%	75.0%	55.3%	77.2%	53.8%	55.1%	100.0%		100.0%	72.6%	48.2%	48.4%	62.0%
2004	66.7%	100.0%	32.1%	58.3%	81.6%	57.9%	28.3%		100.0%	66.9%	71.6%		63.5%
2005	100.0%	88.5%	46.2%	19.0%	56.1%	41.1%			100.0%	60.5%	38.1%	58.5%	50.2%
2006	91.7%	93.4%		57.1%	49.6%	59.8%			92.9%	73.4%	56.6%	23.3%	62.9%
Total	90.2%	88.4%	44.3%	62.5%	64.6%	57.6%	30.1%	30.0%	68.6%	70.7%	58.3%	49.4%	62.9%

Table 23. Summary of RecFIN catch-per-angler data – California (continued).

Catch per angler-day for trips catching black rockfish.

Year	Del Norte	Humboldt	Mendocino	Sonoma	San Mateo	Santa Cruz	Jan/Feb	Mar/Apr	May/Jun	Jul/Aug	Sep/Oct	Nov/Dec	Total
1980				1.00	2.50				2.50		1.00		1.75
1981	4.33		1.00							2.67			2.67
1982		1.00	4.00						1.00			4.00	2.50
1983													
1984				12.67		0.50			12.67		0.50		9.63
1985	1.00			1.50	5.13			1.50	1.50	6.42	4.50	2.71	4.80
1986			7.00		2.00	1.67			2.00	2.29			2.18
1987				2.00	5.25				2.00		6.00	3.00	4.60
1988		12.50			3.25	1.00	1.00			3.57	4.42		3.75
1989			3.50								3.50		3.50
1990													
1991													
1992													
1993													
1994													
1995	10.00	1.33	3.72	2.00						4.34			4.34
1996	13.88	5.24	1.25	2.81	0.61	2.31			11.40	2.87	2.46	2.00	3.90
1997				6.78	4.70	1.77			1.23	8.13	3.35	1.93	5.20
1998		8.00	2.00	3.17	1.60	0.59				5.00	1.11	1.34	2.70
1999		4.50	1.75		4.34	4.47		7.00	2.00	3.91	4.58		4.09
2000				6.00	2.64	5.55			3.73	5.63		2.33	3.94
2001		3.73		3.60	4.17	1.37			4.36	3.59	3.89	1.35	3.83
2002			1.00	3.59	3.73	3.26			2.11	3.51	3.73		3.52
2003	8.00	2.35	3.52	3.37	2.77	1.70	3.83		1.92	3.02	3.00	2.42	2.95
2004	4.22	6.52	2.67	4.36	3.87	1.94	1.90		8.21	3.51	3.18		3.36
2005	8.00	8.06	2.33	2.00	2.62	2.22			8.00	4.73	2.76	2.24	3.57
2006	6.45	6.71		2.70	1.98	2.29			8.10	4.11	2.33	2.57	3.65
Total	8.27	6.03	2.85	3.89	3.36	2.42	2.39	5.17	5.11	3.79	3.05	2.30	3.56

Table 24. PIT tagging study estimates of black rockfish abundance off Newport, OR.

		Recovery Year				
Tag Year	N Tagged	1	2	3	4	5
2002	2312	51	51	41	27	16
2003	2461		41	51	54	52
2004	2527			59	73	60
2005	2622				55	58
2006	2574					89
	12496	51	92	151	209	275

Est. fishery landings	63,251	72,178	58,895	66,721	63,586
Landings scanned	50,994	49,982	44,412	56,264	55,117
Sampling rate	80.6%	69.2%	75.4%	84.3%	86.7%
Year-1 recovery rate	2.21%	1.67%	2.33%	2.10%	3.46%
Observed recovery rate		3.83%	3.23%	2.64%	
Exploitation rate		5.53%	4.28%	3.13%	
Revised est. abundance		1,305,793	1,375,807	2,130,612	
CV (Ni)		19.36%	15.72%	17.65%	

Table 25. Estimates of relative black rockfish habitat area off Oregon.

Spatial Cell	Major Port	Habitat area (km^2) From all observer data	From similar number of locations per spatial cell	Linear km of coastline
A	Garibaldi	9.25	5.44	40.13
B	Pacific City	5.38	5.04	40.13
C	Depoe Bay	18.91	8.16	40.13
D	Newport	22.77	8.87	40.13
E	Reedsport	0.43	0.43	110.89
F	Charleston	20.16	8.92	40.20
G	Port Orford	15.12	9.41	44.15
H	Gold Beach	6.09	6.09	40.03
I	Brookings	15.25	7.14	35.21
Cape Falcon to OR/CA border	All	113.36	59.50	431.00
PMFC Area 2C	Garibaldi to Newport	56.31	27.50	163.07
PIT tag area total	Newport	23.41	9.36	38.47
PIT tag area as percent of OR assessment area.		21%	16%	9%

Table 26. Final base-run model input variance adjustments from iterative model tuning.

Likelihood Component	Index extra CV	- - - - - - Effective N multipliers - - - - - - Length comp	Age comp	Len-at-age
Oregon HKL fishery		0.9098	1.5815	
Oregon TWL fishery		5.5968		
Oregon REC fishery		0.7116		
California HKL fishery		1.6377		
California TWL fishery		3.3032		
California REC fishery		0.3747		
Oregon REC survey 1	0.1661			
Oregon REC survey 2				
Oregon ORBS survey 1	0.1991	0.7873	0.528	0.6998
Oregon ORBS survey 2	0.0598			
Oregon ORBS survey 3				
Oregon tag abundance	0.0473			
California REC survey 1	0.2461			
California REC survey 2	0.1041			
California CPFV survey	0.0900	0.9891		
Pre-recruit survey	0.3680			

Table 27. Final base-run model profile over unexploited recruitment (R0).

Values marked in bold and highlighted indicate the minimum negative log-likelihood value for the given row.

		ln(R0) =	8.6	8.7	8.8	8.9	9.0	9.1	9.2
Component		R0 =	5432	6003	6634	7332	8103	8955	9897
	Lambda	Min Like	- - - - - Change in neg. ln(Like) from Minimum Value - - - - -						
Total		1406.7	12.7	6.2	2.1	0.3	**0.0**	0.9	2.5
Indices		-74.4	5.4	2.8	1.0	0.2	**0.0**	0.2	0.7
OREC-1	1	-18.3	2.7	1.6	0.7	0.2	**0.0**	0.1	0.3
OREC-2	1	-8.9	1.3	0.8	0.5	0.2	0.1	0.0	**0.0**
ORBS-1	1	-16.7	2.2	1.4	0.8	0.4	0.1	0.0	**0.0**
ORBS-2	1	-9.2	1.6	1.0	0.6	0.3	0.2	0.1	**0.0**
ORBS-3	1	-5.2	**0.0**	0.1	0.2	0.3	0.3	0.3	0.3
TAGS	1	-3.3	0.3	0.2	0.1	0.1	0.0	0.0	**0.0**
CREC-1	1	-3.8	**0.0**	0.1	0.3	0.6	0.9	1.2	1.4
CREC-2	1	-9.2	**0.0**	0.5	1.0	1.3	1.6	1.8	1.9
CPFV	1	-3.8	0.2	0.1	0.0	**0.0**	0.0	0.0	0.0
JUV	1	0.8	0.3	0.2	0.1	0.1	0.1	0.0	**0.0**
MnWt	1	-83.0	0.1	0.1	0.1	0.1	0.1	0.0	**0.0**
Length		1377.3	6.0	4.7	3.4	2.1	1.1	0.4	**0.0**
OHKL	1	73.5	3.0	2.6	2.1	1.5	1.0	0.5	**0.0**
OTWL	1	64.4	1.6	1.2	0.8	0.5	0.3	0.1	**0.0**
OREC	1	267.5	**0.0**	1.2	2.5	3.5	4.4	5.1	5.8
CHKL	1	173.1	1.0	1.0	0.9	0.7	0.4	0.2	**0.0**
CTWL	1	138.3	**0.0**	0.2	0.8	1.4	2.1	2.6	3.0
CREC	1	252.1	3.5	2.6	1.6	0.9	0.3	0.1	**0.0**
ORBS	1	244.3	0.3	0.1	0.1	**0.0**	0.0	0.0	0.1
CPFV	1	155.3	5.5	4.6	3.5	2.5	1.5	0.7	**0.0**
Age		163.0	**0.0**	1.9	4.3	7.0	9.7	12.4	15.0
OHKL	1	48.6	**0.0**	0.3	0.6	1.1	1.6	2.1	2.6
ORBS	1	114.4	**0.0**	1.7	3.7	5.9	8.2	10.4	12.4
Len-at-Age	1	31.4	11.9	10.0	7.8	5.5	3.4	1.6	**0.0**
Recruits	1	-15.5	4.0	1.3	0.2	**0.0**	0.3	0.8	1.4
ForecastRecr	1	-6.9	**0.0**	0.0	0.0	0.0	0.0	0.0	0.0

Spawning-0			3195	3522	3883	4282	4722	5209	5748
Spawning-2006			1434	1789	2250	2801	3434	4147	4940
Depletion			44.9%	50.8%	57.9%	65.4%	72.7%	79.6%	85.9%
MSY			719	794	876	967	1068	1180	1303
Tag-Q			27.6%	22.5%	18.1%	14.7%	12.1%	10.1%	8.5%

Table 28. Final base-run model profile over spawner-recruit steepness (H).

Values marked in bold and highlighted indicate the minimum negative log-likelihood value for the given table.

Component		H =	0.40	0.50	0.55	0.60	0.65	0.70	0.80
	Lambda	Min Like	- - - - - Change in neg. ln(Like) from Minimum Value - - - - -						
Total		1406.3	2.4	0.8	0.5	0.3	0.2	0.1	**0.0**
Indices		-74.4	0.3	0.0	**0.0**	0.0	0.0	0.1	0.1
OREC-1	1	-18.3	0.2	0.0	0.0	0.0	**0.0**	0.0	0.0
OREC-2	1	-8.9	0.4	0.2	0.1	0.1	0.1	0.0	**0.0**
ORBS-1	1	-16.6	0.2	0.1	0.0	0.0	0.0	0.0	**0.0**
ORBS-2	1	-9.1	0.5	0.2	0.2	0.1	0.1	0.0	**0.0**
ORBS-3	1	-5.0	**0.0**	0.1	0.1	0.1	0.1	0.1	0.1
TAGS	1	-3.3	0.1	0.1	0.0	0.0	0.0	0.0	**0.0**
CREC-1	1	-3.4	**0.0**	0.2	0.3	0.4	0.4	0.5	0.6
CREC-2	1	-8.2	**0.0**	0.3	0.5	0.5	0.6	0.7	0.7
CPFV	1	-3.8	**0.0**	0.0	0.0	0.0	0.0	0.0	0.0
JUV	1	0.7	0.2	0.1	0.1	0.1	0.1	0.0	**0.0**
MnWt	1	-82.9	0.0	0.0	0.0	0.0	0.0	0.0	**0.0**
Length		1377.0	**0.0**	1.1	1.5	1.8	2.0	2.1	2.4
OHKL	1	74.4	**0.0**	0.2	0.2	0.3	0.3	0.3	0.3
OTWL	1	64.3	**0.0**	0.2	0.3	0.4	0.5	0.5	0.6
OREC	1	269.4	**0.0**	1.3	1.8	2.2	2.5	2.8	3.3
CHKL	1	172.7	**0.0**	0.6	0.7	0.9	1.0	1.1	1.2
CTWL	1	139.2	3.4	1.9	1.4	1.0	0.7	0.4	**0.0**
CREC	1	252.3	**0.0**	0.1	0.2	0.2	0.2	0.2	0.2
ORBS	1	244.1	**0.0**	0.1	0.2	0.2	0.2	0.2	0.2
CPFV	1	157.0	0.1	0.2	0.1	0.1	0.1	0.1	**0.0**
Age		171.5	2.4	0.9	0.6	0.4	0.2	0.1	**0.0**
OHKL	1	50.0	0.6	0.2	0.1	0.1	0.1	0.0	**0.0**
ORBS	1	121.6	1.8	0.7	0.4	0.3	0.2	0.1	**0.0**
Len-at-Age	1	33.9	**0.0**	1.1	1.4	1.5	1.6	1.7	1.8
Recruits	1	-16.3	4.0	2.0	1.4	1.0	0.6	0.4	**0.0**
ForecastRecr	1	-6.9	**0.0**	0.0	0.0	0.0	0.0	0.0	0.0

Spawning-0	5094	4757	4655	4579	4518	4470	4396
Spawning-2006	2700	3004	3125	3227	3312	3384	3499
Depletion	53.0%	63.2%	67.1%	70.5%	73.3%	75.7%	79.6%
MSY	578	898	978	1035	1078	1111	1158
Tag-Q	15.2%	13.7%	13.2%	12.8%	12.5%	12.3%	11.9%

Table 29. Final base-run model parameter values.

Parameter	Value	Est?
Natural Mortality		
Male and female to age-10	0.16	No
Female age 15+	0.24	No
Growth for females		
Length at age-1	11.522	Yes
Length at age-20	51.016	Yes
von Bertalanffy K	0.17074	Yes
CV of length, all ages	0.07	No
Growth for males		
Length at age-1, exp. offset from fem	0	No
Length at age-20, exp. offset from fem	-0.12832	Yes
von Bertalanffy K, exp. offset from fem	0.25892	Yes
CV of length, all ages	0.07	No
Recruitment		
Ln(virgin recruitment, R0)	8.9685	Yes
Steepness	0.6	No
Recruitment variability, Sigma-R	0.5	No
Catchability coefficients		
Ln(OR tagging study, Tag-Q)	-2.0537	Yes

Table 29. Final base-run model parameter values (continued).

Selection Curves

Parameter	Value	Est?	Bound?	Value	Est?	Bound?
Double normal selection curves						
Oregon HKL fishery				California HKL fishery		
Length at peak	40.454	Yes		38.547	Yes	
Width of top	-3.6261	Yes		-6	Yes	Low
Ln(ascending width)	3.6337	Yes		3.9335	Yes	
Ln(descending width)	3.2559	Yes		4.1424	Yes	
Initial selection as logistic	-6	Yes	Low	-6	Yes	Low
Final selection as logistic	-1.8071	Yes		-1.7015	Yes	
Oregon REC fishery				California REC fishery		
Length at peak	38.469	Yes		32.437	Yes	
Width of top	-6	Yes	Low	-5.9908	Yes	Low
Ln(ascending width)	3.8369	Yes		3.6169	Yes	
Ln(descending width)	3.4028	Yes		-1.0171	Yes	
Initial selection as logistic	-6	Yes	Low	-5.6639	Yes	
Final selection as logistic	-1.5458	Yes		0.5058	Yes	
Oregon ORBS survey				California CPFV survey		
Length at peak	39.936	Yes		30.618	Yes	
Width of top	-6	Yes	Low	-6	Yes	Low
Ln(ascending width)	3.7489	Yes		3.0868	Yes	
Ln(descending width)	2.9344	Yes		2.3073	Yes	
Initial selection as logistic	-6	Yes	Low	-5.8454	Yes	
Final selection as logistic	-0.7477	Yes		-0.9587	Yes	
Logistic curves						
Oregon and California TWL fisheries						
Length for 50% selection	45.594	Yes				
Width for 95% selection	7.9284	Yes				

Table 29. Final base-run model parameter values (continued).

Recruitment Deviations

Year	Value	Year	Value
1970	0.34653	1990	0.21164
1971	0.17462	1991	0.32010
1972	-0.10649	1992	0.46725
1973	-0.13996	1993	0.24488
1974	0.02668	1994	0.97211
1975	-0.20653	1995	0.57847
1976	0.05747	1996	0.12007
1977	-0.41779	1997	0.20362
1978	-0.26723	1998	0.13304
1979	-0.43430	1999	0.85944
1980	-0.70754	2000	0.40075
1981	-0.29607	2001	0.27490
1982	-0.39544	2002	-0.02050
1983	-0.26560	2003	-0.61986
1984	-0.06498	2004	-0.29549
1985	0.10825	2005	-0.34315
1986	-0.31381	2006	-0.31180
1987	-0.03292		
1988	-0.35632		
1989	0.09599		

Table 30. Final base-run model time-trajectories of population estimates.

Year	Total Biomass (mt)	Age 2+ Biomass (mt)	Spawning Output (mil. larvae)	Depletion	Age-0 Recruits (1000s)	Spawning Potential Ratio	Total Catch (mt)	Total Exploit. Rate
1915	29344	29100	4578.5	100.0%	7852	100.0%	0.0	0.0%
1916	29344	29100	4578.5	100.0%	7852	99.9%	2.9	0.0%
1917	29341	29097	4578.0	100.0%	7852	99.8%	5.9	0.0%
1918	29336	29091	4577.1	100.0%	7852	99.7%	8.8	0.0%
1919	29328	29083	4575.7	99.9%	7851	99.6%	11.7	0.0%
1920	29317	29073	4573.8	99.9%	7851	99.5%	14.7	0.1%
1921	29305	29061	4571.6	99.8%	7850	99.4%	17.6	0.1%
1922	29291	29047	4568.9	99.8%	7849	99.3%	20.5	0.1%
1923	29276	29032	4565.9	99.7%	7848	99.2%	23.5	0.1%
1924	29259	29015	4562.7	99.7%	7847	99.1%	26.4	0.1%
1925	29241	28997	4559.2	99.6%	7846	99.0%	29.3	0.1%
1926	29222	28978	4555.4	99.5%	7845	98.9%	32.3	0.1%
1927	29202	28958	4551.5	99.4%	7844	98.8%	35.2	0.1%
1928	29181	28937	4547.5	99.3%	7843	98.8%	34.4	0.1%
1929	29163	28919	4543.8	99.2%	7842	97.9%	63.1	0.2%
1930	29119	28875	4536.0	99.1%	7840	97.9%	62.5	0.2%
1931	29079	28835	4528.4	98.9%	7838	98.1%	55.5	0.2%
1932	29052	28808	4521.5	98.8%	7836	98.6%	41.7	0.1%
1933	29041	28797	4517.8	98.7%	7834	98.8%	35.4	0.1%
1934	29039	28795	4515.5	98.6%	7834	98.5%	45.5	0.2%
1935	29027	28784	4513.2	98.6%	7833	98.2%	53.3	0.2%
1936	29009	28766	4510.0	98.5%	7832	98.0%	60.5	0.2%
1937	28985	28742	4506.4	98.4%	7831	98.2%	53.7	0.2%
1938	28971	28727	4503.4	98.4%	7830	98.1%	55.0	0.2%
1939	28957	28713	4500.3	98.3%	7829	97.7%	67.9	0.2%
1940	28932	28688	4495.0	98.2%	7828	97.9%	64.0	0.2%
1941	28913	28670	4491.0	98.1%	7827	98.0%	61.1	0.2%
1942	28899	28656	4488.1	98.0%	7826	98.0%	58.6	0.2%
1943	28890	28646	4485.3	98.0%	7825	94.9%	157.7	0.5%
1944	28789	28546	4464.6	97.5%	7819	92.0%	249.2	0.9%
1945	28627	28384	4416.7	96.5%	7804	86.0%	458.7	1.6%
1946	28309	28067	4321.9	94.4%	7775	87.4%	396.9	1.4%
1947	28085	27843	4257.6	93.0%	7755	90.7%	277.3	1.0%
1948	27991	27750	4232.4	92.4%	7746	93.0%	204.0	0.7%
1949	27971	27730	4230.9	92.4%	7746	93.5%	187.8	0.7%

Table 30. Final base-run model time-trajectories of population estimates (continued).

Year	Total Biomass (mt)	Age 2+ Biomass (mt)	Spawning Output (mil. larvae)	Depletion	Age-0 Recruits (1000s)	Spawning Potential Ratio	Total Catch (mt)	Total Exploit. Rate
1950	27963	27722	4234.9	92.5%	7747	92.4%	220.5	0.8%
1951	27922	27681	4232.5	92.4%	7746	91.2%	257.2	0.9%
1952	27848	27607	4221.9	92.2%	7743	92.9%	201.6	0.7%
1953	27825	27584	4225.2	92.3%	7744	92.7%	205.8	0.7%
1954	27798	27557	4224.8	92.3%	7744	91.6%	241.6	0.9%
1955	27735	27494	4217.2	92.1%	7741	91.4%	246.3	0.9%
1956	27671	27430	4207.6	91.9%	7738	93.4%	183.7	0.7%
1957	27669	27428	4210.1	92.0%	7739	92.4%	210.7	0.8%
1958	27640	27399	4206.7	91.9%	7738	89.7%	286.8	1.0%
1959	27539	27298	4190.6	91.5%	7733	90.3%	272.5	1.0%
1960	27457	27217	4176.1	91.2%	7728	90.5%	264.6	1.0%
1961	27391	27151	4162.4	90.9%	7723	93.0%	191.0	0.7%
1962	27400	27159	4164.7	91.0%	7724	92.6%	204.6	0.7%
1963	27395	27155	4164.7	91.0%	7724	90.8%	258.1	0.9%
1964	27343	27103	4153.1	90.7%	7720	92.7%	202.7	0.7%
1965	27349	27109	4153.6	90.7%	7720	89.8%	285.7	1.0%
1966	27276	27036	4140.2	90.4%	7716	90.4%	265.5	1.0%
1967	27225	26985	4134.2	90.3%	7714	89.3%	296.7	1.1%
1968	27143	26903	4124.1	90.1%	7710	89.0%	305.3	1.1%
1969	27059	26820	4110.1	89.8%	7706	86.0%	399.5	1.5%
1970	26926	26654	4078.4	89.1%	9603	83.5%	470.6	1.7%
1971	26707	26434	4035.9	88.1%	8071	86.7%	369.7	1.4%
1972	26699	26481	4008.1	87.5%	6085	83.4%	470.9	1.8%
1973	26621	26435	3966.3	86.6%	5873	82.9%	480.4	1.8%
1974	26479	26279	3932.0	85.9%	6927	79.6%	589.6	2.2%
1975	26085	25894	3888.3	84.9%	5474	82.7%	479.6	1.8%
1976	25760	25562	3876.8	84.7%	7124	77.5%	642.6	2.5%
1977	25087	24910	3847.2	84.0%	4423	77.3%	637.8	2.5%
1978	24466	24316	3808.9	83.2%	5132	76.3%	659.0	2.7%
1979	23668	23521	3737.9	81.6%	4326	67.3%	967.0	4.1%
1980	22540	22424	3584.4	78.3%	3264	68.5%	898.7	4.0%
1981	21446	21317	3419.6	74.7%	4878	56.1%	1344.9	6.3%
1982	19831	19689	3168.1	69.2%	4344	50.9%	1455.3	7.3%
1983	18183	18040	2904.9	63.4%	4848	51.5%	1303.5	7.2%
1984	16739	16572	2676.5	58.5%	5806	49.2%	1206.9	7.2%

Table 30. Final base-run model time-trajectories of population estimates (continued).

Year	Total Biomass (mt)	Age 2+ Biomass (mt)	Spawning Output (mil. larvae)	Depletion	Age-0 Recruits (1000s)	Spawning Potential Ratio	Total Catch (mt)	Total Exploit. Rate
1985	15526	15329	2469.2	53.9%	6759	48.5%	1134.8	7.3%
1986	14537	14368	2253.9	49.2%	4320	58.2%	767.4	5.3%
1987	14181	14025	2108.9	46.1%	5610	65.1%	591.4	4.2%
1988	14038	13890	2000.2	43.7%	3994	63.7%	616.8	4.4%
1989	14037	13876	1916.1	41.9%	6193	56.3%	798.8	5.7%
1990	13804	13600	1843.6	40.3%	6865	53.2%	882.1	6.4%
1991	13610	13385	1793.6	39.2%	7582	50.1%	962.5	7.1%
1992	13474	13220	1744.1	38.1%	8700	40.0%	1269.3	9.4%
1993	13206	12966	1652.9	36.1%	6836	51.3%	868.9	6.6%
1994	13709	13375	1627.9	35.6%	14068	52.7%	842.9	6.1%
1995	14234	13873	1614.2	35.3%	9461	54.1%	847.3	6.0%
1996	15215	14978	1632.7	35.7%	6007	55.9%	850.5	5.6%
1997	16302	16105	1684.3	36.8%	6603	59.5%	814.3	5.0%
1998	17373	17174	1778.8	38.8%	6270	64.7%	754.7	4.3%
1999	18447	18133	1923.6	42.0%	13305	69.3%	703.2	3.8%
2000	19202	18866	2126.8	46.5%	8678	73.0%	655.4	3.4%
2001	20203	19946	2375.1	51.9%	7900	66.5%	876.0	4.3%
2002	20844	20630	2580.9	56.4%	6013	72.9%	689.1	3.3%
2003	21618	21475	2759.6	60.3%	3359	61.9%	1060.9	4.9%
2004	21788	21662	2844.9	62.1%	4681	74.1%	686.5	3.2%
2005	21918	21775	2970.5	64.9%	4510	73.7%	717.7	3.3%
2006	21699	21555	3100.3	67.7%	4700	76.5%	627.2	2.9%
2007	21300	21109	3226.5	70.5%	7339	74.1%	na	na

Table 31. Final base-run model estimates of numbers-at-age by sex.

Females (1000s)

Age	1915	1916	1917	1918	1919	1920	1921	1922	1923	1924	1925	1926	1927	1928	1929	1930	1931
0	3926	3926	3926	3926	3926	3925	3925	3925	3924	3924	3923	3923	3922	3922	3921	3920	3919
1	3346	3346	3346	3345	3345	3345	3345	3345	3344	3344	3344	3343	3343	3342	3342	3341	3340
2	2851	2851	2851	2851	2851	2851	2851	2850	2850	2850	2850	2849	2849	2848	2848	2848	2847
3	2429	2429	2429	2429	2429	2429	2429	2429	2429	2429	2428	2428	2428	2428	2427	2427	2427
4	2070	2070	2070	2070	2070	2070	2070	2070	2070	2070	2069	2069	2069	2069	2068	2068	2068
5	1764	1764	1764	1764	1764	1764	1764	1764	1763	1763	1763	1763	1763	1762	1762	1761	1761
6	1503	1503	1503	1503	1503	1502	1502	1502	1502	1502	1501	1501	1501	1500	1500	1499	1498
7	1281	1281	1281	1281	1280	1280	1280	1279	1279	1278	1278	1278	1277	1277	1277	1275	1274
8	1092	1092	1091	1091	1091	1090	1090	1089	1089	1088	1088	1088	1087	1086	1086	1084	1083
9	930	930	930	930	929	929	928	928	927	927	926	926	925	925	924	923	921
10	793	793	793	792	792	792	791	791	790	789	789	788	788	787	787	785	784
11	675	675	675	675	675	675	674	674	673	673	672	671	671	670	670	669	667
12	566	566	566	566	566	566	565	565	564	564	563	563	562	562	561	560	559
13	467	467	467	467	467	467	467	466	466	465	465	465	464	464	463	462	461
14	380	380	380	380	379	379	379	379	379	378	378	377	377	377	376	375	375
15	303	303	303	303	303	303	303	303	303	302	302	302	301	301	301	300	300
16	239	239	239	239	239	239	238	238	238	238	238	237	237	237	237	236	236
17	188	188	188	188	188	188	188	187	187	187	187	187	187	186	186	186	185
18	148	148	148	148	148	148	148	147	147	147	147	147	147	147	146	146	146
19	116	116	116	116	116	116	116	116	116	116	116	116	116	115	115	115	115
20	91	91	91	91	91	91	91	91	91	91	91	91	91	91	91	91	90
21	72	72	72	72	72	72	72	72	72	72	72	72	72	71	71	71	71
22	57	57	57	57	57	57	57	56	56	56	56	56	56	56	56	56	56
23	44	44	44	44	44	44	44	44	44	44	44	44	44	44	44	44	44
24	35	35	35	35	35	35	35	35	35	35	35	35	35	35	35	35	35
25	28	28	28	28	28	28	28	27	27	27	27	27	27	27	27	27	27
26	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	21
27	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17
28	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13
29	11	11	11	11	11	11	11	11	11	11	11	11	11	10	10	10	10
30	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8
31	7	7	7	7	7	7	7	7	7	7	7	7	6	6	6	6	6
32	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
33	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
34	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
35	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
36	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
37	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
38	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
39	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
40	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4

Table 31. Final base-run model estimates of numbers-at-age by sex (continued).

Females (1000s)

Age	1932	1933	1934	1935	1936	1937	1938	1939	1940	1941	1942	1943	1944	1945	1946	1947	1948
0	3918	3917	3917	3917	3916	3916	3915	3915	3914	3913	3913	3912	3909	3902	3888	3877	3873
1	3339	3339	3338	3338	3337	3337	3337	3336	3336	3335	3335	3334	3334	3331	3325	3313	3304
2	2846	2846	2845	2844	2844	2844	2844	2843	2843	2843	2842	2842	2841	2841	2839	2834	2823
3	2426	2426	2425	2424	2424	2424	2423	2423	2423	2423	2422	2422	2421	2421	2421	2419	2414
4	2068	2067	2067	2066	2066	2065	2065	2065	2065	2064	2064	2064	2063	2063	2063	2062	2060
5	1761	1761	1761	1760	1759	1759	1759	1759	1758	1758	1758	1758	1757	1757	1757	1755	1754
6	1498	1499	1500	1499	1498	1497	1497	1497	1496	1496	1496	1496	1494	1494	1494	1492	1491
7	1274	1275	1276	1276	1275	1273	1273	1273	1272	1272	1272	1273	1269	1268	1267	1266	1266
8	1083	1084	1085	1085	1085	1083	1082	1082	1082	1081	1081	1081	1078	1076	1072	1071	1072
9	921	921	922	923	923	922	921	920	919	919	919	919	915	911	905	903	905
10	783	783	784	784	785	784	783	783	782	781	781	781	777	772	763	760	761
11	666	666	666	667	667	667	667	666	665	664	664	664	661	655	644	638	639
12	558	558	558	558	558	558	558	558	557	556	556	555	553	547	535	528	527
13	461	460	460	459	459	459	459	459	459	458	458	457	455	450	438	431	429
14	374	374	373	373	372	372	372	372	372	372	371	371	369	364	354	347	344
15	299	298	298	298	297	297	297	297	297	297	297	296	295	290	281	275	272
16	235	235	234	234	234	233	233	233	233	233	233	233	231	228	220	215	212
17	185	185	184	184	184	184	183	183	183	183	183	183	182	179	173	168	166
18	146	145	145	145	145	144	144	144	144	144	144	143	143	140	136	132	130
19	115	114	114	114	114	114	113	113	113	113	113	113	112	110	106	103	101
20	90	90	90	90	89	89	89	89	89	89	89	88	88	87	83	81	80
21	71	71	71	71	70	70	70	70	70	70	70	69	69	68	65	64	62
22	56	56	56	56	55	55	55	55	55	55	55	55	54	53	51	50	49
23	44	44	44	44	44	44	43	43	43	43	43	43	43	42	40	39	38
24	35	35	34	34	34	34	34	34	34	34	34	34	34	33	32	31	30
25	27	27	27	27	27	27	27	27	27	27	27	27	26	26	25	24	24
26	21	21	21	21	21	21	21	21	21	21	21	21	21	20	20	19	19
27	17	17	17	17	17	17	17	17	17	17	16	16	16	16	15	15	15
28	13	13	13	13	13	13	13	13	13	13	13	13	13	13	12	12	11
29	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	9	9
30	8	8	8	8	8	8	8	8	8	8	8	8	8	8	7	7	7
31	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6
32	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	4	4
33	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	3
34	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
35	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
36	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
37	2	2	2	2	2	2	2	2	2	2	2	1	1	1	1	1	1
38	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
39	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
40	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3

Table 31. Final base-run model estimates of numbers-at-age by sex (continued).

Females (1000s)

Age	1949	1950	1951	1952	1953	1954	1955	1956	1957	1958	1959	1960	1961	1962	1963	1964	1965
0	3873	3874	3873	3872	3872	3872	3871	3869	3870	3869	3866	3864	3862	3862	3862	3860	3860
1	3301	3300	3301	3301	3299	3300	3299	3298	3297	3297	3297	3295	3293	3291	3291	3291	3289
2	2815	2812	2812	2813	2812	2811	2812	2812	2811	2809	2810	2809	2807	2806	2804	2804	2804
3	2405	2399	2396	2396	2397	2396	2395	2396	2395	2395	2393	2394	2393	2392	2390	2389	2389
4	2056	2048	2042	2040	2039	2039	2039	2037	2038	2037	2033	2033	2034	2035	2034	2032	2032
5	1753	1749	1741	1735	1732	1732	1731	1729	1729	1728	1721	1720	1721	1725	1725	1723	1724
6	1491	1489	1484	1477	1472	1470	1467	1466	1466	1464	1458	1454	1454	1458	1460	1460	1460
7	1266	1265	1263	1258	1252	1248	1244	1242	1242	1242	1237	1232	1230	1232	1234	1235	1236
8	1073	1073	1072	1068	1065	1060	1055	1052	1052	1052	1049	1045	1042	1041	1042	1043	1046
9	907	909	908	905	904	902	896	892	891	890	888	885	882	881	881	880	883
10	765	767	767	766	765	764	761	756	754	753	751	749	747	746	745	743	744
11	643	646	647	646	647	646	644	641	639	637	634	632	631	631	630	628	627
12	530	534	536	536	537	537	536	534	533	531	528	525	524	524	524	522	522
13	430	433	435	436	438	438	438	437	437	436	432	430	428	428	429	427	427
14	344	346	347	348	350	351	351	351	351	351	349	346	344	344	345	344	343
15	271	272	273	273	275	277	277	277	278	278	276	275	273	273	273	272	272
16	211	211	211	211	212	214	215	215	216	216	215	214	213	213	212	211	211
17	165	164	164	163	164	165	166	167	167	168	167	167	166	166	166	165	164
18	128	128	127	126	127	127	128	129	130	130	130	130	129	129	129	128	128
19	100	100	99	98	98	98	99	99	100	101	101	101	100	101	101	100	100
20	79	78	77	77	76	76	76	77	77	78	78	78	78	78	78	78	78
21	62	61	60	60	60	59	59	59	60	60	60	60	60	61	61	61	61
22	48	48	47	47	46	46	46	46	46	46	46	47	47	47	47	47	47
23	38	38	37	37	36	36	36	36	36	36	36	36	36	36	37	37	37
24	30	29	29	29	28	28	28	28	28	28	28	28	28	28	28	28	28
25	23	23	23	22	22	22	22	22	22	22	21	21	21	22	22	22	22
26	18	18	18	18	17	17	17	17	17	17	17	17	17	17	17	17	17
27	14	14	14	14	14	14	13	13	13	13	13	13	13	13	13	13	13
28	11	11	11	11	11	11	11	10	10	10	10	10	10	10	10	10	10
29	9	9	9	8	8	8	8	8	8	8	8	8	8	8	8	8	8
30	7	7	7	7	7	7	6	6	6	6	6	6	6	6	6	6	6
31	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
32	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
33	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
34	3	3	3	3	3	2	2	2	2	2	2	2	2	2	2	2	2
35	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
36	2	2	2	2	2	2	2	1	1	1	1	1	1	1	1	1	1
37	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
38	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
39	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
40	3	3	3	3	3	3	3	3	3	3	3	3	2	2	2	2	2

Table 31. Final base-run model estimates of numbers-at-age by sex (continued).

Females (1000s)

Age	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982
0	3858	3857	3855	3853	4801	4035	3043	2937	3463	2737	3562	2211	2566	2163	1632	2439	2172
1	3289	3288	3287	3285	3283	4092	3439	2593	2502	2951	2332	3035	1884	2186	1843	1391	2078
2	2803	2803	2801	2801	2799	2797	3486	2930	2209	2132	2515	1987	2586	1606	1863	1570	1185
3	2389	2388	2388	2386	2386	2384	2383	2970	2495	1881	1816	2141	1692	2202	1367	1586	1337
4	2030	2029	2027	2027	2025	2021	2023	2020	2514	2110	1592	1534	1810	1431	1860	1156	1335
5	1720	1717	1713	1712	1710	1701	1705	1702	1695	2103	1768	1327	1280	1511	1189	1552	952
6	1457	1452	1446	1444	1439	1432	1433	1431	1424	1412	1757	1467	1101	1062	1242	983	1259
7	1233	1230	1223	1219	1213	1206	1206	1202	1198	1187	1181	1459	1217	912	868	1021	791
8	1044	1041	1036	1031	1023	1016	1015	1012	1007	999	994	981	1209	1007	743	711	816
9	882	880	877	873	864	856	854	850	847	839	836	825	813	1000	818	606	565
10	744	744	741	738	731	723	719	714	711	704	701	693	683	672	812	666	481
11	626	627	626	624	618	611	606	600	596	591	588	581	574	565	546	660	526
12	519	519	519	518	514	508	503	497	493	487	485	480	474	467	451	435	512
13	425	424	423	423	420	415	411	406	401	396	394	389	385	379	367	354	332
14	342	341	340	339	337	334	331	326	322	317	315	311	307	303	294	283	265
15	271	270	269	268	266	264	262	258	255	251	248	244	241	238	231	223	208
16	211	210	210	209	207	205	203	201	198	195	193	189	187	184	179	172	161
17	164	164	163	163	161	159	158	156	154	151	150	147	145	143	138	133	124
18	127	127	127	127	125	124	122	121	119	118	116	114	113	111	107	103	96
19	99	99	99	99	98	96	95	94	93	91	90	89	87	86	83	79	74
20	77	77	77	77	76	75	74	73	72	71	70	69	68	67	64	62	57
21	60	60	60	60	59	58	58	57	56	55	54	54	53	52	50	48	44
22	47	47	47	46	46	45	45	44	44	43	42	42	41	40	39	37	34
23	37	36	36	36	36	35	35	34	34	33	33	32	32	31	30	29	27
24	28	28	28	28	28	27	27	27	26	26	26	25	25	24	23	22	21
25	22	22	22	22	22	21	21	21	21	20	20	20	19	19	18	17	16
26	17	17	17	17	17	17	16	16	16	16	15	15	15	15	14	13	13
27	13	13	13	13	13	13	13	13	12	12	12	12	12	11	11	10	10
28	10	10	10	10	10	10	10	10	10	9	9	9	9	9	9	8	8
29	8	8	8	8	8	8	8	8	8	7	7	7	7	7	7	6	6
30	6	6	6	6	6	6	6	6	6	6	6	6	5	5	5	5	5
31	5	5	5	5	5	5	5	5	5	4	4	4	4	4	4	4	4
32	4	4	4	4	4	4	4	4	4	3	3	3	3	3	3	3	3
33	3	3	3	3	3	3	3	3	3	3	3	3	3	3	2	2	2
34	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
35	2	2	2	2	2	2	2	2	2	2	2	2	2	2	1	1	1
36	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
37	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
38	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
39	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0
40	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2

Table 31. Final base-run model estimates of numbers-at-age by sex (continued).

Females (1000s)

Age	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
0	2424	2903	3380	2160	2805	1997	3097	3433	3791	4350	3418	7034	4731	3003	3302	3135	6653
1	1851	2065	2474	2880	1841	2390	1702	2639	2925	3230	3707	2912	5994	4031	2559	2813	2672
2	1771	1577	1759	2107	2453	1568	2036	1450	2248	2492	2751	3158	2481	5106	3434	2180	2397
3	1008	1507	1342	1497	1793	2089	1335	1734	1234	1913	2120	2342	2688	2112	4348	2925	1857
4	1123	851	1265	1123	1257	1513	1763	1125	1459	1039	1607	1782	1971	2267	1785	3682	2478
5	1093	927	692	1025	920	1042	1253	1450	923	1198	844	1311	1461	1622	1875	1485	3074
6	763	876	730	545	823	751	849	1006	1156	736	934	668	1046	1167	1304	1520	1214
7	997	599	678	567	434	666	606	670	786	901	555	725	523	818	918	1035	1221
8	621	774	460	524	449	349	535	475	519	605	667	428	564	406	637	721	824
9	639	481	596	356	414	362	280	420	368	399	446	516	332	438	316	501	575
10	442	496	373	462	283	334	291	221	328	284	296	348	403	260	344	250	401
11	375	344	388	291	369	229	270	231	174	255	214	233	274	318	206	274	202
12	404	289	267	299	230	295	182	212	181	134	191	167	182	214	250	163	219
13	386	308	222	204	234	181	232	142	165	138	100	147	129	141	167	196	129
14	246	290	234	167	157	182	141	178	109	125	102	77	112	99	109	129	153
15	193	183	218	174	128	120	139	107	135	82	91	77	58	85	75	83	100
16	150	141	135	160	131	96	91	104	80	100	59	68	57	43	64	57	63
17	115	110	105	99	120	99	73	68	78	59	73	44	51	43	33	49	43
18	89	85	82	77	75	91	74	55	51	58	43	55	33	38	33	25	37
19	69	65	63	60	58	57	69	56	41	38	42	32	41	25	29	25	19
20	53	51	49	47	45	44	43	52	42	31	28	32	24	31	19	22	19
21	41	39	38	36	35	34	33	32	39	32	22	21	24	18	23	14	17
22	32	30	29	28	27	27	26	25	24	29	23	17	16	18	14	18	11
23	25	23	23	22	21	21	20	20	19	18	21	17	13	12	14	11	14
24	19	18	17	17	16	16	16	15	15	14	13	16	13	10	9	10	8
25	15	14	14	13	13	12	12	12	11	11	10	10	12	10	7	7	8
26	12	11	11	10	10	10	9	9	9	9	8	8	8	9	8	6	5
27	9	9	8	8	8	7	7	7	7	7	6	6	6	6	7	6	4
28	7	7	6	6	6	6	6	5	5	5	5	5	5	4	4	5	4
29	5	5	5	5	5	4	4	4	4	4	4	4	4	3	3	3	4
30	4	4	4	4	4	3	3	3	3	3	3	3	3	3	3	3	3
31	3	3	3	3	3	3	3	3	2	2	2	2	2	2	2	2	2
32	3	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
33	2	2	2	2	2	2	2	2	2	1	1	1	1	1	1	1	1
34	2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
35	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
36	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
37	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0
38	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
39	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
40	2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1

Table 31. Final base-run model estimates of numbers-at-age by sex (continued).

Females (1000s)

Age	2000	2001	2002	2003	2004	2005	2006	2007
0	4339	3950	3007	1680	2341	2255	2350	3670
1	5669	3697	3366	2562	1431	1995	1921	2002
2	2276	4830	3150	2868	2182	1219	1699	1637
3	2041	1939	4113	2683	2441	1859	1039	1447
4	1573	1731	1638	3485	2255	2071	1575	880
5	2071	1318	1438	1371	2859	1892	1732	1319
6	2526	1710	1076	1187	1106	2365	1561	1435
7	985	2063	1380	879	950	905	1934	1284
8	985	801	1658	1123	702	774	738	1587
9	665	801	644	1350	899	572	631	606
10	466	543	647	526	1084	735	469	520
11	327	382	441	531	425	891	604	387
12	162	265	307	357	423	345	723	493
13	174	130	210	245	282	340	276	582
14	101	138	102	166	191	223	269	219
15	119	79	106	79	127	149	174	210
16	76	91	60	82	60	98	115	134
17	48	59	70	46	62	46	75	88
18	33	37	45	53	35	48	36	58
19	29	26	29	35	41	27	37	28
20	15	22	20	22	26	31	21	28
21	15	11	17	15	17	20	24	16
22	13	11	9	13	11	13	16	19
23	8	10	9	7	10	9	10	12
24	10	7	8	7	5	8	7	8
25	6	8	5	6	5	4	6	5
26	6	5	6	4	4	4	3	5
27	4	5	4	5	3	3	3	2
28	3	3	4	3	4	2	3	2
29	3	3	2	3	2	3	2	2
30	3	3	2	2	2	2	2	1
31	2	2	2	2	1	2	1	2
32	2	2	2	2	1	1	1	1
33	1	1	1	1	1	1	1	1
34	1	1	1	1	1	1	1	1
35	1	1	1	1	1	1	1	1
36	1	1	1	1	1	1	1	1
37	0	0	0	0	0	0	0	1
38	0	0	0	0	0	0	0	0
39	0	0	0	0	0	0	0	0
40	1	1	1	1	1	1	1	1

Table 31. Final base-run model estimates of numbers-at-age by sex (continued).

Males (1000s)

Age	1915	1916	1917	1918	1919	1920	1921	1922	1923	1924	1925	1926	1927	1928	1929	1930	1931
0	3926	3926	3926	3926	3926	3925	3925	3925	3924	3924	3923	3923	3922	3922	3921	3920	3919
1	3346	3346	3346	3345	3345	3345	3345	3345	3344	3344	3344	3343	3343	3342	3342	3341	3340
2	2851	2851	2851	2851	2851	2851	2851	2850	2850	2850	2850	2849	2849	2848	2848	2848	2847
3	2429	2429	2429	2429	2429	2429	2429	2429	2429	2429	2428	2428	2428	2428	2427	2427	2427
4	2070	2070	2070	2070	2070	2070	2070	2070	2070	2070	2069	2069	2069	2069	2068	2068	2068
5	1764	1764	1764	1764	1764	1764	1764	1764	1763	1763	1763	1763	1763	1762	1762	1761	1761
6	1503	1503	1503	1503	1503	1503	1502	1502	1502	1502	1501	1501	1501	1500	1500	1499	1498
7	1281	1281	1281	1281	1280	1280	1280	1279	1279	1279	1278	1278	1278	1277	1277	1275	1274
8	1092	1092	1091	1091	1091	1090	1090	1090	1089	1089	1088	1088	1087	1087	1087	1085	1084
9	930	930	930	930	929	929	929	928	928	927	927	926	926	925	925	923	922
10	793	793	793	792	792	792	791	791	790	789	789	788	788	787	787	785	784
11	675	675	675	675	675	674	674	674	673	672	672	671	671	670	670	668	667
12	576	576	576	575	575	575	574	574	573	573	572	572	571	571	570	569	568
13	490	490	490	490	490	490	489	489	489	488	488	487	486	486	485	484	483
14	418	418	418	418	418	417	417	417	416	416	415	415	414	414	413	413	412
15	356	356	356	356	356	356	355	355	355	354	354	354	353	353	352	351	351
16	303	303	303	303	303	303	303	303	302	302	302	301	301	300	300	299	299
17	259	259	259	259	258	258	258	258	258	257	257	257	256	256	256	255	254
18	220	220	220	220	220	220	220	220	220	219	219	219	218	218	218	217	217
19	188	188	188	188	188	188	187	187	187	187	187	186	186	186	186	185	185
20	160	160	160	160	160	160	160	160	159	159	159	159	159	158	158	158	157
21	136	136	136	136	136	136	136	136	136	136	136	135	135	135	135	134	134
22	116	116	116	116	116	116	116	116	116	116	116	115	115	115	115	115	114
23	99	99	99	99	99	99	99	99	99	99	98	98	98	98	98	98	97
24	84	84	84	84	84	84	84	84	84	84	84	84	84	84	83	83	83
25	72	72	72	72	72	72	72	72	72	72	72	71	71	71	71	71	71
26	61	61	61	61	61	61	61	61	61	61	61	61	61	61	61	60	60
27	52	52	52	52	52	52	52	52	52	52	52	52	52	52	52	52	51
28	44	44	44	44	44	44	44	44	44	44	44	44	44	44	44	44	44
29	38	38	38	38	38	38	38	38	38	38	38	38	38	38	38	37	37
30	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32
31	28	28	28	28	28	28	27	27	27	27	27	27	27	27	27	27	27
32	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23
33	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20
34	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17
35	15	15	15	15	15	15	14	14	14	14	14	14	14	14	14	14	14
36	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12
37	11	11	11	11	11	11	11	11	11	10	10	10	10	10	10	10	10
38	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9
39	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8
40	44	44	44	44	44	44	44	44	44	44	44	44	44	44	44	44	43

Table 31. Final base-run model estimates of numbers-at-age by sex (continued).

Males (1000s)

Age	1932	1933	1934	1935	1936	1937	1938	1939	1940	1941	1942	1943	1944	1945	1946	1947	1948
0	3918	3917	3917	3917	3916	3916	3915	3915	3914	3913	3913	3912	3909	3902	3888	3877	3873
1	3339	3339	3338	3338	3337	3337	3337	3336	3336	3335	3335	3334	3334	3331	3325	3313	3304
2	2846	2846	2845	2844	2844	2844	2844	2843	2843	2843	2842	2842	2841	2841	2839	2834	2823
3	2426	2426	2425	2424	2424	2424	2423	2423	2423	2423	2422	2422	2421	2421	2421	2419	2414
4	2067	2067	2067	2066	2065	2065	2065	2065	2065	2064	2064	2064	2063	2063	2063	2062	2060
5	1761	1761	1761	1760	1760	1759	1759	1759	1758	1758	1758	1758	1757	1757	1757	1756	1755
6	1499	1499	1500	1499	1498	1497	1497	1497	1497	1496	1496	1497	1495	1495	1494	1493	1492
7	1275	1275	1277	1276	1275	1274	1273	1273	1273	1273	1273	1273	1270	1270	1269	1268	1267
8	1084	1084	1086	1086	1085	1084	1083	1083	1082	1082	1082	1082	1079	1078	1076	1075	1075
9	921	922	923	923	923	922	921	921	920	920	920	920	917	915	911	910	910
10	784	784	784	785	785	784	784	783	782	782	782	782	779	776	772	769	770
11	667	666	667	667	667	667	667	666	666	665	665	664	662	659	653	650	650
12	567	567	567	567	567	567	567	567	566	566	565	565	562	559	553	549	548
13	483	482	482	482	482	482	482	482	482	481	481	480	478	475	469	464	463
14	411	411	411	410	410	410	410	410	410	409	409	408	406	403	397	393	391
15	350	350	349	349	349	348	348	348	348	348	348	347	346	343	337	333	331
16	298	298	297	297	297	296	296	296	296	296	296	296	294	291	286	282	280
17	254	253	253	253	253	252	252	252	252	251	251	251	250	248	243	239	237
18	216	216	216	215	215	215	214	214	214	214	214	214	213	211	206	203	201
19	184	184	184	183	183	183	183	182	182	182	182	182	181	179	175	173	171
20	157	157	156	156	156	156	155	155	155	155	155	154	154	152	149	147	145
21	134	134	133	133	133	133	132	132	132	132	131	131	131	129	127	125	123
22	114	114	114	113	113	113	113	113	112	112	112	112	111	110	108	106	105
23	97	97	97	97	96	96	96	96	96	95	95	95	95	94	92	90	89
24	83	83	83	82	82	82	82	82	81	81	81	81	80	80	78	76	76
25	71	70	70	70	70	70	70	70	69	69	69	69	68	68	66	65	64
26	60	60	60	60	60	60	59	59	59	59	59	59	58	58	56	55	55
27	51	51	51	51	51	51	51	50	50	50	50	50	50	49	48	47	46
28	44	44	44	43	43	43	43	43	43	43	43	43	42	42	41	40	39
29	37	37	37	37	37	37	37	37	37	36	36	36	36	36	35	34	34
30	32	32	32	32	31	31	31	31	31	31	31	31	31	30	30	29	29
31	27	27	27	27	27	27	27	27	27	26	26	26	26	26	25	25	24
32	23	23	23	23	23	23	23	23	23	23	22	22	22	22	21	21	21
33	20	20	20	20	19	19	19	19	19	19	19	19	19	19	18	18	18
34	17	17	17	17	17	17	17	16	16	16	16	16	16	16	16	15	15
35	14	14	14	14	14	14	14	14	14	14	14	14	14	14	13	13	13
36	12	12	12	12	12	12	12	12	12	12	12	12	12	12	11	11	11
37	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	9	9
38	9	9	9	9	9	9	9	9	9	9	9	9	9	8	8	8	8
39	8	8	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7
40	43	43	43	43	43	43	43	43	43	42	42	42	42	41	40	40	39

Table 31. Final base-run model estimates of numbers-at-age by sex (continued).

Males (1000s)

Age	1949	1950	1951	1952	1953	1954	1955	1956	1957	1958	1959	1960	1961	1962	1963	1964	1965
0	3873	3874	3873	3872	3872	3872	3871	3869	3870	3869	3866	3864	3862	3862	3862	3860	3860
1	3301	3300	3301	3301	3299	3300	3299	3298	3297	3297	3297	3295	3293	3291	3291	3291	3289
2	2815	2812	2812	2813	2812	2811	2812	2812	2811	2809	2810	2809	2807	2806	2804	2804	2804
3	2405	2399	2396	2396	2397	2396	2395	2395	2395	2395	2393	2394	2393	2392	2390	2389	2389
4	2056	2048	2042	2040	2039	2039	2039	2037	2037	2037	2033	2033	2034	2035	2034	2032	2032
5	1753	1749	1741	1735	1733	1732	1731	1730	1729	1728	1722	1720	1721	1725	1726	1723	1724
6	1491	1489	1485	1477	1472	1470	1467	1466	1466	1465	1458	1454	1454	1458	1460	1460	1460
7	1267	1266	1263	1259	1252	1248	1245	1242	1243	1242	1236	1232	1230	1232	1234	1235	1237
8	1075	1075	1073	1070	1067	1062	1057	1053	1053	1053	1049	1045	1042	1042	1043	1044	1046
9	911	912	911	908	906	904	898	894	893	892	889	886	883	882	881	881	884
10	771	772	772	770	769	768	764	759	757	755	753	751	749	748	746	745	746
11	651	653	653	652	651	651	649	645	643	640	638	635	634	634	632	630	630
12	550	551	552	551	551	551	550	548	546	544	540	538	536	536	536	534	533
13	464	465	466	466	466	466	465	464	463	462	458	456	454	454	453	452	451
14	391	392	393	393	394	394	393	392	392	392	389	386	384	384	383	382	382
15	330	331	331	331	332	333	332	332	332	332	330	328	326	325	324	323	323
16	279	279	279	279	280	280	280	280	281	280	279	278	277	275	275	273	273
17	236	236	236	235	236	236	236	236	237	237	236	235	234	234	233	231	231
18	200	200	199	198	199	199	199	199	200	200	200	199	198	198	198	196	195
19	170	169	168	168	168	168	168	168	168	169	169	168	168	168	167	166	166
20	144	143	143	142	142	141	141	141	142	142	142	142	142	142	142	141	141
21	122	122	121	120	120	120	119	119	119	120	120	120	120	120	120	119	119
22	104	103	103	102	101	101	101	100	101	101	101	101	101	101	101	101	101
23	88	88	87	86	86	86	85	85	85	85	85	85	85	85	85	85	85
24	75	75	74	73	73	73	72	72	72	72	72	71	72	72	72	72	72
25	64	63	63	62	62	62	61	61	61	61	60	60	60	60	61	61	61
26	54	54	53	53	53	52	52	52	51	51	51	51	51	51	51	51	51
27	46	46	45	45	45	44	44	44	44	43	43	43	43	43	43	43	43
28	39	39	39	38	38	38	37	37	37	37	36	36	36	36	36	36	36
29	33	33	33	32	32	32	32	32	31	31	31	31	31	31	31	30	31
30	28	28	28	28	27	27	27	27	27	26	26	26	26	26	26	26	26
31	24	24	24	23	23	23	23	23	23	22	22	22	22	22	22	22	22
32	21	20	20	20	20	20	19	19	19	19	19	19	19	19	18	18	18
33	17	17	17	17	17	17	17	16	16	16	16	16	16	16	16	16	16
34	15	15	15	14	14	14	14	14	14	14	14	14	13	13	13	13	13
35	13	13	12	12	12	12	12	12	12	12	12	11	11	11	11	11	11
36	11	11	11	10	10	10	10	10	10	10	10	10	10	10	10	9	9
37	9	9	9	9	9	9	9	9	9	8	8	8	8	8	8	8	8
38	8	8	8	8	8	7	7	7	7	7	7	7	7	7	7	7	7
39	7	7	7	6	6	6	6	6	6	6	6	6	6	6	6	6	6
40	39	38	38	37	37	37	36	36	36	35	35	34	34	34	33	33	33

Table 31. Final base-run model estimates of numbers-at-age by sex (continued).

Males (1000s)

Age	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982
0	3858	3857	3855	3853	4801	4035	3043	2937	3463	2737	3562	2211	2566	2163	1632	2439	2172
1	3289	3288	3287	3285	3283	4092	3439	2593	2502	2951	2332	3035	1884	2186	1843	1391	2078
2	2803	2803	2801	2800	2799	2797	3486	2930	2209	2132	2515	1987	2586	1606	1863	1570	1185
3	2389	2388	2388	2386	2385	2384	2383	2969	2495	1881	1816	2141	1692	2202	1367	1586	1337
4	2030	2029	2026	2027	2025	2021	2023	2019	2513	2110	1591	1533	1809	1430	1859	1156	1334
5	1720	1717	1713	1712	1710	1702	1705	1702	1695	2103	1769	1328	1280	1511	1190	1553	953
6	1457	1452	1446	1444	1440	1432	1433	1431	1424	1412	1758	1468	1102	1063	1244	985	1262
7	1233	1230	1223	1219	1213	1206	1206	1202	1198	1187	1181	1459	1217	913	870	1025	795
8	1044	1041	1036	1031	1024	1017	1016	1012	1007	999	994	981	1209	1008	745	715	823
9	883	881	877	873	865	858	856	852	848	840	836	825	813	1001	821	611	572
10	746	745	743	739	733	725	722	717	714	707	703	694	684	672	814	671	487
11	629	629	628	625	620	613	609	604	601	594	591	583	575	565	546	664	534
12	531	531	530	529	524	519	515	510	506	500	497	491	483	475	459	446	528
13	449	448	447	446	443	439	436	431	426	421	418	412	406	399	386	374	353
14	380	379	377	376	374	370	368	364	360	355	352	347	342	336	324	314	296
15	322	320	319	317	315	312	311	308	304	300	296	292	287	282	273	264	249
16	272	271	270	268	266	263	262	260	257	253	250	246	242	237	229	222	209
17	230	229	228	227	225	222	221	219	217	214	211	208	204	200	193	186	175
18	194	194	193	192	190	188	186	184	183	180	178	175	172	168	162	157	147
19	164	164	163	162	161	159	157	155	154	152	150	148	145	142	137	132	124
20	139	139	138	137	136	134	133	131	130	128	127	125	123	120	115	111	104
21	118	117	117	116	115	114	113	111	110	108	107	105	103	101	97	94	88
22	100	100	99	98	97	96	95	94	93	91	90	89	87	85	82	79	74
23	85	84	84	83	82	81	80	79	78	77	76	75	73	72	69	67	62
24	72	71	71	71	70	69	68	67	66	65	64	63	62	61	58	56	53
25	61	60	60	60	59	58	58	57	56	55	54	53	52	51	49	47	44
26	51	51	51	51	50	49	49	48	47	47	46	45	44	43	41	40	37
27	43	43	43	43	42	42	41	41	40	39	39	38	37	36	35	34	32
28	36	36	36	36	36	35	35	34	34	33	33	32	32	31	30	28	27
29	31	31	31	30	30	30	30	29	29	28	28	27	27	26	25	24	22
30	26	26	26	26	26	25	25	25	24	24	24	23	23	22	21	20	19
31	22	22	22	22	22	21	21	21	21	20	20	19	19	19	18	17	16
32	18	18	18	18	18	18	18	18	17	17	17	17	16	16	15	15	14
33	15	15	15	15	15	15	15	15	15	14	14	14	14	13	13	12	11
34	13	13	13	13	13	13	13	13	12	12	12	12	12	11	11	10	10
35	11	11	11	11	11	11	11	11	10	10	10	10	10	10	9	9	8
36	9	9	9	9	9	9	9	9	9	9	9	8	8	8	8	7	7
37	8	8	8	8	8	8	8	7	7	7	7	7	7	7	7	6	6
38	7	7	7	7	7	6	6	6	6	6	6	6	6	6	6	5	5
39	6	6	6	6	6	5	5	5	5	5	5	5	5	5	5	5	4
40	33	32	32	32	31	31	30	30	29	29	28	28	27	27	26	25	23

Table 31. Final base-run model estimates of numbers-at-age by sex (continued).

Males (1000s)

Age	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
0	2424	2903	3380	2160	2805	1997	3097	3433	3791	4350	3418	7034	4731	3003	3302	3135	6653
1	1851	2065	2474	2880	1841	2390	1702	2639	2925	3230	3707	2912	5994	4031	2559	2813	2672
2	1770	1577	1759	2107	2453	1568	2036	1450	2248	2492	2751	3157	2481	5106	3434	2180	2397
3	1008	1507	1341	1496	1793	2088	1335	1733	1234	1913	2120	2341	2687	2112	4347	2924	1857
4	1122	851	1264	1122	1256	1512	1762	1124	1459	1038	1605	1780	1970	2265	1784	3681	2478
5	1094	928	693	1026	921	1043	1254	1452	924	1200	845	1313	1463	1624	1877	1487	3076
6	766	882	735	549	827	754	852	1011	1164	742	943	673	1053	1175	1313	1530	1220
7	1004	606	687	574	438	671	610	676	796	915	566	737	531	829	931	1050	1236
8	628	785	468	532	455	354	540	480	527	617	685	438	575	413	650	736	840
9	647	488	603	361	421	367	284	424	372	405	457	528	340	446	322	511	587
10	448	501	375	465	286	339	294	223	328	286	299	353	410	264	347	253	406
11	381	347	386	289	368	230	272	231	173	252	211	231	274	319	206	273	201
12	417	295	268	299	229	297	185	214	180	133	186	163	180	214	249	162	218
13	412	324	229	208	237	185	239	146	167	138	99	145	128	141	167	197	130
14	276	320	252	177	165	191	149	188	114	129	103	77	113	100	111	132	158
15	231	215	249	195	141	133	154	118	148	88	96	81	60	89	79	88	106
16	194	180	167	194	156	114	108	122	93	115	66	75	63	47	70	63	71
17	163	151	141	130	155	126	92	85	96	72	86	52	59	50	37	56	50
18	137	127	118	110	104	125	102	73	67	75	54	68	41	47	39	30	45
19	115	107	99	92	88	84	101	81	58	52	56	43	53	32	37	31	24
20	96	90	84	78	74	71	68	80	64	45	39	44	33	42	26	30	25
21	81	75	70	65	62	60	57	54	64	50	34	31	35	27	33	20	24
22	68	63	59	55	52	50	48	46	43	50	38	27	25	28	21	27	17
23	58	53	50	46	44	42	41	39	36	33	37	30	21	19	22	17	22
24	49	45	42	39	37	36	34	32	30	28	25	30	23	17	15	18	14
25	41	38	35	33	31	30	29	27	26	24	21	20	23	19	13	12	14
26	35	32	30	28	26	25	24	23	22	20	18	17	16	19	15	11	10
27	29	27	25	23	22	21	20	19	18	17	15	14	13	13	15	12	9
28	25	23	21	20	19	18	17	16	15	14	13	12	11	11	10	12	10
29	21	19	18	17	16	15	15	14	13	12	11	10	9	9	8	8	10
30	17	16	15	14	13	13	12	12	11	10	9	9	8	8	7	7	6
31	15	14	13	12	11	11	10	10	9	9	8	7	7	6	6	6	5
32	13	12	11	10	9	9	9	8	8	7	6	6	6	5	5	5	5
33	11	10	9	8	8	8	7	7	7	6	5	5	5	4	4	4	4
34	9	8	8	7	7	6	6	6	6	5	5	4	4	4	4	3	3
35	8	7	7	6	6	5	5	5	5	4	4	4	3	3	3	3	3
36	6	6	5	5	5	5	4	4	4	4	3	3	3	3	3	2	2
37	5	5	5	4	4	4	4	4	3	3	3	3	2	2	2	2	2
38	5	4	4	4	3	3	3	3	3	3	2	2	2	2	2	2	2
39	4	4	3	3	3	3	3	3	2	2	2	2	2	2	2	1	1
40	21	20	18	17	16	15	15	14	13	12	11	10	9	9	8	8	8

Table 31. Final base-run model estimates of numbers-at-age by sex (continued).

Males (1000s)

Age	2000	2001	2002	2003	2004	2005	2006	2007
0	4339	3950	3007	1680	2341	2255	2350	3670
1	5669	3697	3366	2562	1431	1995	1921	2002
2	2276	4830	3150	2868	2182	1219	1699	1637
3	2041	1939	4112	2683	2440	1859	1038	1447
4	1573	1730	1638	3484	2253	2070	1574	880
5	2072	1318	1439	1372	2863	1892	1733	1320
6	2537	1716	1080	1191	1110	2374	1566	1438
7	995	2080	1391	886	956	911	1948	1291
8	1001	811	1676	1134	709	781	744	1601
9	678	814	652	1364	906	577	636	611
10	473	551	654	530	1090	738	470	522
11	328	385	443	532	424	888	602	386
12	163	267	310	361	427	346	725	495
13	176	133	216	253	290	349	283	597
14	105	144	107	176	203	237	286	233
15	128	86	117	88	142	167	195	235
16	86	105	70	96	71	116	137	161
17	57	71	85	57	77	58	96	113
18	41	47	58	70	46	63	48	79
19	37	34	38	47	56	38	52	39
20	20	30	27	31	38	46	31	43
21	21	16	25	22	25	31	38	26
22	20	17	13	20	18	21	26	32
23	13	16	14	11	16	15	17	21
24	18	11	13	11	9	13	12	14
25	11	14	9	11	9	7	11	10
26	12	9	12	7	9	8	6	9
27	8	10	7	10	6	7	6	5
28	7	7	8	6	8	5	6	5
29	8	6	5	6	5	6	4	5
30	8	6	5	5	5	4	5	3
31	5	6	5	4	4	4	3	4
32	4	4	5	4	3	3	4	3
33	4	4	4	4	3	3	2	3
34	3	3	3	3	3	3	2	2
35	3	3	3	2	2	3	2	2
36	2	2	2	2	2	2	2	2
37	2	2	2	2	2	2	2	2
38	2	2	2	1	1	1	1	1
39	1	1	1	1	1	1	1	1
40	7	7	7	7	6	6	6	6

Table 32. Base-run model estimated standard deviations and coefficients of variation for spawning output and recruitment.

	Spawning Output		Recruitment			Spawning Output		Recruitment	
Year	Std Dev	CV	Std Dev	CV	Year	Std Dev	CV	Std Dev	CV
1915	403.1	8.80%	696.4	8.87%	1970	403.7	9.90%	3963.9	41.28%
					1971	403.8	10.01%	3456.5	42.83%
1920	403.1	8.81%	696.4	8.87%	1972	403.8	10.08%	2462.6	40.47%
					1973	403.9	10.18%	2227.0	37.92%
1925	403.1	8.84%	696.4	8.88%	1974	403.3	10.26%	2191.0	31.63%
					1975	400.6	10.30%	1781.3	32.54%
1930	403.1	8.89%	696.4	8.88%	1976	394.2	10.17%	1541.0	21.63%
					1977	385.8	10.03%	1178.4	26.64%
1935	403.1	8.93%	696.4	8.89%	1978	377.2	9.90%	1110.3	21.64%
					1979	367.1	9.82%	960.8	22.21%
1940	403.1	8.97%	696.4	8.90%	1980	354.4	9.89%	763.6	23.39%
1941	403.1	8.98%	696.4	8.90%	1981	340.1	9.94%	764.3	15.67%
1942	403.1	8.98%	696.4	8.90%	1982	324.4	10.24%	737.3	16.97%
1943	403.1	8.99%	696.4	8.90%	1983	308.4	10.62%	827.9	17.08%
1944	403.2	9.03%	696.5	8.91%	1984	292.8	10.94%	914.9	15.76%
1945	403.2	9.13%	696.6	8.93%	1985	277.4	11.24%	967.8	14.32%
1946	403.4	9.33%	696.8	8.96%	1986	262.7	11.65%	875.4	20.26%
1947	403.4	9.47%	697.0	8.99%	1987	249.1	11.81%	937.8	16.72%
1948	403.3	9.53%	697.1	9.00%	1988	237.5	11.88%	743.6	18.62%
1949	403.2	9.53%	697.1	9.00%	1989	228.3	11.92%	833.9	13.46%
1950	403.2	9.52%	697.1	9.00%	1990	222.1	12.05%	925.3	13.48%
1951	403.2	9.53%	697.1	9.00%	1991	219.3	12.22%	1041.3	13.73%
1952	403.2	9.55%	697.1	9.00%	1992	219.4	12.58%	1272.9	14.63%
1953	403.2	9.54%	697.1	9.00%	1993	221.9	13.43%	1108.9	16.22%
1954	403.2	9.54%	697.1	9.00%	1994	226.0	13.89%	2031.3	14.44%
1955	403.3	9.56%	697.2	9.01%	1995	232.6	14.41%	1577.2	16.67%
1956	403.3	9.59%	697.2	9.01%	1996	243.0	14.88%	1150.1	19.15%
1957	403.3	9.58%	697.2	9.01%	1997	258.7	15.36%	1194.4	18.09%
1958	403.3	9.59%	697.2	9.01%	1998	280.6	15.78%	1140.7	18.19%
1959	403.4	9.63%	697.3	9.02%	1999	309.3	16.08%	2157.9	16.22%
1960	403.4	9.66%	697.4	9.02%	2000	346.1	16.28%	1567.0	18.06%
1961	403.5	9.69%	697.5	9.03%	2001	389.8	16.41%	1421.6	17.99%
1962	403.5	9.69%	697.5	9.03%	2002	433.4	16.79%	1200.5	19.96%
1963	403.5	9.69%	697.5	9.03%	2003	471.3	17.08%	829.2	24.69%
1964	403.5	9.72%	697.5	9.03%	2004	503.0	17.68%	1493.1	31.90%
1965	403.5	9.71%	697.5	9.03%	2005	534.2	17.98%	1680.6	37.27%
1966	403.5	9.75%	697.6	9.04%	2006	567.0	18.29%	1959.8	41.70%
1967	403.6	9.76%	697.6	9.04%	2007	598.0	18.53%	3756.5	51.18%
1968	403.6	9.79%	697.7	9.05%					
1969	403.7	9.82%	697.8	9.06%					

Table 33. Sensitivity of the preliminary base-run model to assumed catch histories.

	Treatment =	Base	H-HKL	L-HKL	H-TWL	L-TWL	H-REC	L-REC	H-All	L-All
	Fishery	- - - - - Level assumed for catch history (High, Medium, Low) - - - - -								
	HKL =	M	**H**	**L**	M	M	M	M	**H**	**L**
	TWL =	M	M	M	**H**	**L**	M	M	**H**	**L**
Component	REC =	M	M	M	M	M	**H**	**L**	**H**	**L**
	Lambda									
Total		1444.2	1444.5	1443.9	1448.7	1442.2	1443.9	1444.6	1448.0	1441.9
Indices		-72.1	-72.1	-72.2	-71.6	-72.4	-72.2	-72.0	-71.7	-72.3
OREC-1	1	-18.0	-18.1	-18.0	-18.1	-18.0	-18.0	-18.0	-18.1	-17.9
OREC-2	1	-8.6	-8.6	-8.6	-8.7	-8.5	-8.6	-8.6	-8.7	-8.5
ORBS-1	1	-16.4	-16.4	-16.4	-16.4	-16.5	-16.4	-16.5	-16.3	-16.5
ORBS-2	1	-10.7	-10.6	-10.7	-10.5	-10.8	-10.7	-10.6	-10.5	-10.8
TAGS	1	-4.9	-4.9	-4.9	-4.8	-4.9	-4.9	-4.8	-4.8	-4.9
CREC-1	1	-3.3	-3.3	-3.3	-3.1	-3.4	-3.3	-3.3	-3.1	-3.4
CREC-2	1	-7.6	-7.5	-7.6	-7.3	-7.7	-7.6	-7.5	-7.4	-7.7
CPFV	1	-3.8	-3.8	-3.8	-3.8	-3.8	-3.8	-3.8	-3.8	-3.7
JUV	1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1
MnWt	1	-82.8	-82.8	-82.8	-82.8	-82.8	-82.8	-82.8	-82.8	-82.8
Length		1385.4	1385.6	1385.3	1388.3	1384.1	1385.4	1385.5	1387.9	1383.7
OHKL	1	76.1	76.1	76.1	75.9	76.1	76.1	76.0	76.0	76.0
OTWL	1	63.5	63.5	63.5	64.4	63.0	63.3	63.7	64.2	63.1
OREC	1	273.6	273.7	273.6	276.3	272.4	273.3	274.1	275.6	272.5
CHKL	1	175.4	175.5	175.3	175.9	175.1	175.4	175.4	175.9	175.0
CTWL	1	134.0	134.0	134.1	132.1	135.2	134.2	133.9	132.4	135.3
CREC	1	267.6	267.7	267.5	268.2	267.3	268.0	267.1	268.5	266.7
ORBS	1	242.7	242.8	242.7	243.3	242.5	242.7	242.8	243.2	242.4
CPFV	1	152.5	152.5	152.5	152.3	152.5	152.4	152.6	152.3	152.6
Age		163.0	163.0	163.0	163.0	163.1	163.0	163.0	163.0	163.2
OHKL	1	49.4	49.4	49.4	49.4	49.5	49.4	49.4	49.4	49.4
ORBS	1	113.6	113.6	113.6	113.7	113.7	113.6	113.6	113.6	113.7
Len-at-Age	1	76.2	76.2	76.2	76.6	75.9	76.1	76.4	76.4	76.1
Recruits	1	-15.6	-15.5	-15.6	-14.9	-15.8	-15.6	-15.6	-15.0	-15.9
ForecastRecr	1	-9.9	-9.9	-9.9	-9.9	-9.9	-9.9	-9.9	-9.9	-9.9
Spawning-0		3724	3748	3701	3970	3614	4281	3169	4546	3034
Spawning-2006		2318	2343	2295	2574	2211	2637	2002	2909	1870
Depletion		62.3%	62.5%	62.0%	64.8%	61.2%	61.6%	63.2%	64.0%	61.6%
MSY		847	853	842	900	823	972	723	1029	694
Tag-Q		22.0%	21.8%	22.2%	20.0%	23.0%	19.3%	25.5%	17.7%	27.2%

Table 34. Sensitivity of the preliminary base-run model to the assumed natural mortality formulation.

Values marked in bold and highlighted indicate the minimum negative log-likelihood value for the given table.

The base-run model has Yng-M equal to 0.16 and Old-M-offset-Females equal to 0.4055.

	Old-M-offset-Females			Old-M-offset-Females			Old-M-offset-Females		
	Total			Indices			MnWt		
Yng-M	0.3	0.4	0.5	0.3	0.4	0.5	0.3	0.4	0.5
0.12	1444.5	1444.5	1439.6	-69.0	-69.0	-69.5	**-83.1**	**-83.1**	-83.1
0.14	1440.1	1439.1	**1438.8**	-71.3	-71.3	-71.4	-82.9	-82.9	-82.9
0.16	1444.2	1444.2	1444.7	**-72.2**	-72.2	-72.1	-82.8	-82.8	-82.8
0.18	1451.6	1452.1	1453.0	-72.1	-72.0	-71.9	-82.7	-82.7	-82.7

	Length			Age			Len-at-Age		
Yng-M	0.3	0.4	0.5	0.3	0.4	0.5	0.3	0.4	0.5
0.12	1378.2	1378.2	**1376.2**	172.5	172.5	168.6	**68.6**	**68.6**	71.4
0.14	1380.8	1380.1	1379.9	166.6	165.2	164.1	72.6	73.9	75.1
0.16	1385.9	1385.4	1385.4	164.0	163.0	162.3	74.9	76.2	77.4
0.18	1391.3	1391.0	1391.1	163.2	162.5	**161.9**	76.2	77.4	78.6

	Recruits			Virgin SB		
Yng-M	0.3	0.4	0.5	0.3	0.4	0.5
0.12	-12.7	-12.7	-14.0	3586.3	3586.3	3324.6
0.14	-15.7	-15.9	**-16.0**	3579.9	3476.0	3379.2
0.16	-15.7	-15.6	-15.5	3795.8	3728.0	3664.1
0.18	-14.3	-14.1	-14.0	4418.2	4413.6	4408.9

	Depletion			MSY			Tag-Q		
Yng-M	0.3	0.4	0.5	0.3	0.4	0.5	0.3	0.4	0.5
0.12	28.2%	28.2%	32.3%	576.0	576.0	607.5	50.6%	50.6%	47.2%
0.14	40.6%	43.6%	46.6%	668.5	690.2	711.3	35.3%	33.7%	32.3%
0.16	58.2%	62.0%	65.7%	813.0	845.4	877.0	23.2%	22.1%	21.1%
0.18	79.8%	84.1%	88.1%	1074.8	1131.9	1188.3	14.5%	13.7%	13.0%

Old-M = Yng-M * exp(Old-M-offset)

Old-M-offset =		0.3	0.4	0.5
exp(Old-M-offset) =		1.35	1.49	1.65
Yng-M	0.12	0.162	0.179	0.198
	0.14	0.189	0.209	0.231
	0.16	0.216	**0.239**	0.264
	0.18	0.243	0.269	0.297

Table 35. Sensitivity of the final base-run model to the mean length-at-age data.

	Base-Run Model		Reduced Len-at-age	
Component	Lambda	Neg. log-Like	Lambda	Neg. log-Like
Total		1406.6		1346.1
Indices		-74.4		-72.3
OREC-1	1	-18.3	1	-17.6
OREC-2	1	-8.8	1	-8.4
ORBS-1	1	-16.5	1	-15.7
ORBS-2	1	-9.0	1	-8.8
ORBS-3	1	-4.9	1	-4.8
TAGS	1	-3.3	1	-3.3
CREC-1	1	-3.0	1	-3.4
CREC-2	1	-7.6	1	-7.5
CPFV	1	-3.8	1	-3.7
JUV	1	0.8	1	1.1
MnWt	1	-82.9	1	-82.2
Length		1378.7		1366.1
OHKL	1	74.6	1	72.8
OTWL	1	64.7	1	63.3
OREC	1	271.6	1	265.7
CHKL	1	173.6	1	176.0
CTWL	1	140.2	1	142.2
CREC	1	252.5	1	254.0
ORBS	1	244.3	1	233.8
CPFV	1	157.1	1	158.3
Age		171.9		142.8
OHKL	1	50.0	1	48.6
ORBS	1	121.9	1	94.2
Length-at-Age	1	35.4	0.1	14.5
Recruits	1	-15.3	1	-15.9
Forecast Recr	1	-6.9	1	-6.9
Spawning-0		4578.5		3774.0
Depletion		70.5%		53.3%
MSY		1035.4		839.7
Tag-Q		12.8%		20.6%

Table 36. Final base-run model forecasts of optimum yield, spawning output, and recruitment.

	- - - - - Oregon Catch (mt) - - - - -			- - - - California Catch (mt) - - - -		
Year	HKL	TWL	REC	HKL	TWL	REC
2007	96.9	0	306.8	160.8	0	131.6
2008	96.9	0	306.8	160.8	0	131.6
2009	201.1	0	615.2	361.8	0	275.6
2010	178.0	0	544.7	323.0	0	257.5
2011	159.7	0	498.1	296.1	0	249.6
2012	148.5	0	478.3	282.8	0	246.7
2013	144.1	0	477.7	279.5	0	244.6
2014	144.0	0	485.2	281.0	0	242.6
2015	145.5	0	493.2	283.6	0	240.6
2016	147.1	0	498.3	285.5	0	238.6
2017	148.1	0	499.9	286.1	0	236.5
2018	148.3	0	498.5	285.4	0	234.4
2019	147.7	0	495.0	283.7	0	232.3
2020	146.6	0	490.4	281.3	0	230.2
2021	145.2	0	485.5	278.7	0	228.3

Year	OY Catch (mt)	Spawning Output	Recruits	Depletion	Exploitation
2007	696	3227	7339	70.5%	3.30%
2008	696	3293	7372	71.9%	3.41%
2009	1454	3284	7368	71.7%	7.33%
2010	1303	3077	7262	67.2%	7.01%
2011	1203	2844	7127	62.1%	6.78%
2012	1156	2616	6980	57.1%	6.73%
2013	1146	2422	6838	52.9%	6.80%
2014	1153	2277	6720	49.7%	6.94%
2015	1163	2181	6636	47.6%	7.08%
2016	1170	2122	6582	46.3%	7.19%
2017	1171	2088	6550	45.6%	7.26%
2018	1167	2070	6533	45.2%	7.29%
2019	1159	2060	6523	45.0%	7.30%
2020	1149	2050	6514	44.8%	7.30%
2021	1138	2040	6503	44.6%	7.29%

Table 37. Decision table for southern black rockfish.

Management Action		State of Nature: Low Productivity (mal-M=0.14, fem-M=0.21, low trawl catch; 25% probability)		Medium Productivity (mal-M=0.16, fem-M=0.24, medium trawl catch; 50% probability)		High Productivity (mal-M=0.18, fem-M=0.27, high trawl catch; 25% probability)	
Year	Catch	Spawning output	Depletion	Spawning output	Depletion	Spawning output	Depletion
Low Catch Series: F50% OY stream from the Low Productivity State							
2007	696	2160	53.0%	3227	70.5%	5660	91.9%
2008	696	2203	54.1%	3293	71.9%	5748	93.3%
2009	909	2195	53.9%	3284	71.7%	5710	92.7%
2010	831	2099	51.6%	3168	69.2%	5518	89.6%
2011	782	1981	48.6%	3015	65.9%	5258	85.4%
2012	765	1860	45.7%	2855	62.3%	4982	80.9%
2013	772	1756	43.1%	2714	59.3%	4737	76.9%
2014	789	1683	41.3%	2614	57.1%	4555	74.0%
2015	806	1641	40.3%	2556	55.8%	4446	72.2%
2016	819	1623	39.9%	2534	55.3%	4399	71.4%
Medium Catch Series: F50% OY stream from the Medium Productivity State							
2007	696	2160	53.0%	3227	70.5%	5660	91.9%
2008	696	2203	54.1%	3293	71.9%	5748	93.3%
2009	1454	2195	53.9%	3284	71.7%	5710	92.7%
2010	1303	2007	49.3%	3077	67.2%	5428	88.1%
2011	1203	1804	44.3%	2844	62.1%	5092	82.7%
2012	1156	1612	39.6%	2616	57.1%	4753	77.2%
2013	1146	1450	35.6%	2422	52.9%	4458	72.4%
2014	1153	1329	32.6%	2277	49.7%	4237	68.8%
2015	1163	1242	30.5%	2181	47.6%	4094	66.5%
2016	1170	1180	29.0%	2122	46.3%	4017	65.2%
High Catch Series: F50% OY stream from the High Productivity State							
2007	696	2160	53.0%	3227	70.5%	5660	91.9%
2008	696	2203	54.1%	3293	71.9%	5748	93.3%
2009	2660	2195	53.9%	3284	71.7%	5710	92.7%
2010	2333	1802	44.3%	2876	62.8%	5231	84.9%
2011	2112	1416	34.8%	2467	53.9%	4726	76.7%
2012	1994	1072	26.3%	2096	45.8%	4252	69.0%
2013	1945	796	19.5%	1791	39.1%	3854	62.6%
2014	1930	583	14.3%	1557	34.0%	3551	57.7%
2015	1925	415	10.2%	1380	30.2%	3339	54.2%
2016	1918	271	6.7%	1244	27.2%	3197	51.9%

Figure 1. Areas used for compiling data for the southern black rockfish stock assessment.

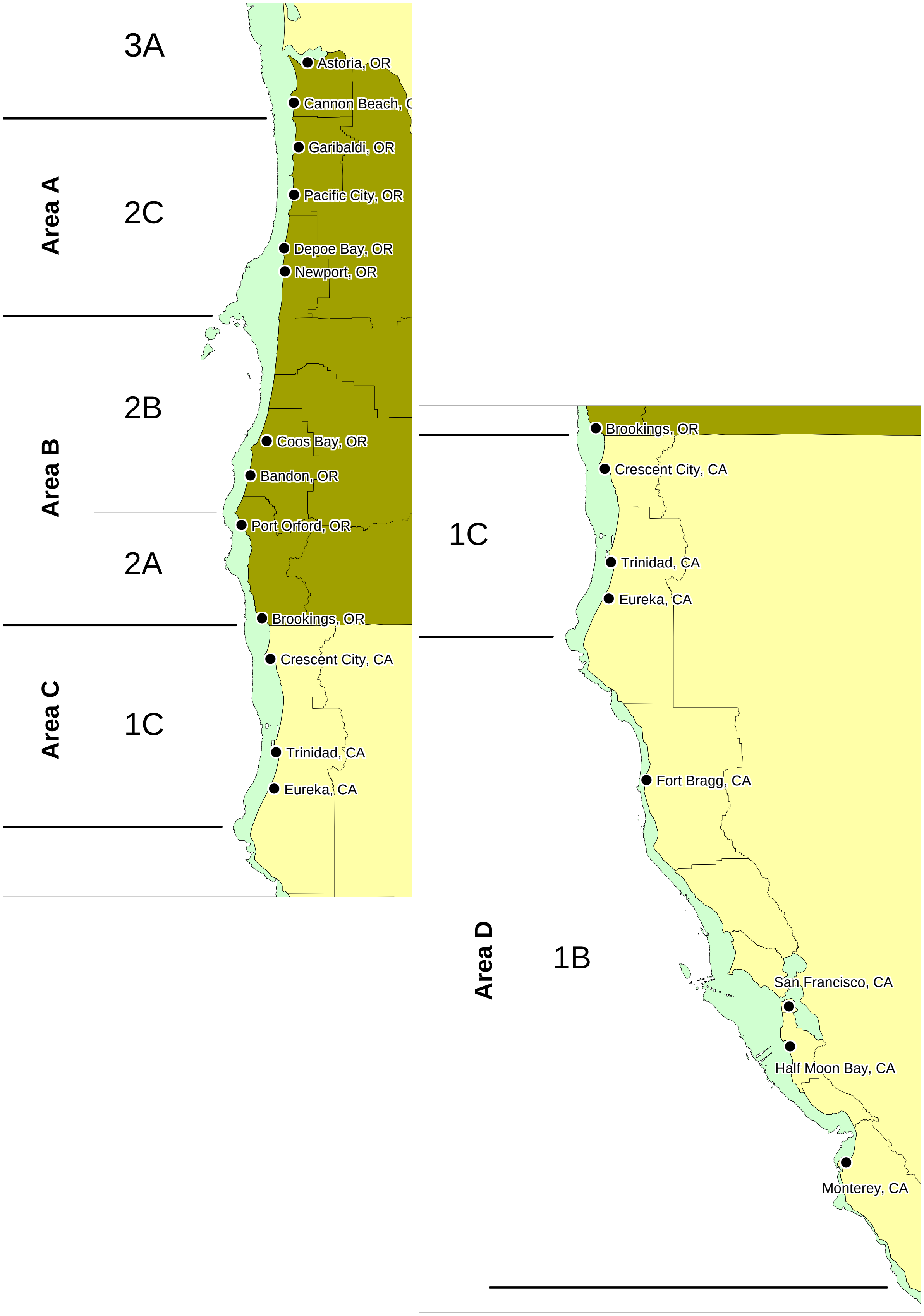
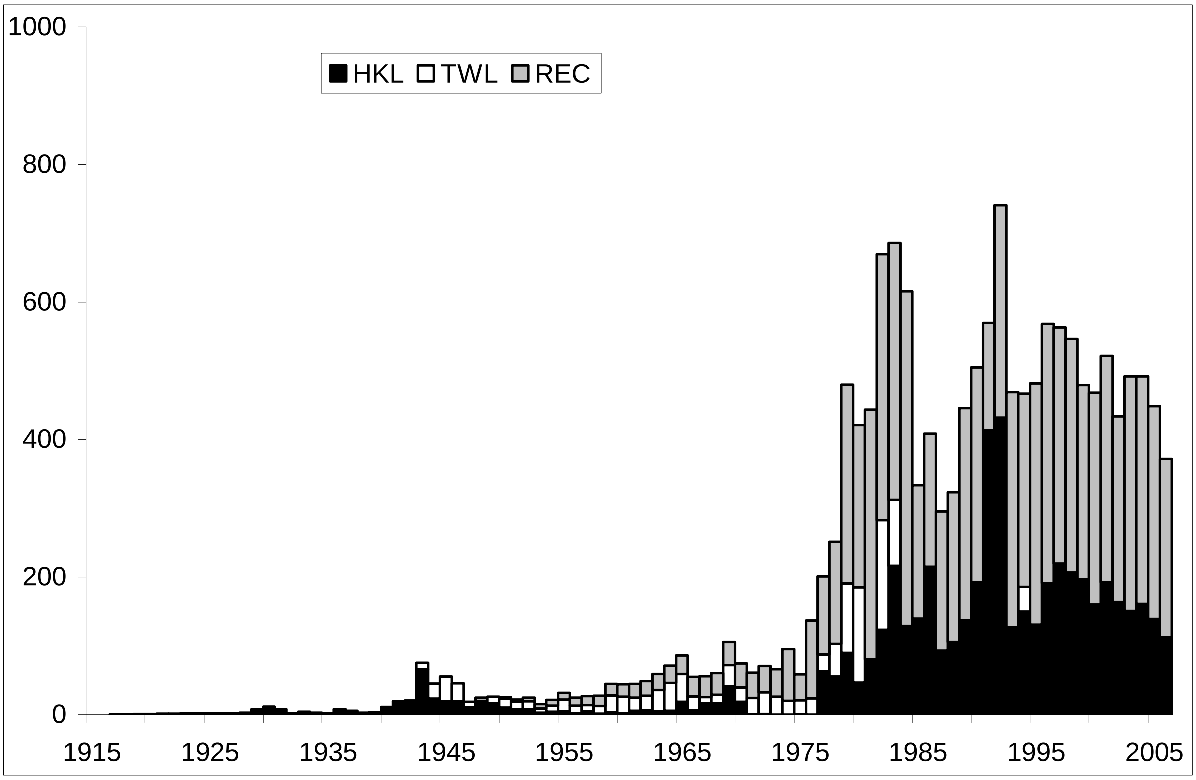


Figure 2. Base landings history for black rockfish off Oregon and California.

Landings (MTs) by fishery - Oregon.



Landings (MTs) by fishery - California.

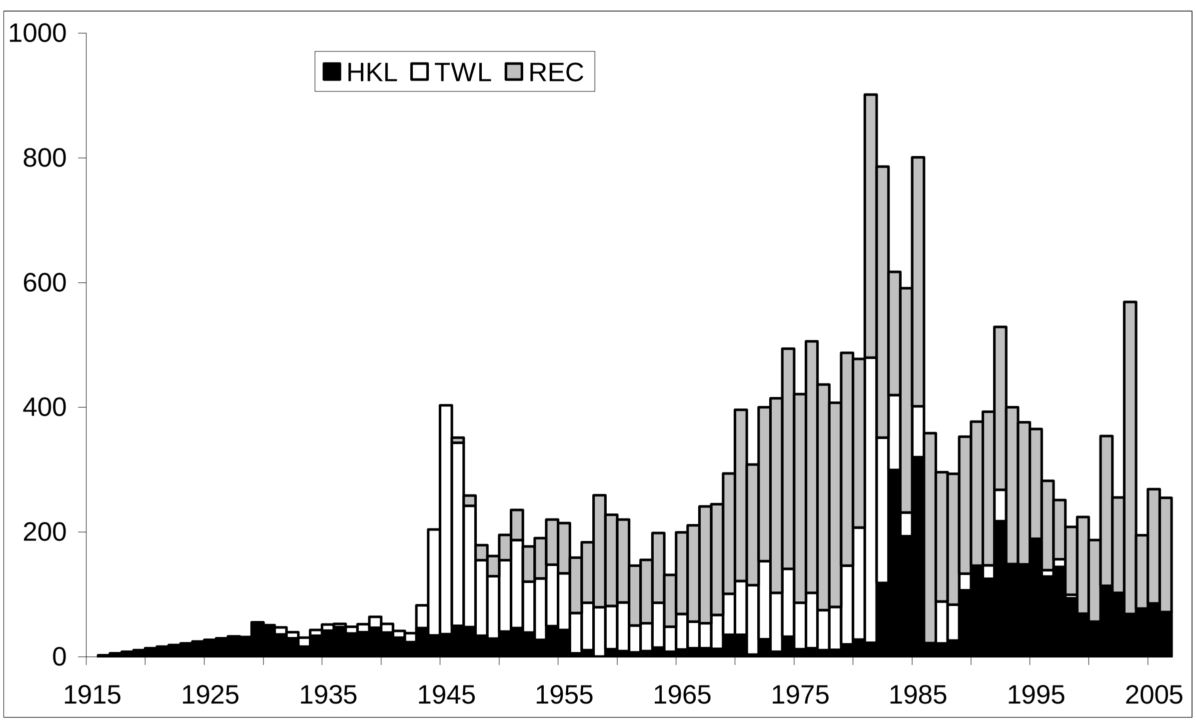
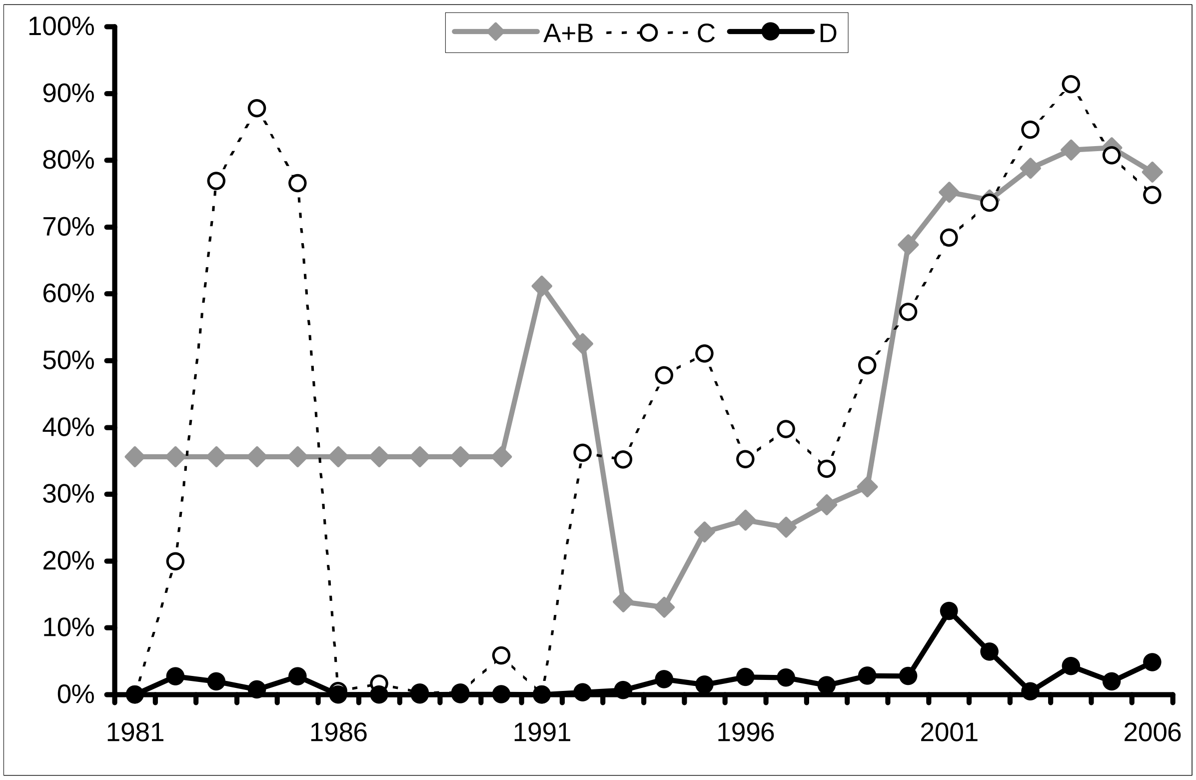


Figure 3. Percent black rockfish from "speciated" PacFIN landings data, by year and area.

Gear =   HKL



Gear =   TWL

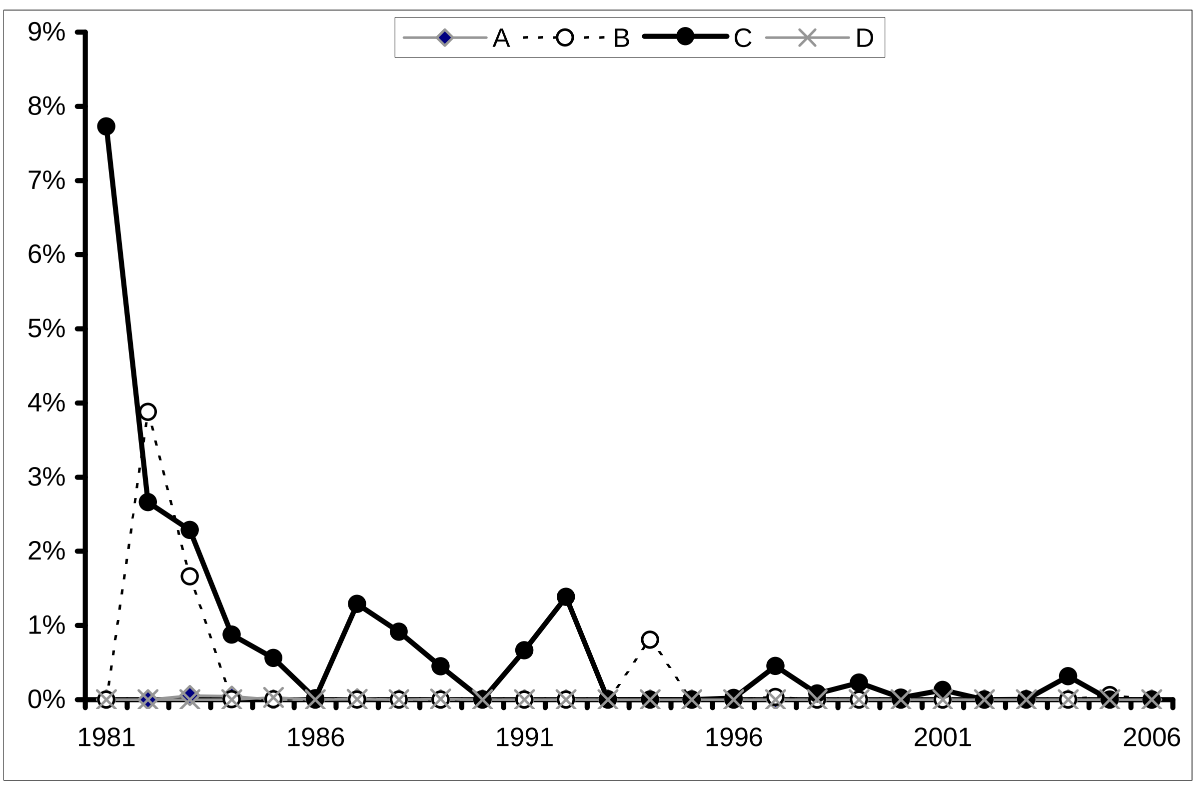
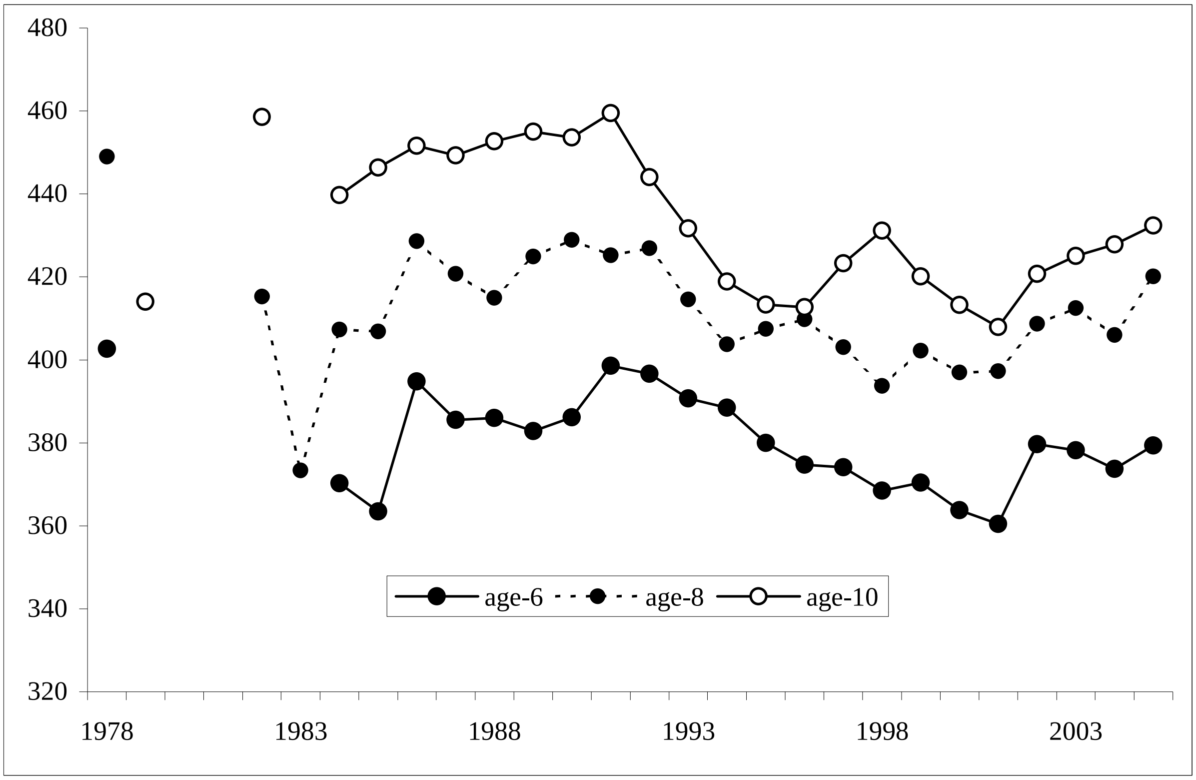


Figure 4. Black rockfish average lengths-at-age (mm), from the complete ODFW database.

Females



Males

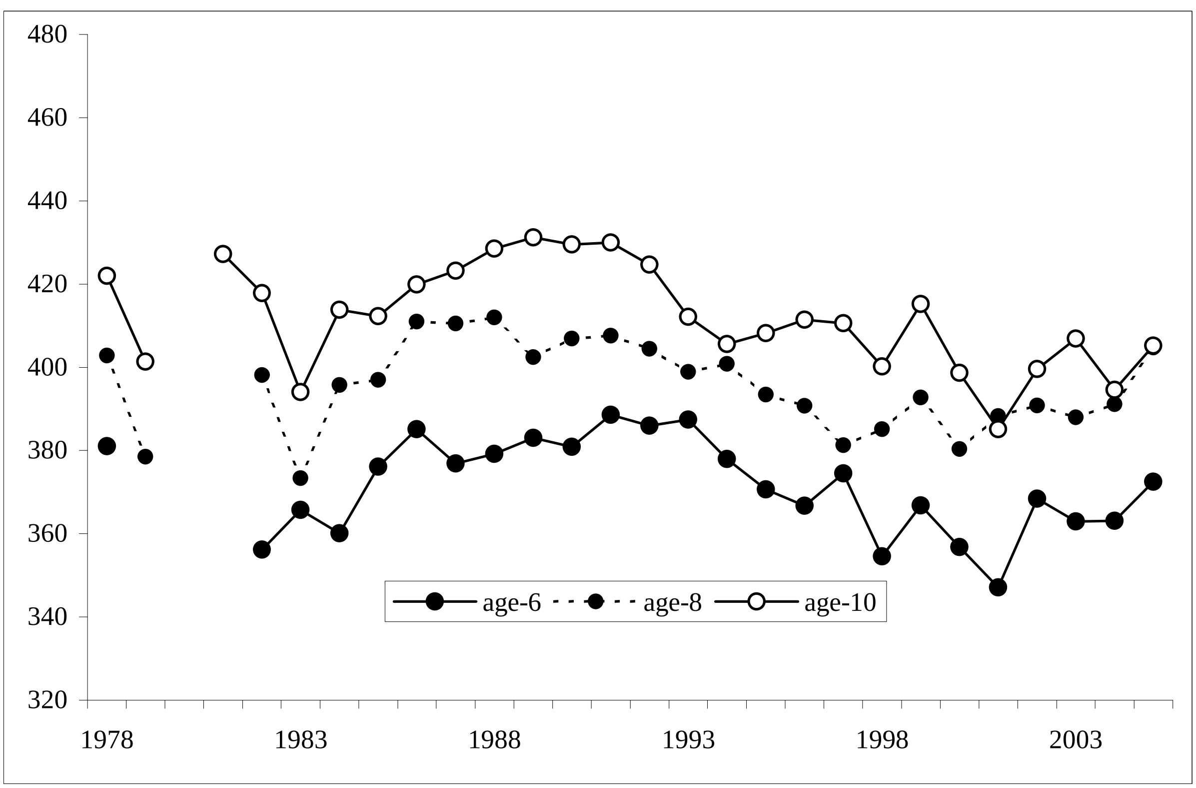
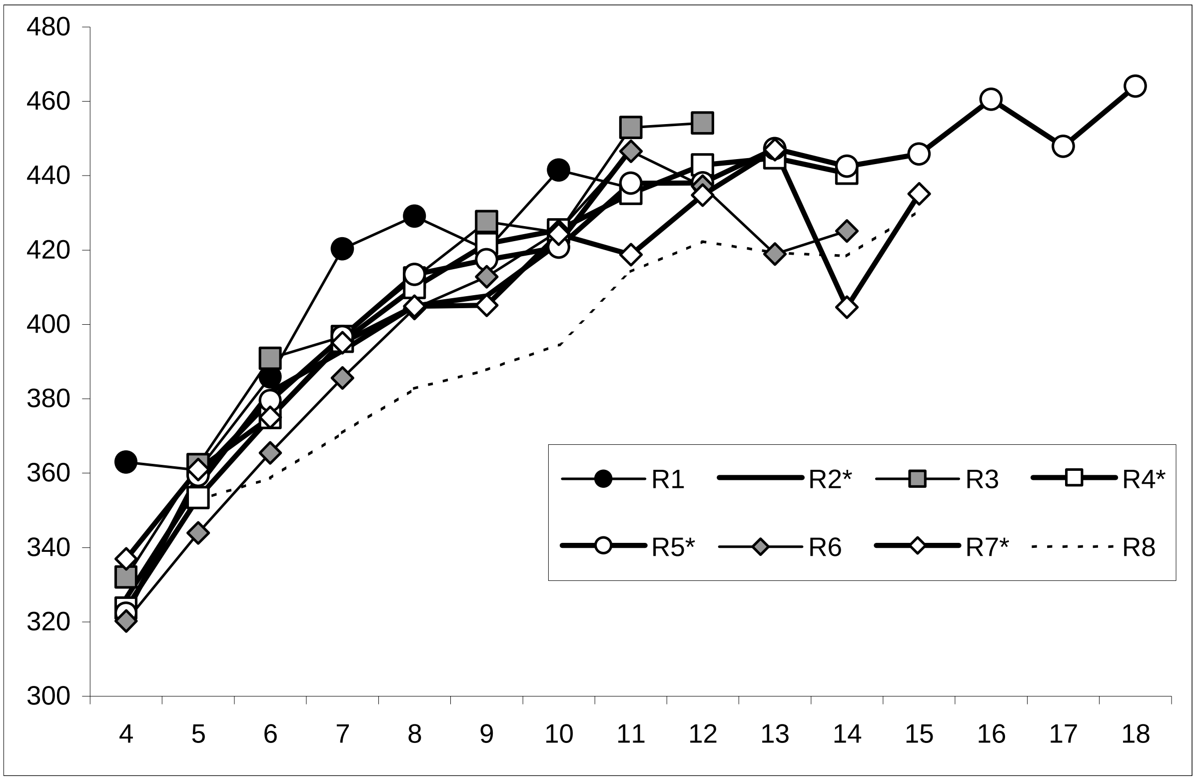


Figure 5. Age-reader comparisons.
Readers marked with asterisks were selected for the set of standard readers.

Females



Males

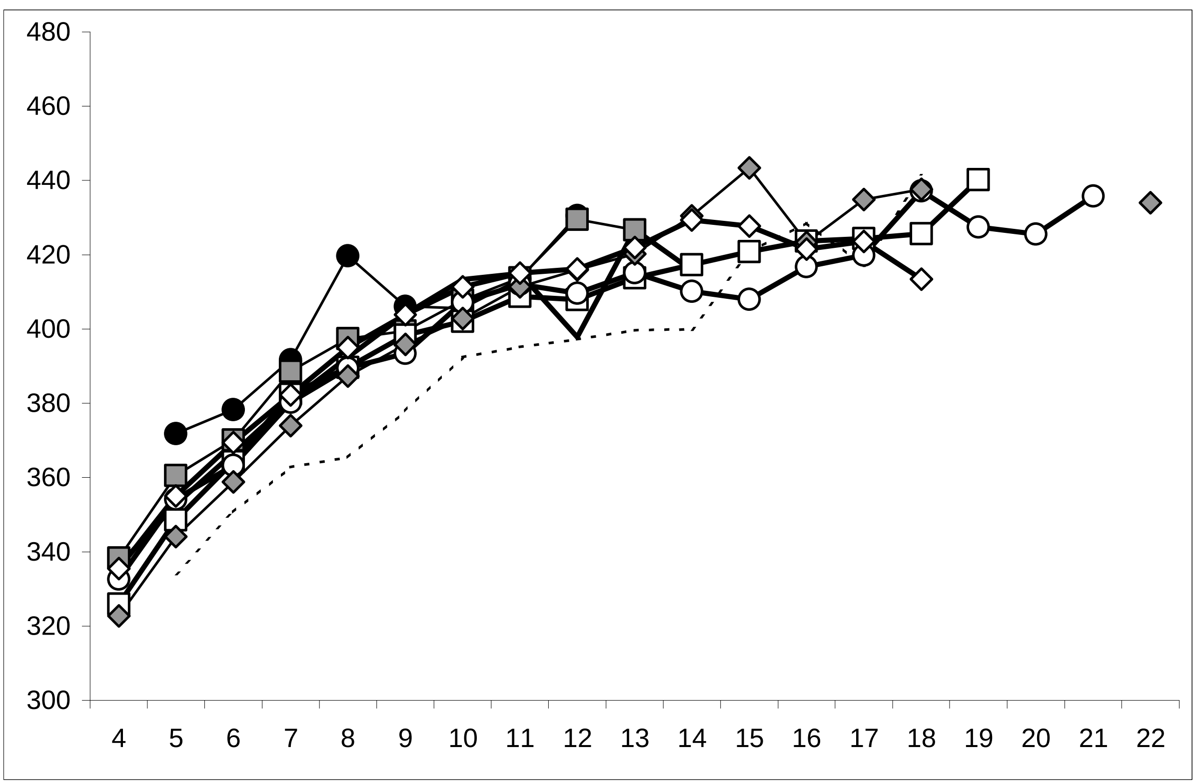
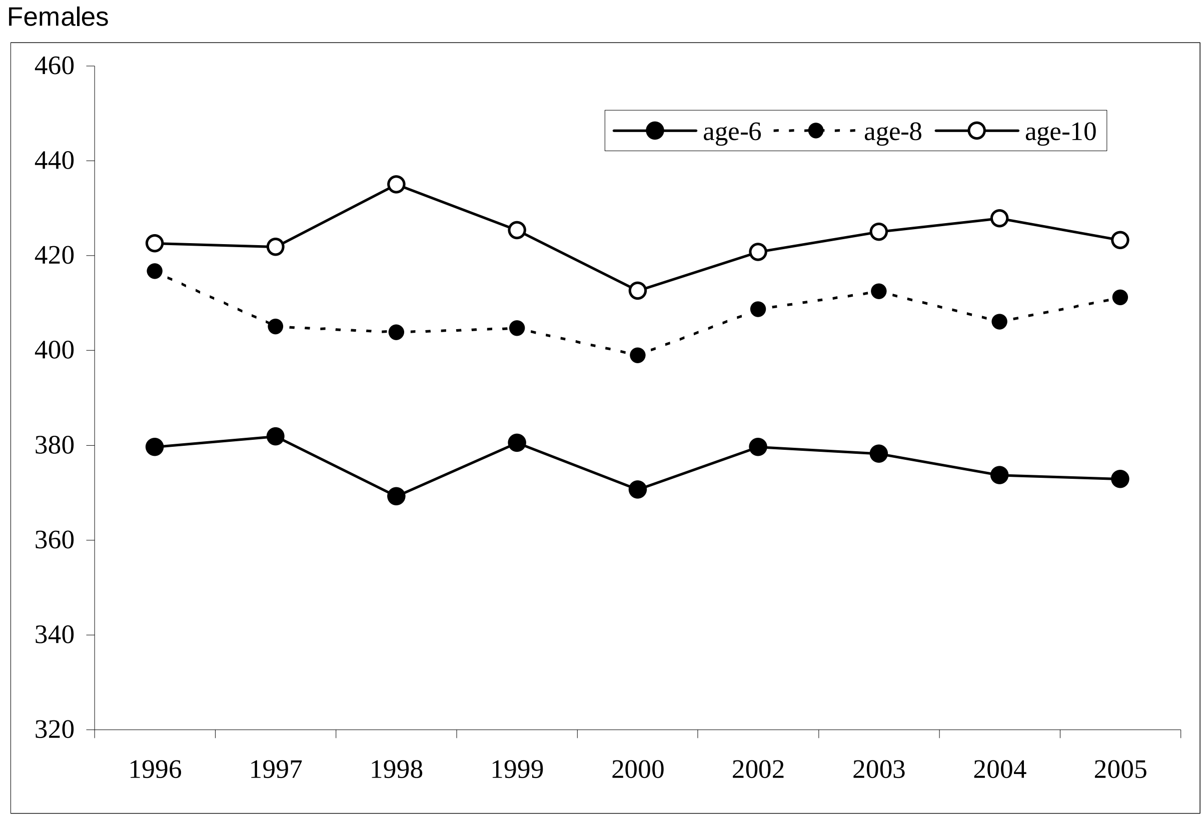


Figure 6. Black rockfish average lengths-at-age (mm) by the set of standard readers.



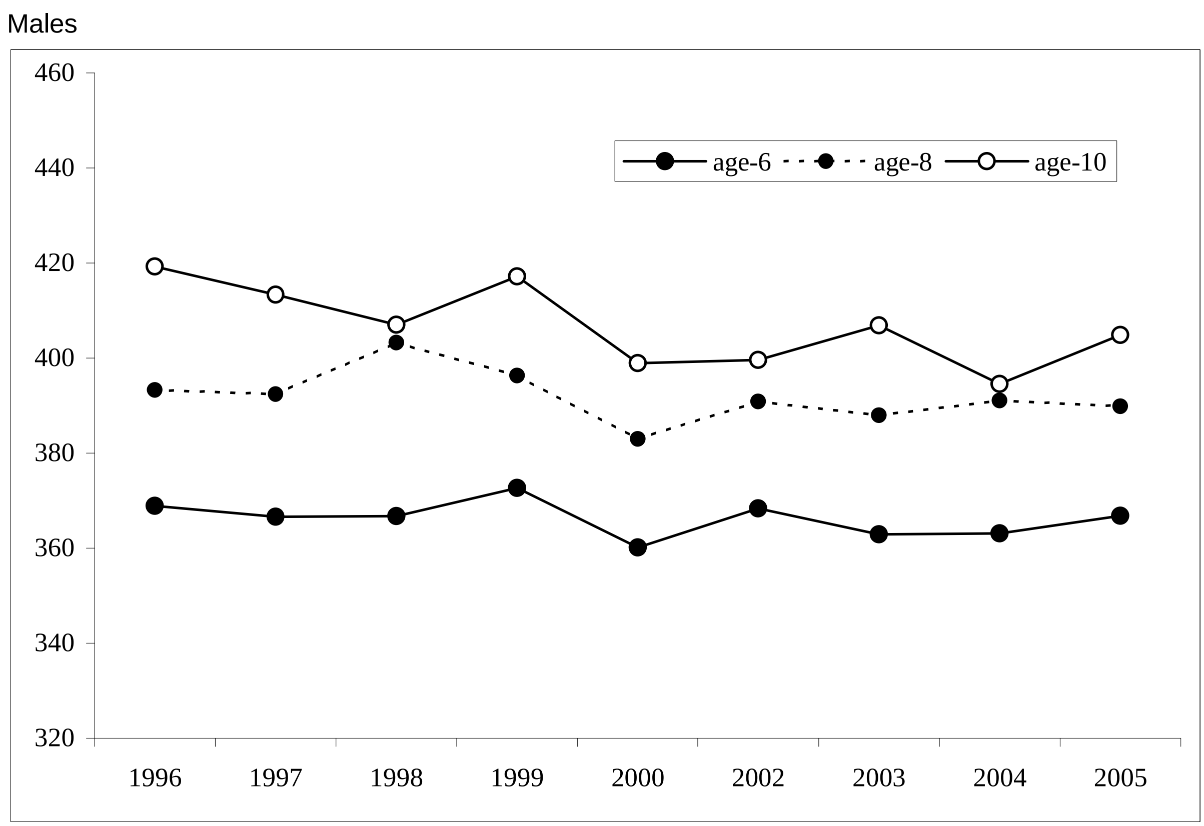
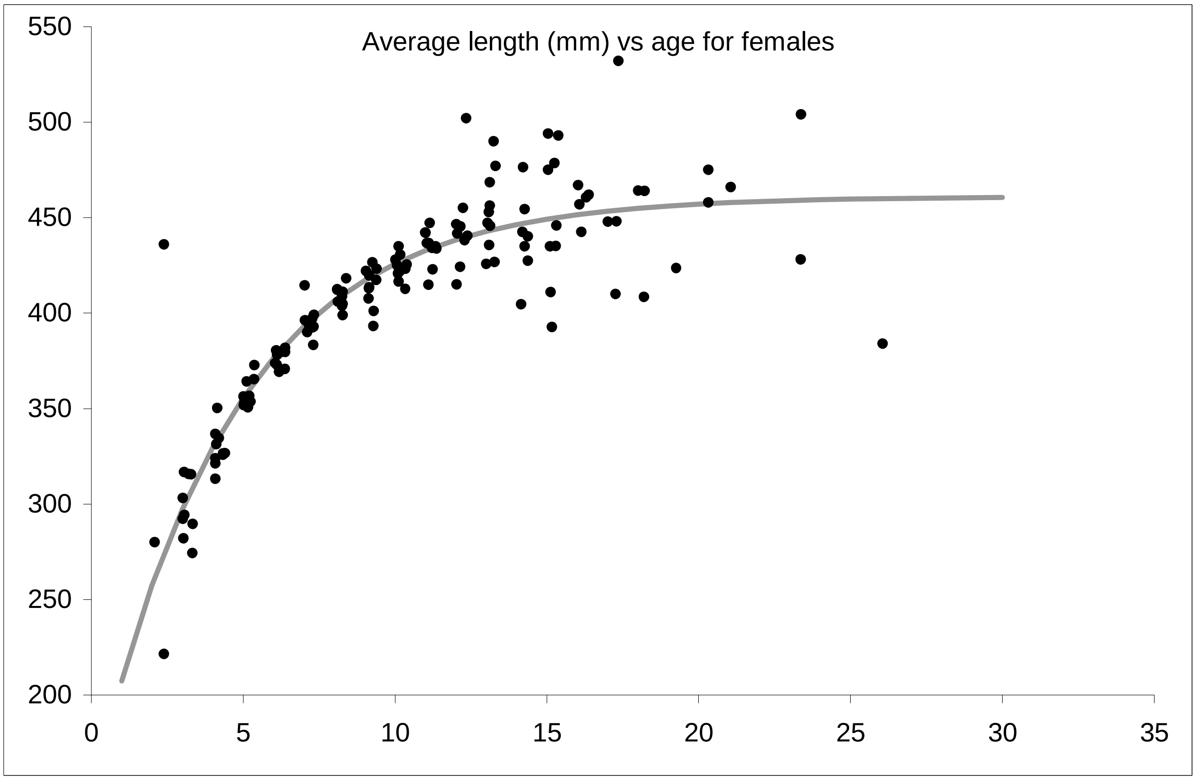


Figure 7. Black rockfish growth curves based on age-reads by the standard set of readers.



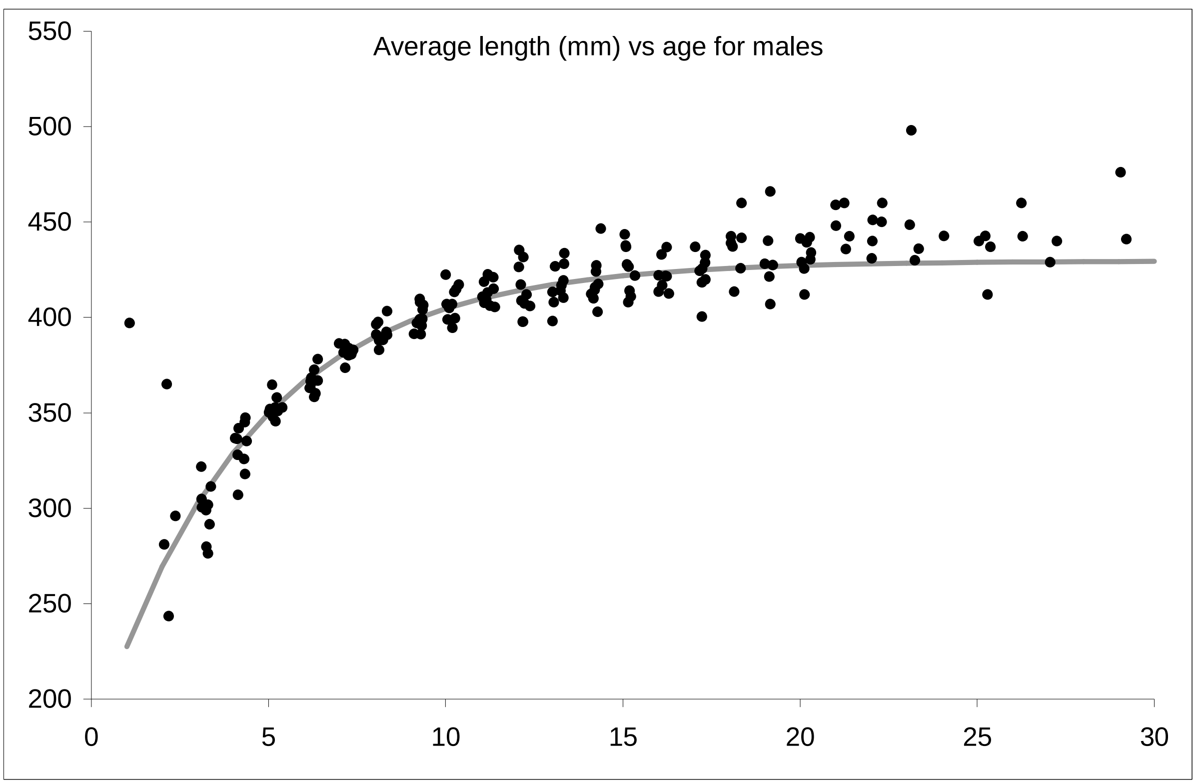


Figure 8. Variability in length-at-age for age-reads by the standard set of readers.

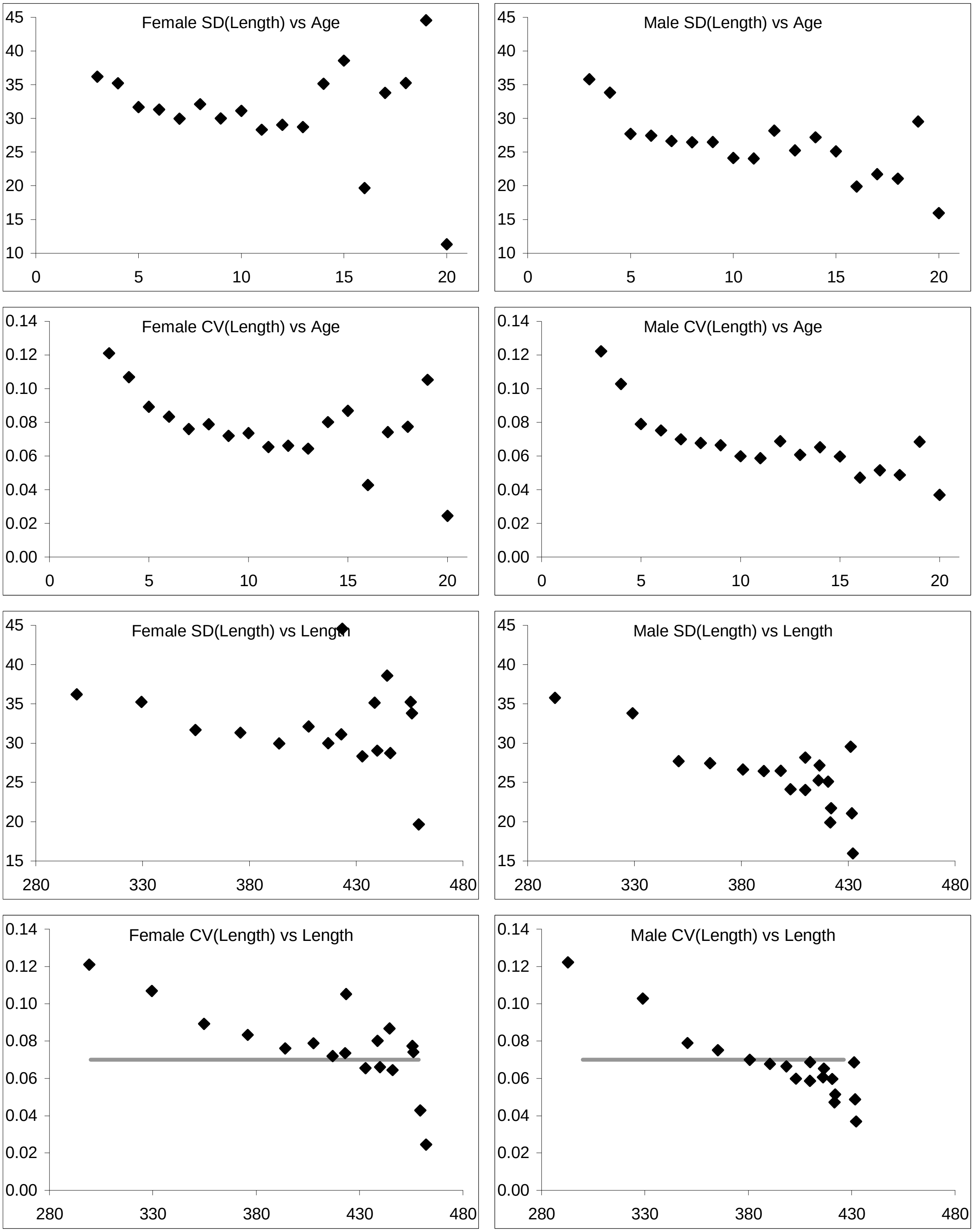


Figure 9. Age-reading variability among the standard set of readers.

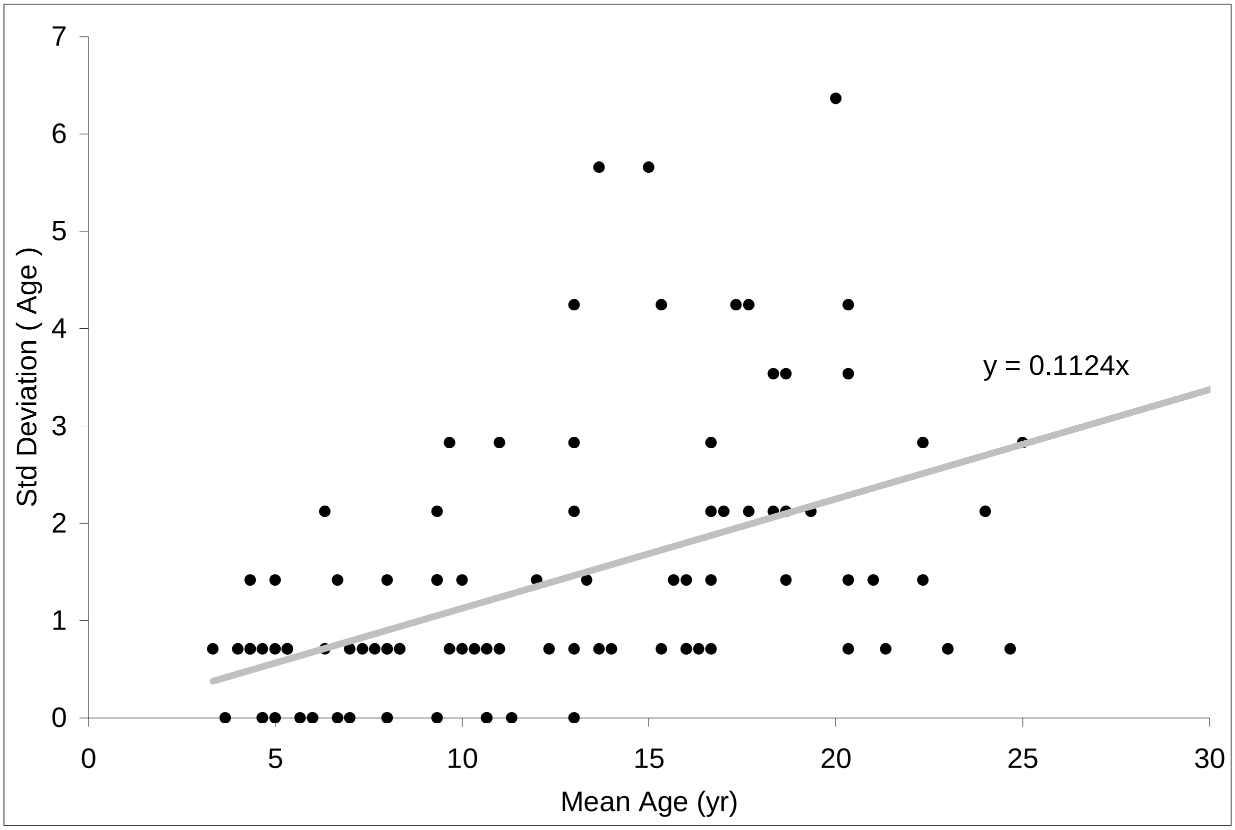
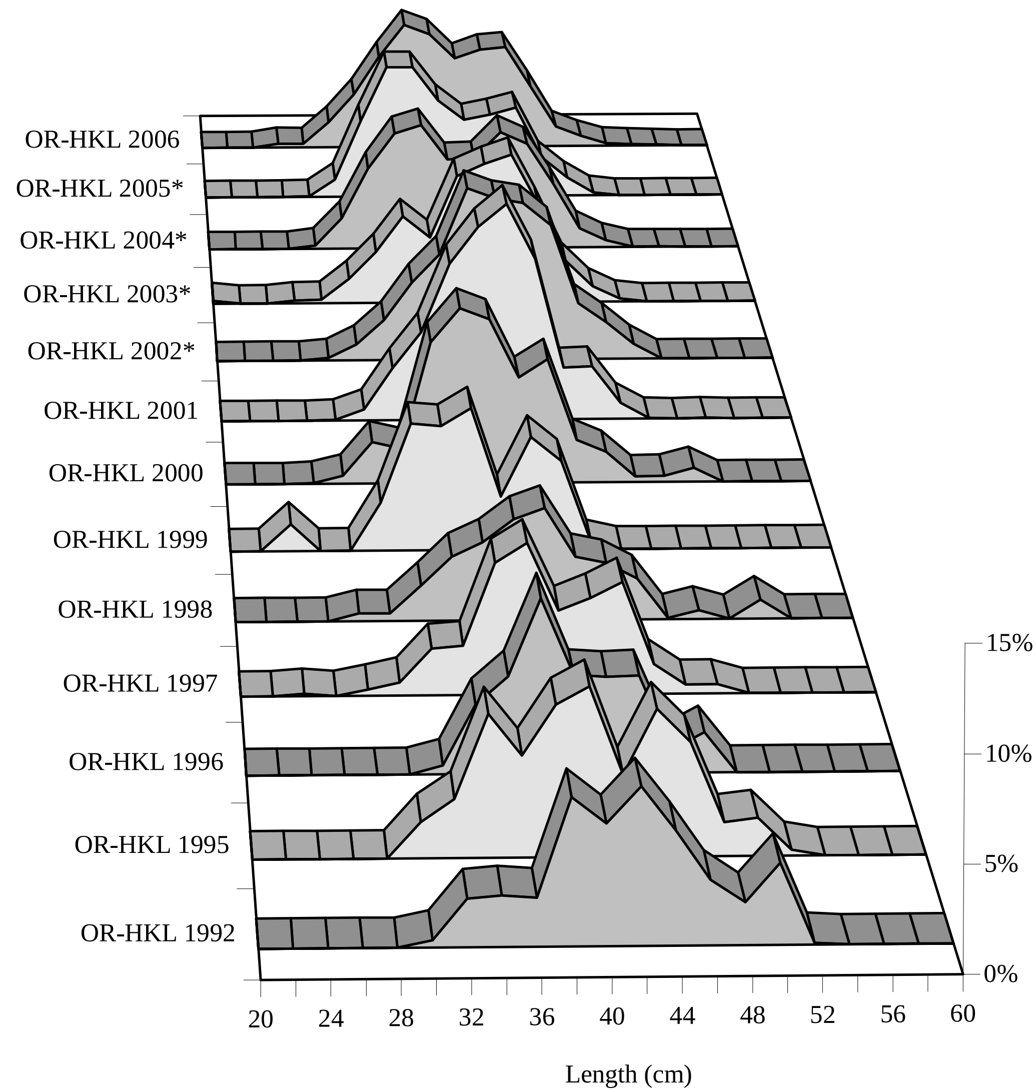


Figure 10. Black rockfish length composition data.

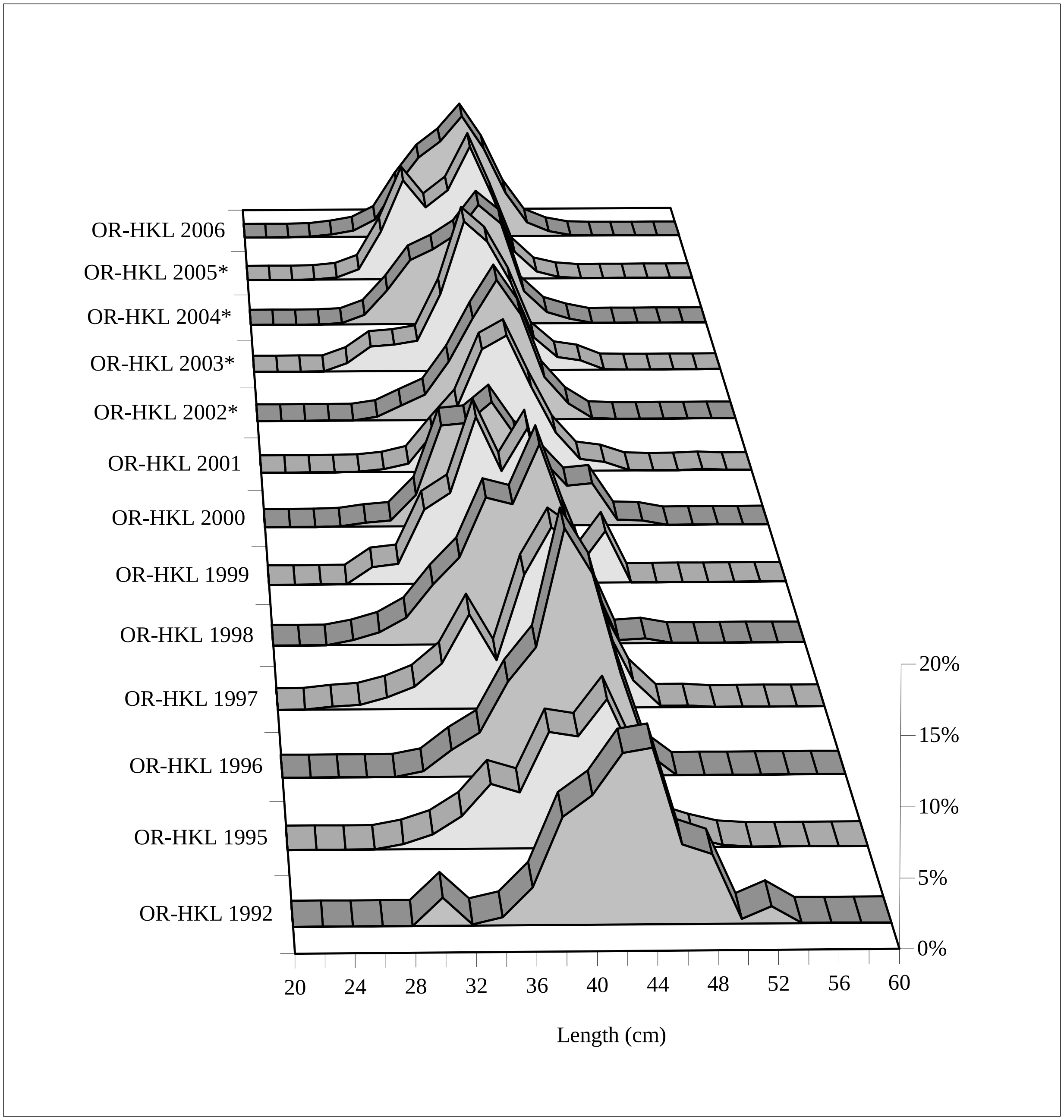
Oregon HKL length compositions - females.



* Length data not included in model because age-composition data used instead.

Figure 10. Black rockfish length composition data (continued).

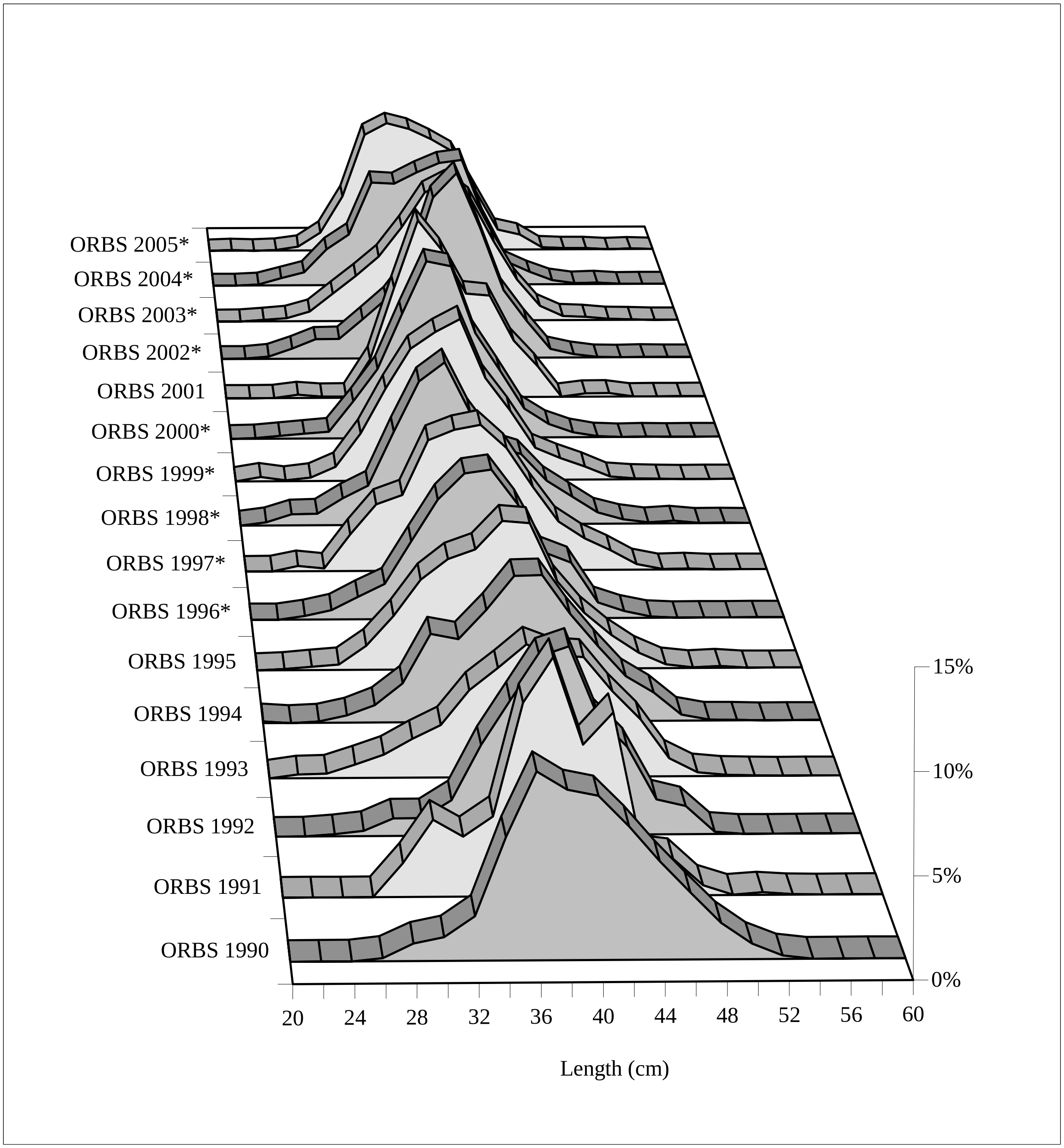
Oregon HKL length compositions - males.



* Length data not included in model because age-composition data used instead.

Figure 10. Black rockfish length composition data (continued).

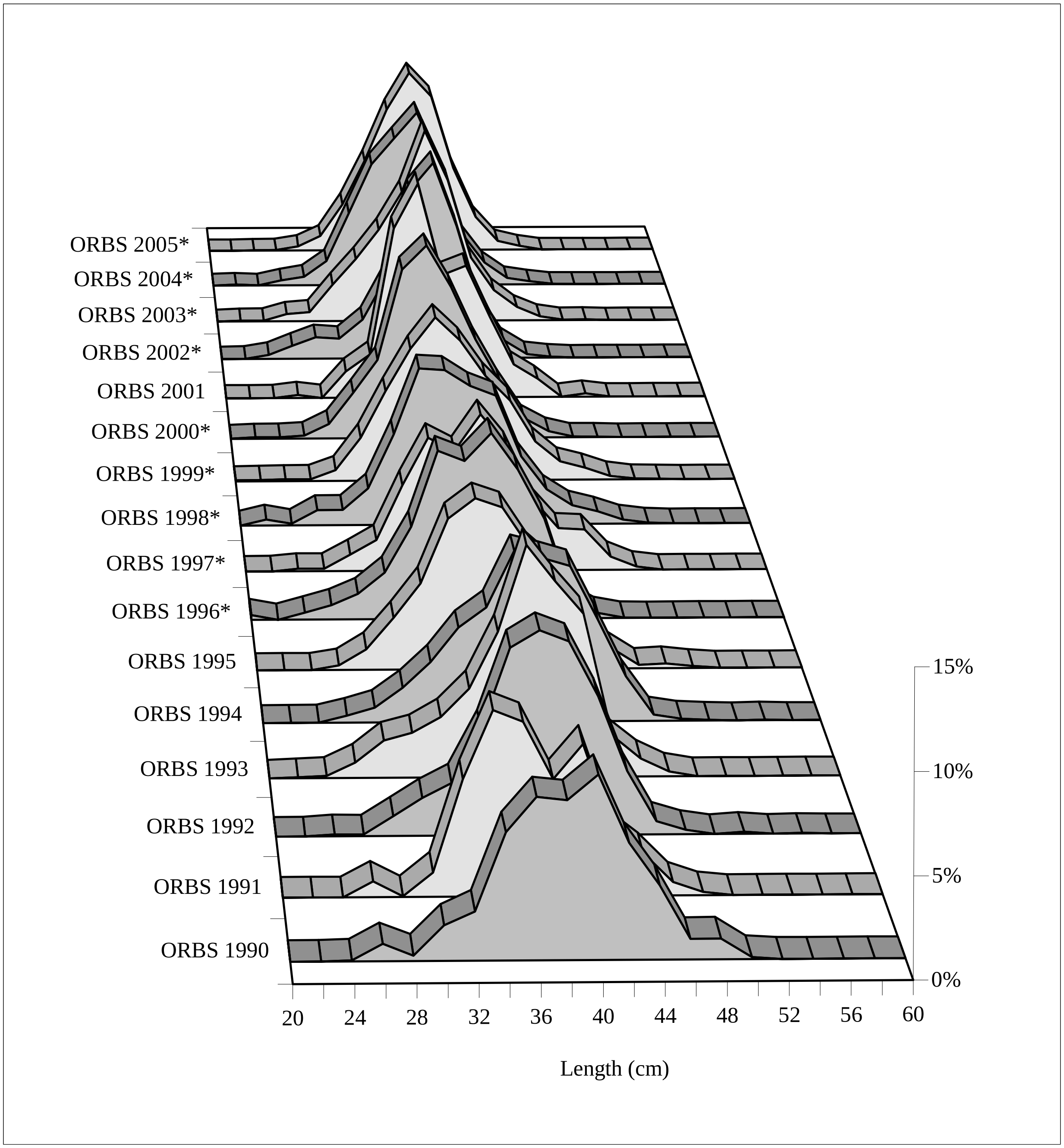
Oregon REC-ORBS length compositions - females.



* Length data not included in model because age-composition data used instead.

Figure 10. Black rockfish length composition data (continued).

Oregon REC-ORBS length compositions - males.



* Length data not included in model because age-composition data used instead.

Figure 10. Black rockfish length composition data (continued).

Oregon TWL length compositions - sexes combined.

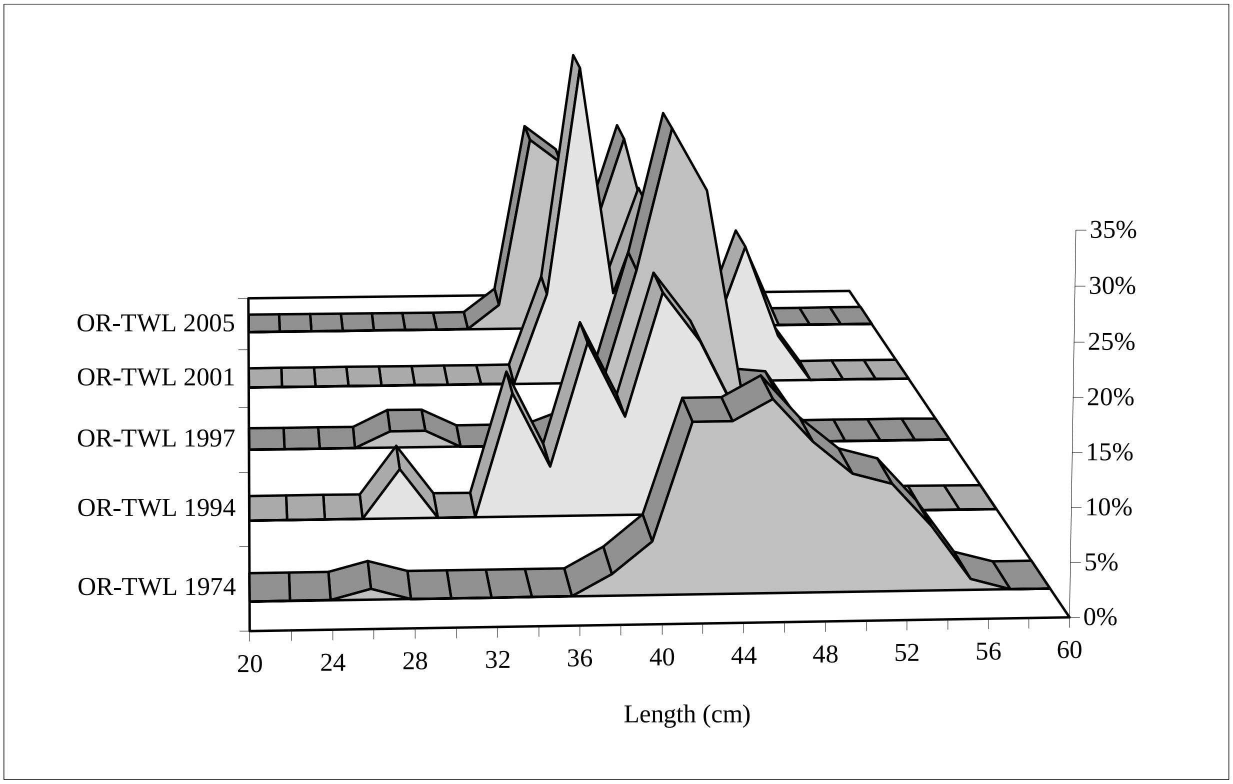


Figure 10. Black rockfish length composition data (continued).

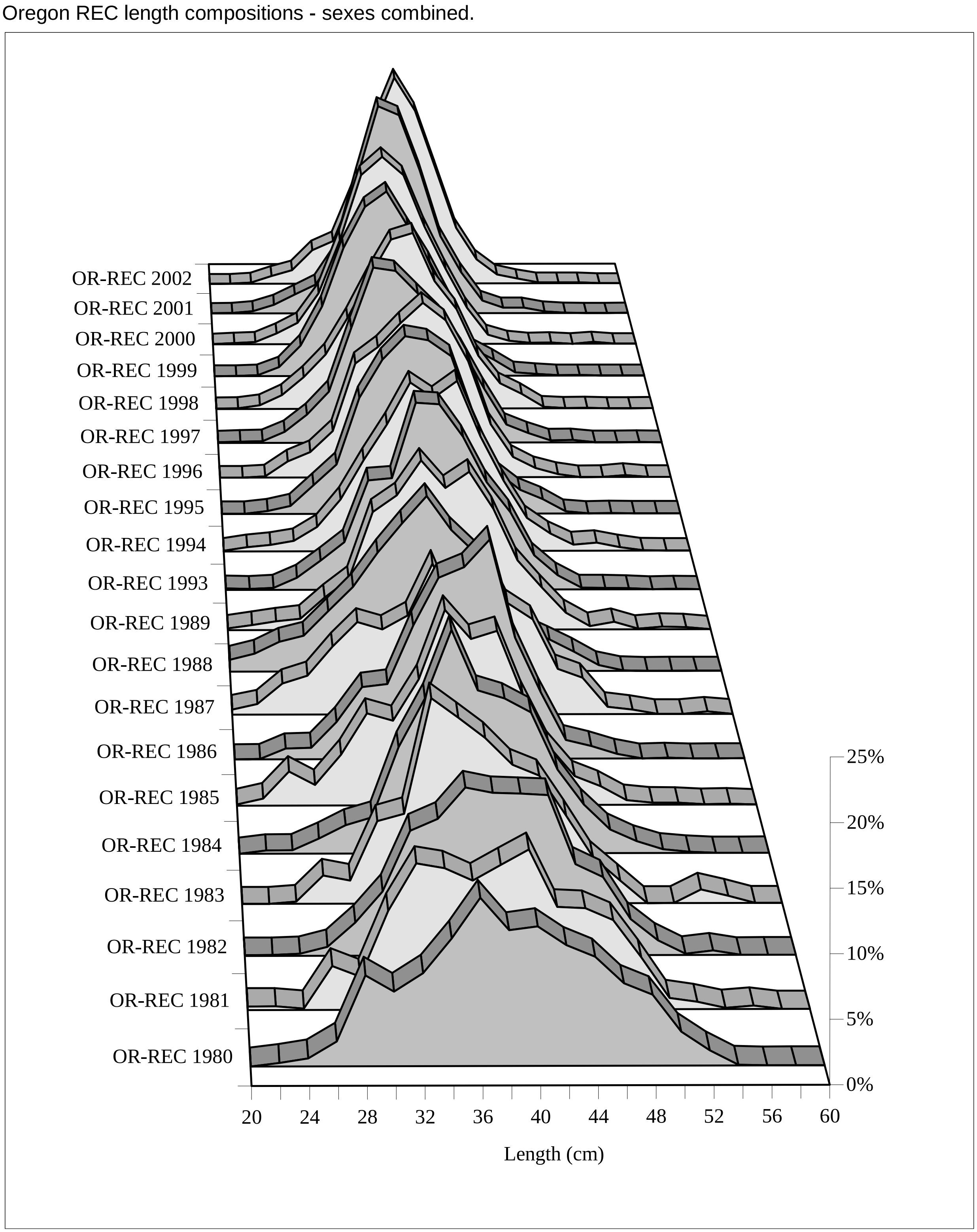


Figure 10. Black rockfish length composition data (continued).

Oregon REC-ORBS length compositions - sexes combined.

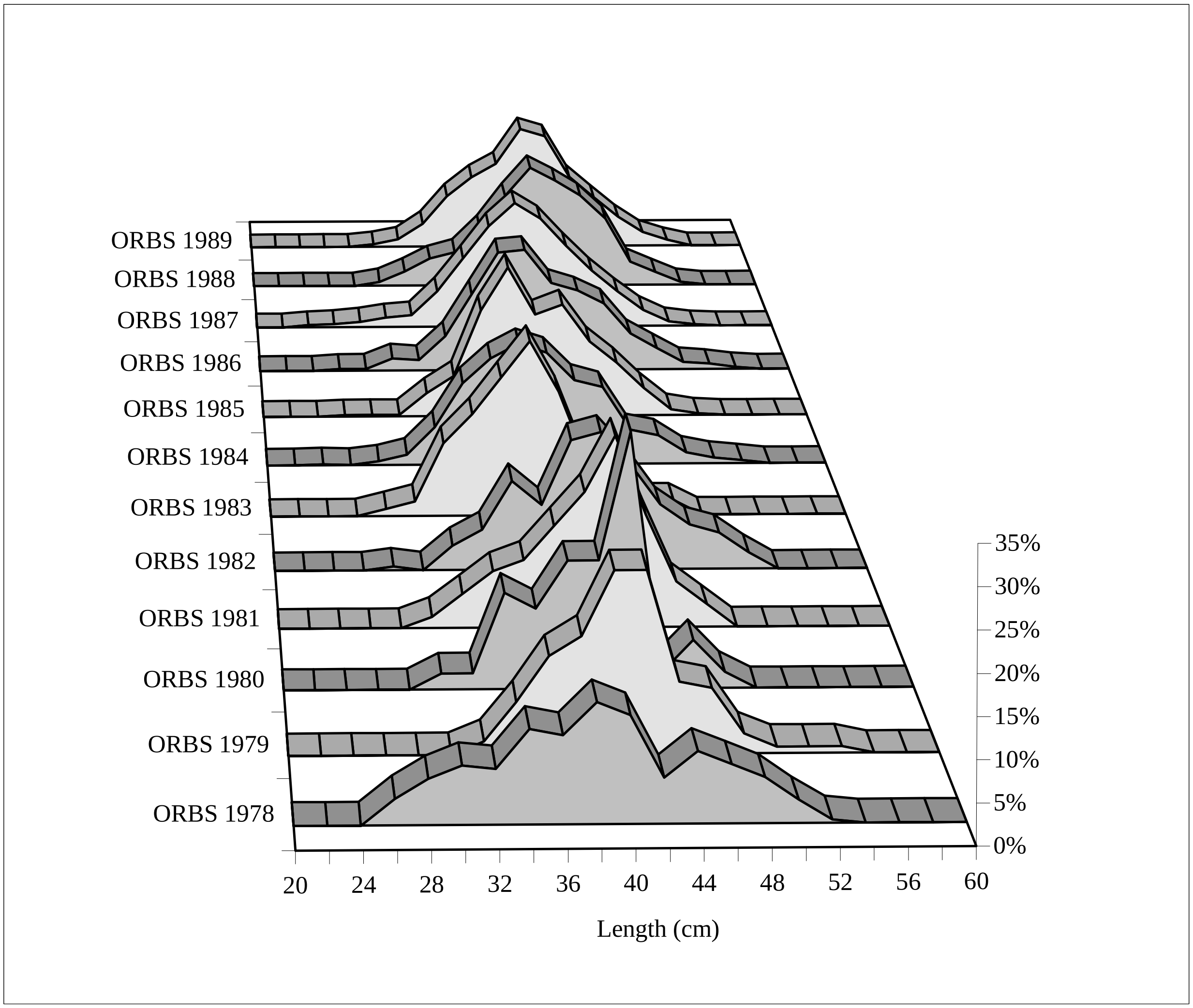


Figure 10. Black rockfish length composition data (continued).

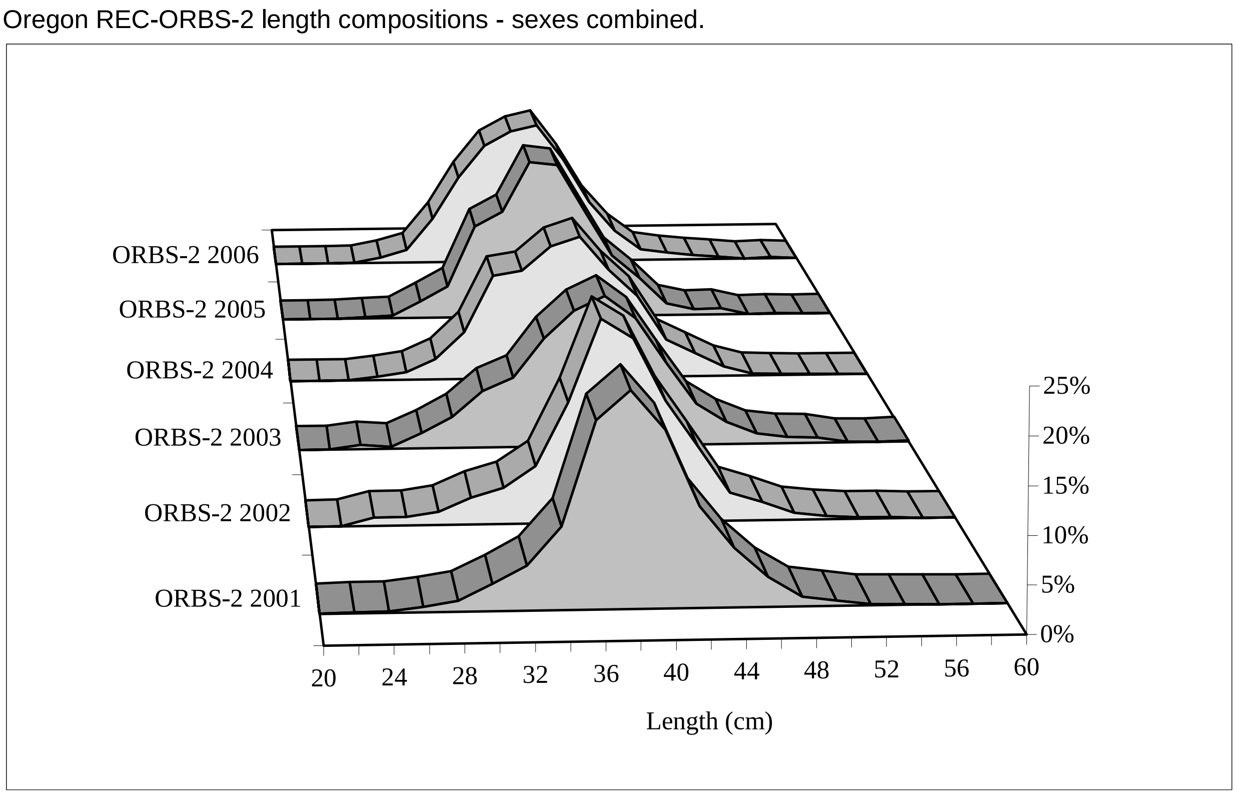


Figure 10. Black rockfish length composition data (continued).

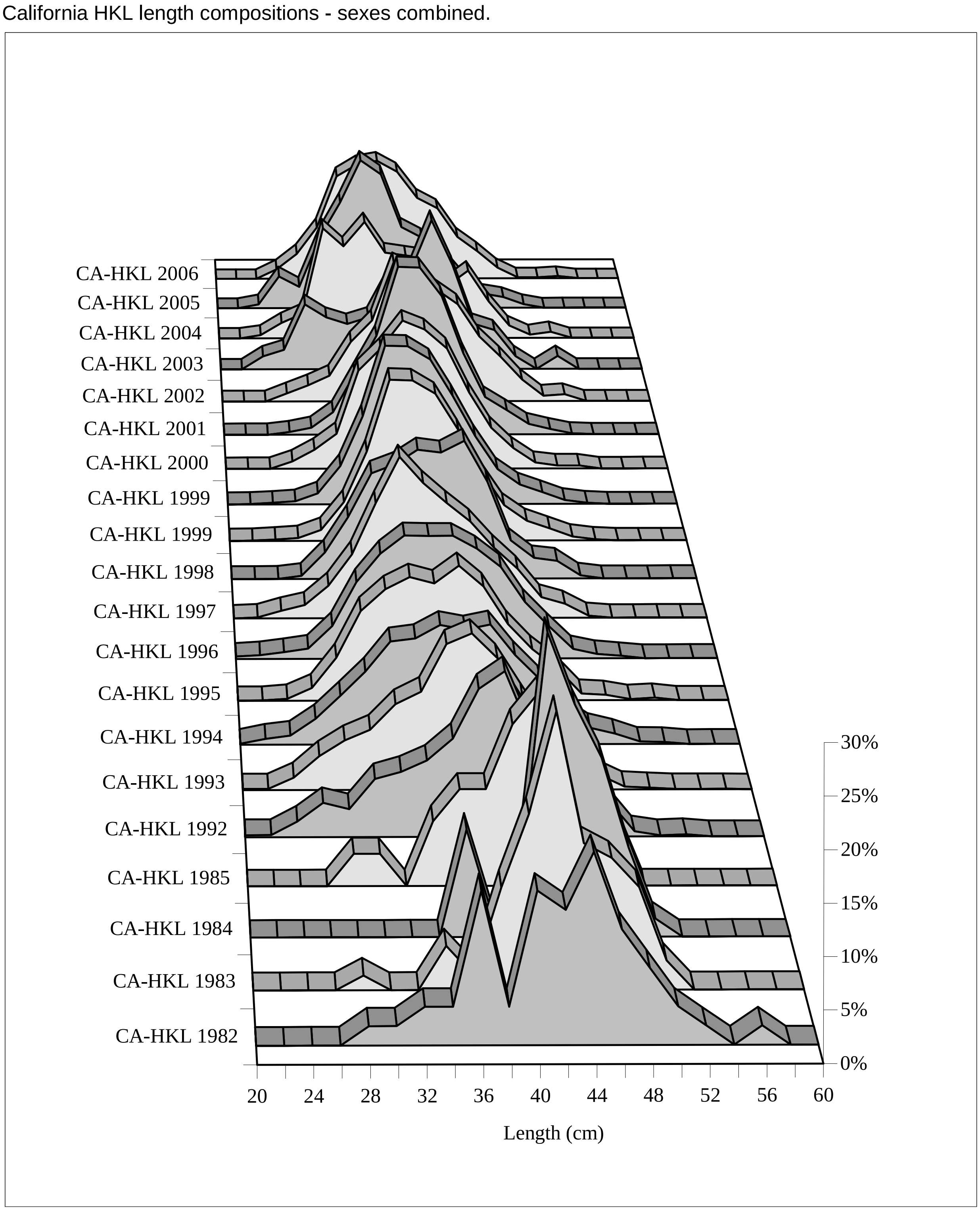
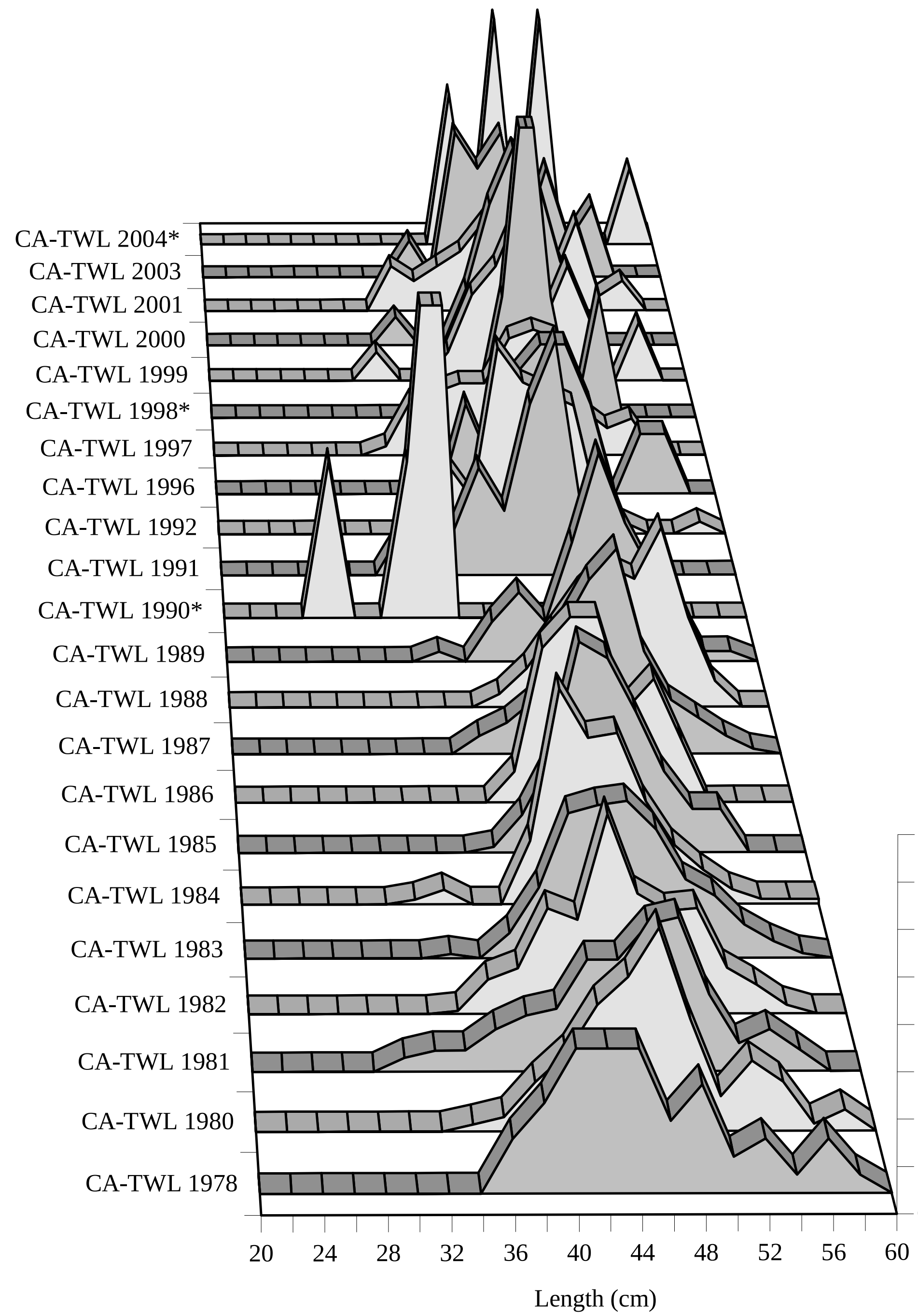


Figure 10. Black rockfish length composition data (continued).

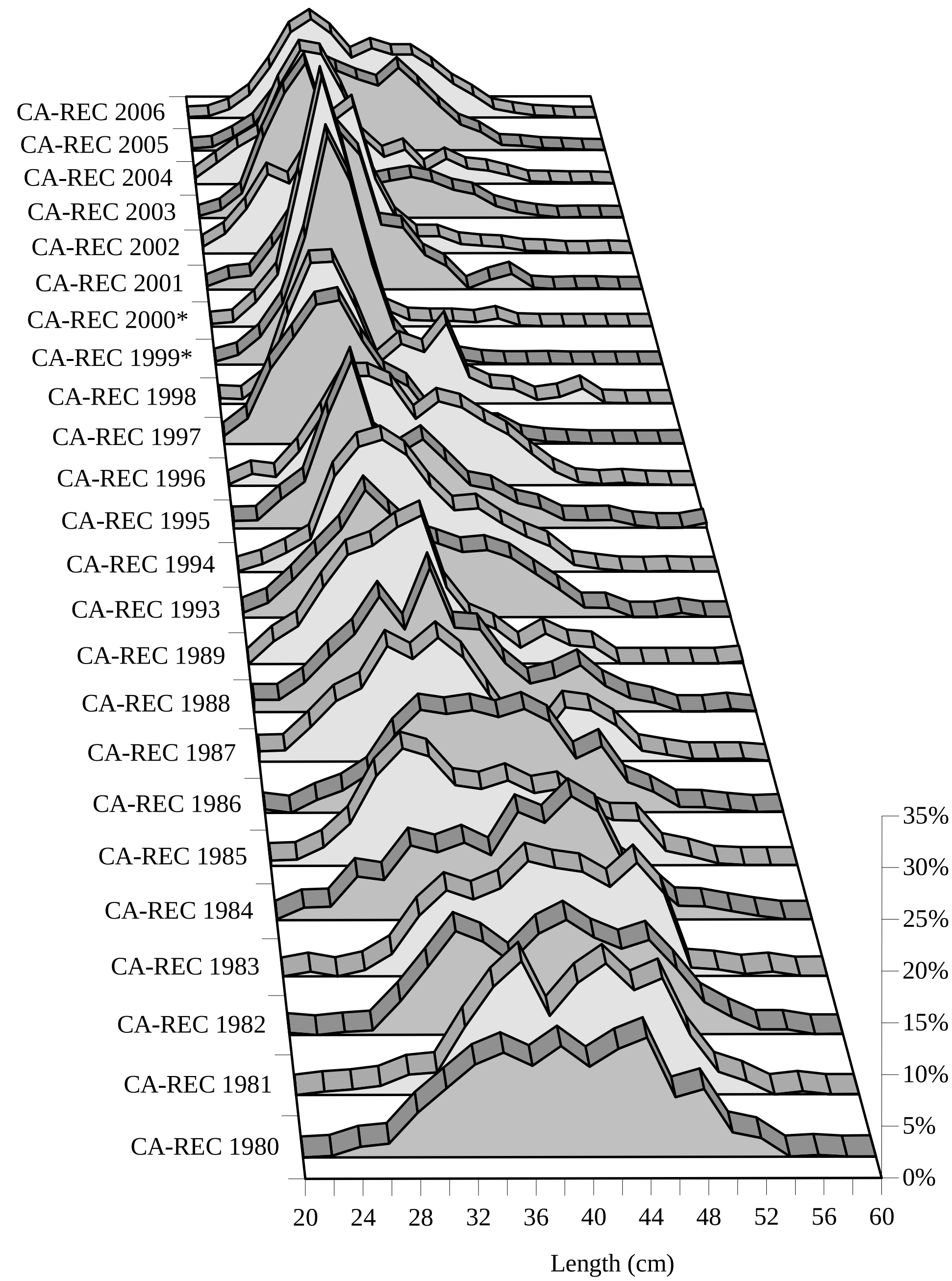
California TWL length compositions - sexes combined.



* Data not included in model because too small sample size.

Figure 10. Black rockfish length composition data (continued).

California REC length compositions - sexes combined.



* Data not included in model because extremely narrow distribution.

Figure 10. Black rockfish length composition data (continued).

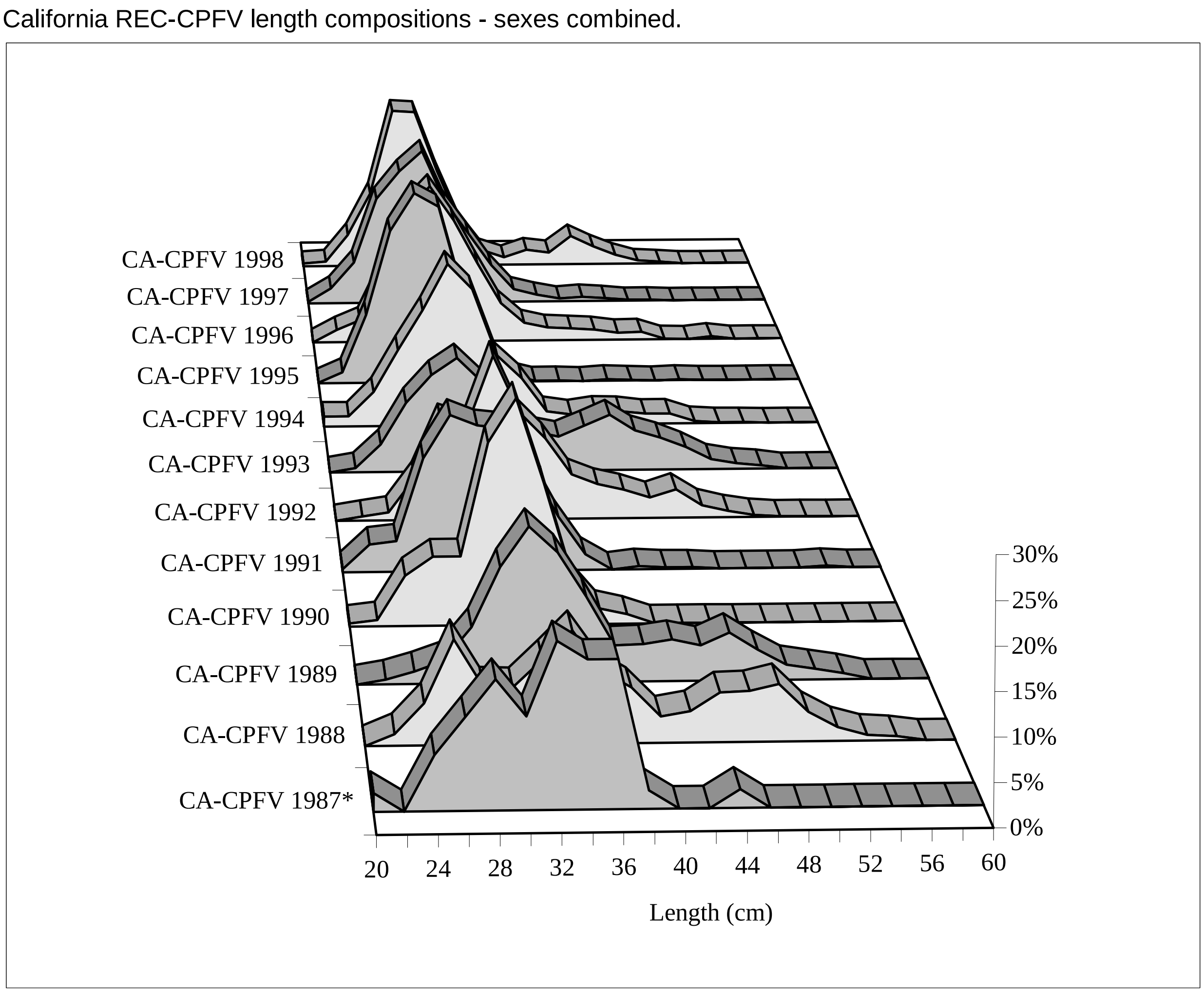


Figure 11. Black rockfish age composition data.

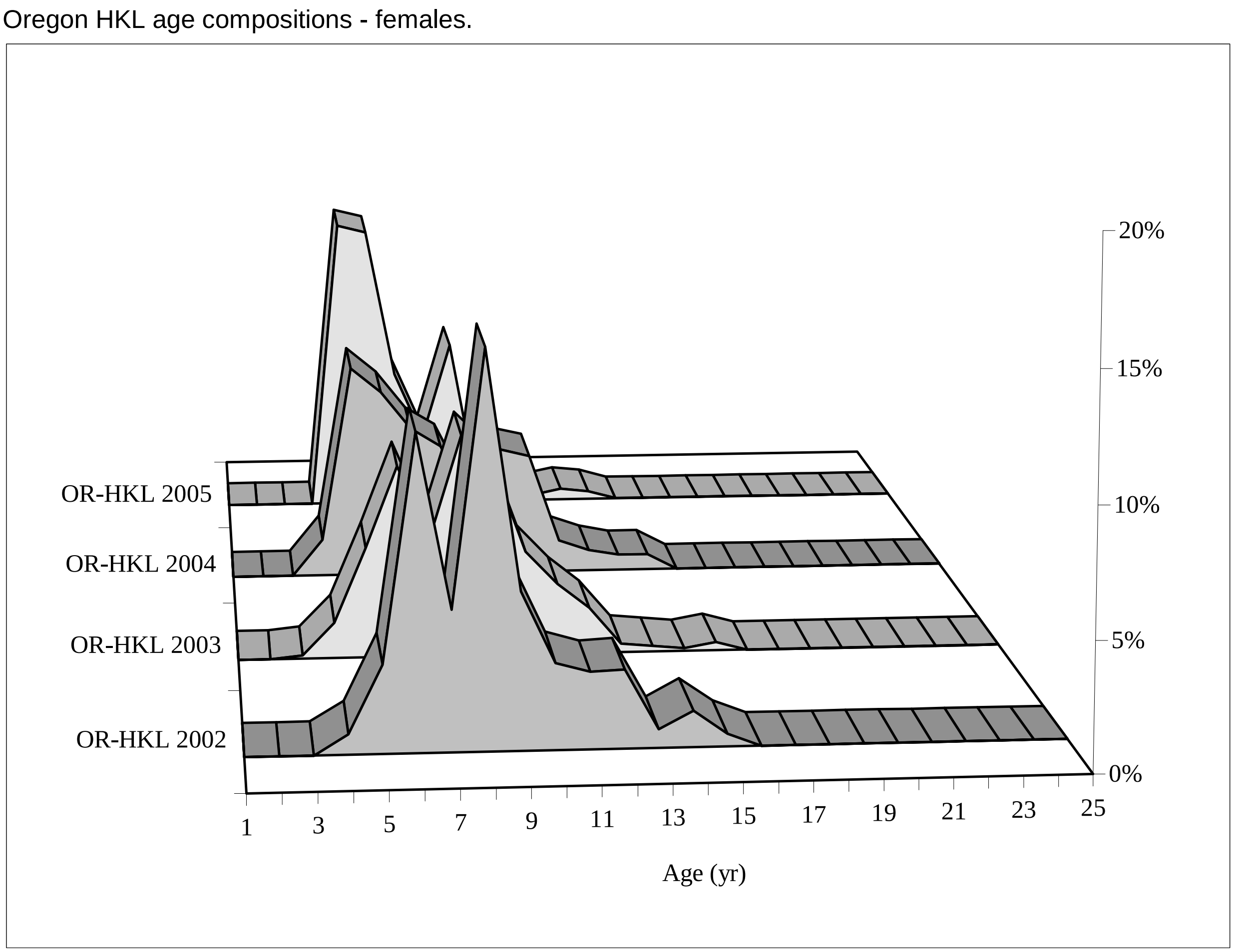


Figure 11. Black rockfish age composition data (continued).

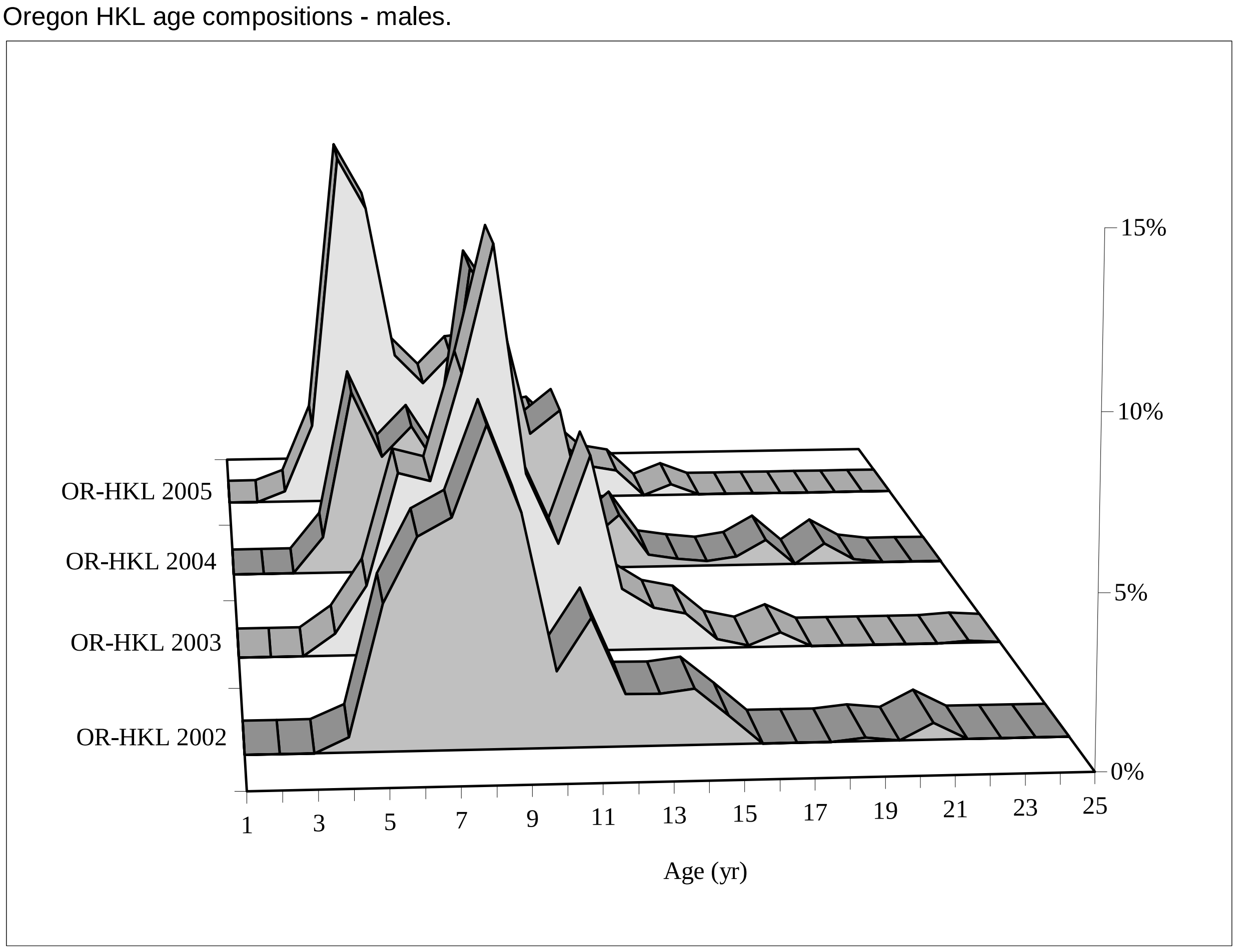


Figure 11. Black rockfish age composition data (continued).

Oregon REC-ORBS length compositions - females.

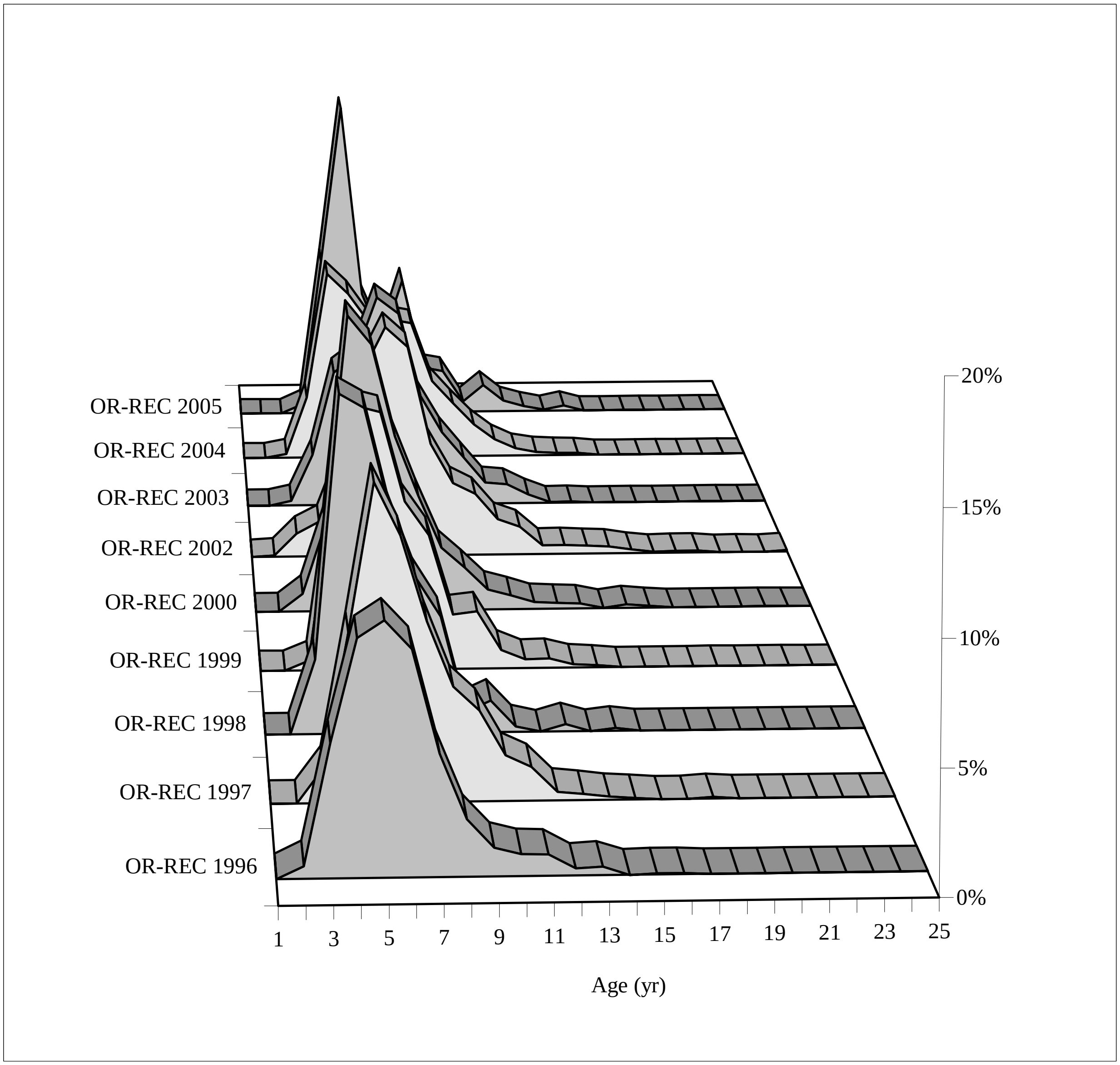


Figure 11. Black rockfish age composition data (continued).

Oregon REC-ORBS length compositions - males.

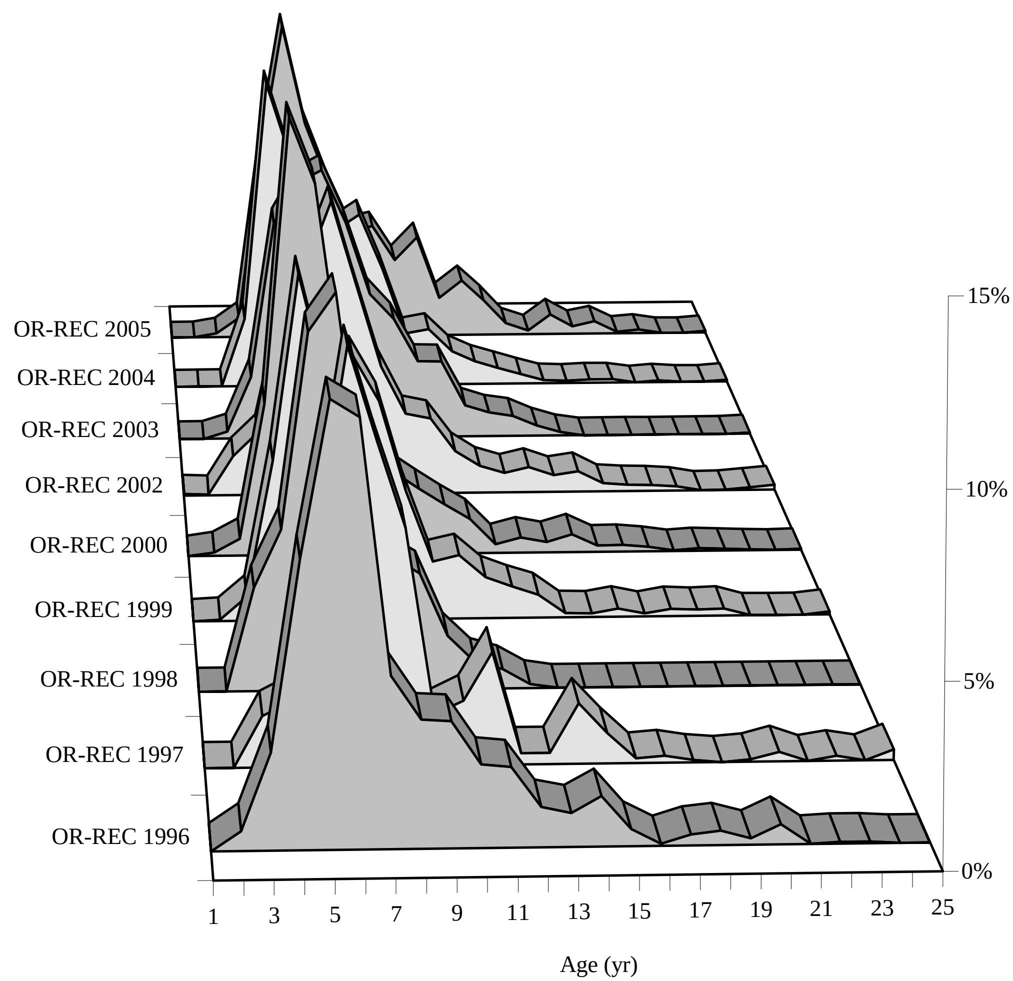
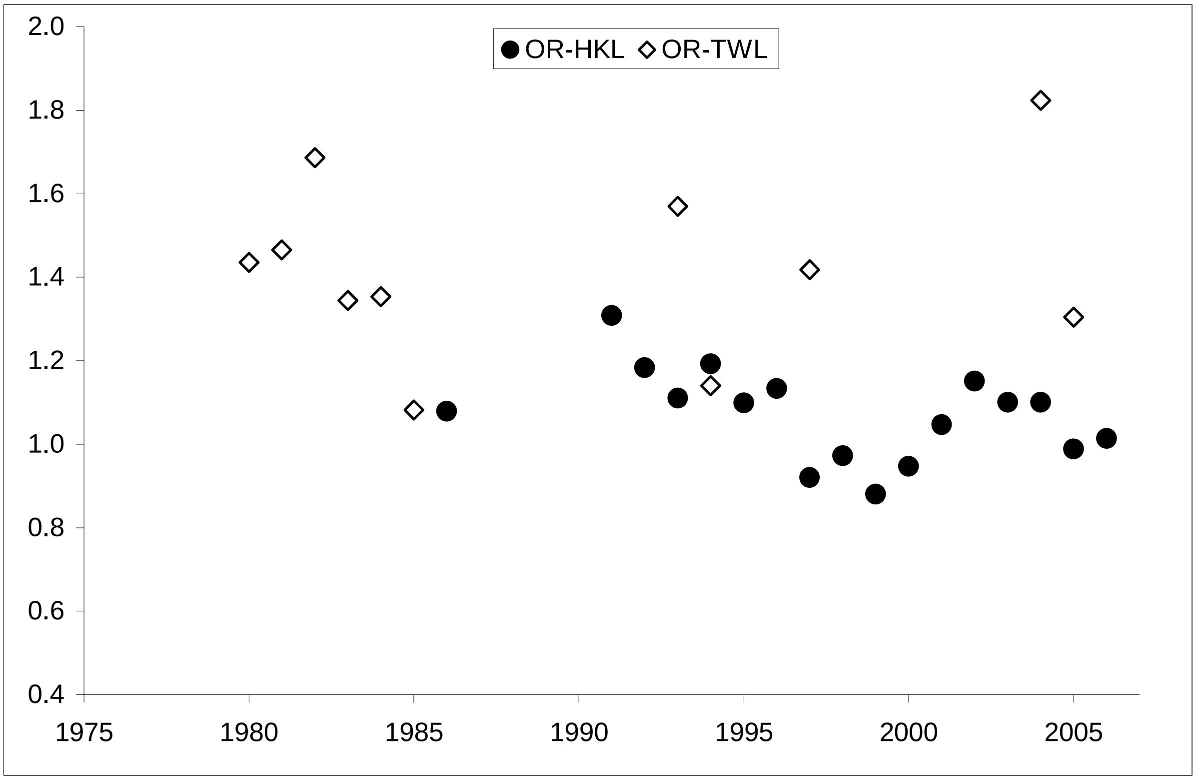


Figure 12. Black rockfish mean weights from species composition samples.

Oregon Commercial Fisheries - Average Fish Weight (kg)



California Commercial Fisheries - Average Fish Weight (kg)

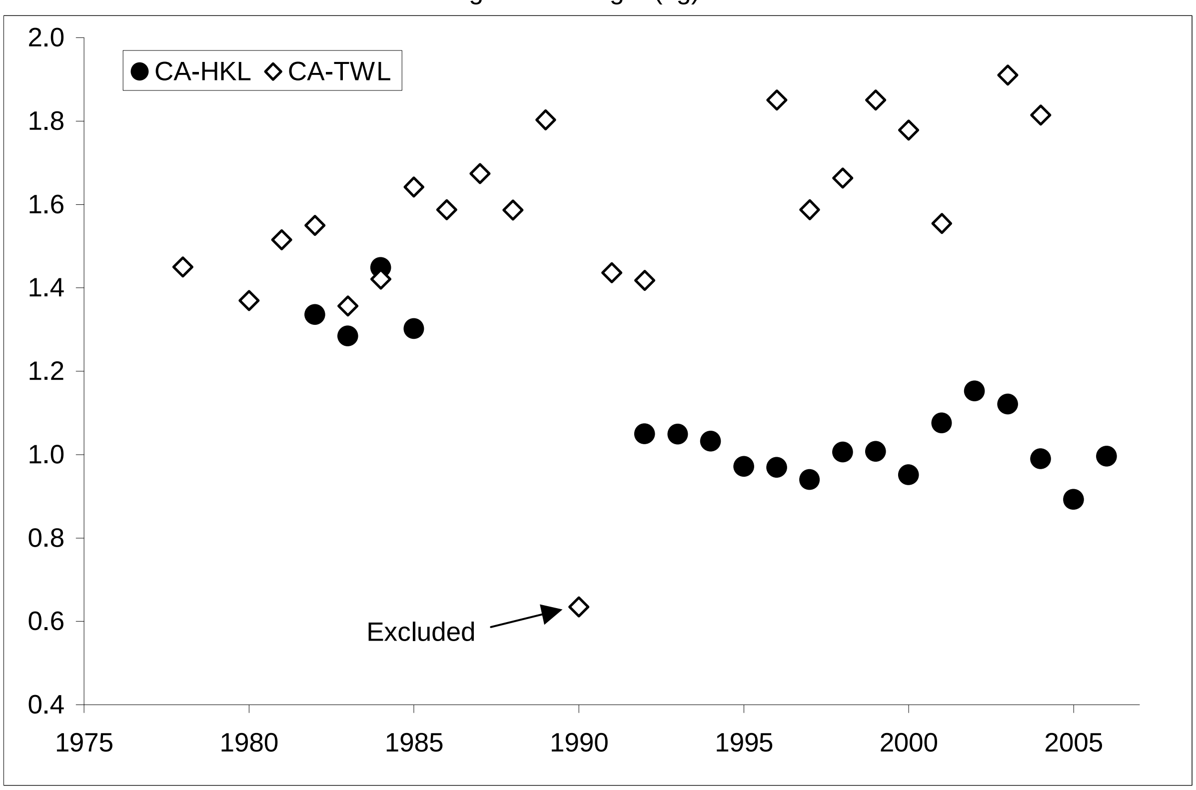
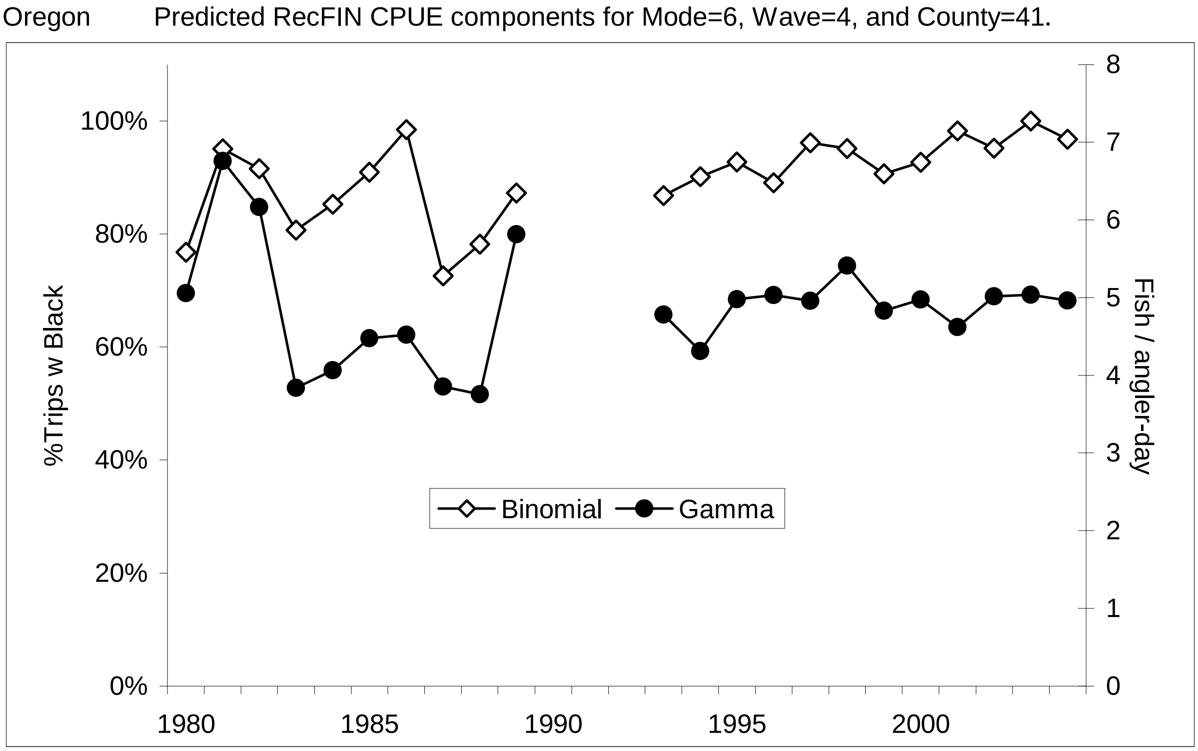


Figure 13. RecFIN CPUE abundance indices.

Oregon



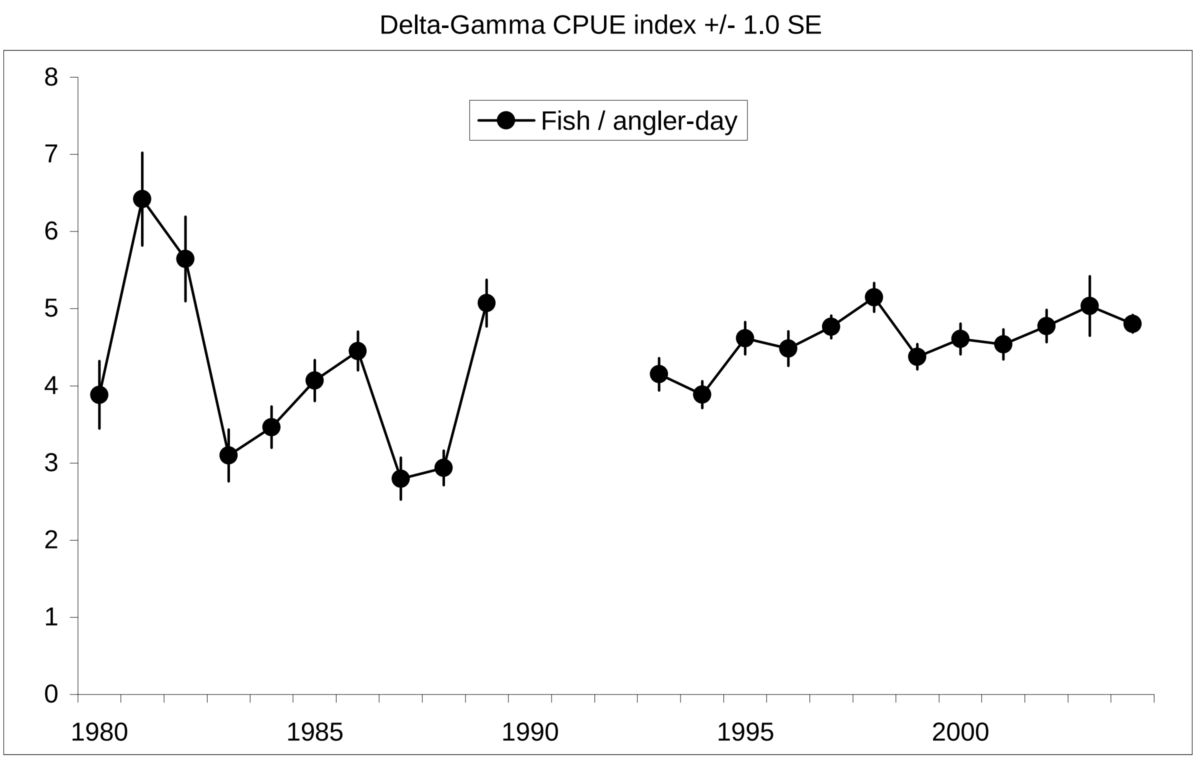
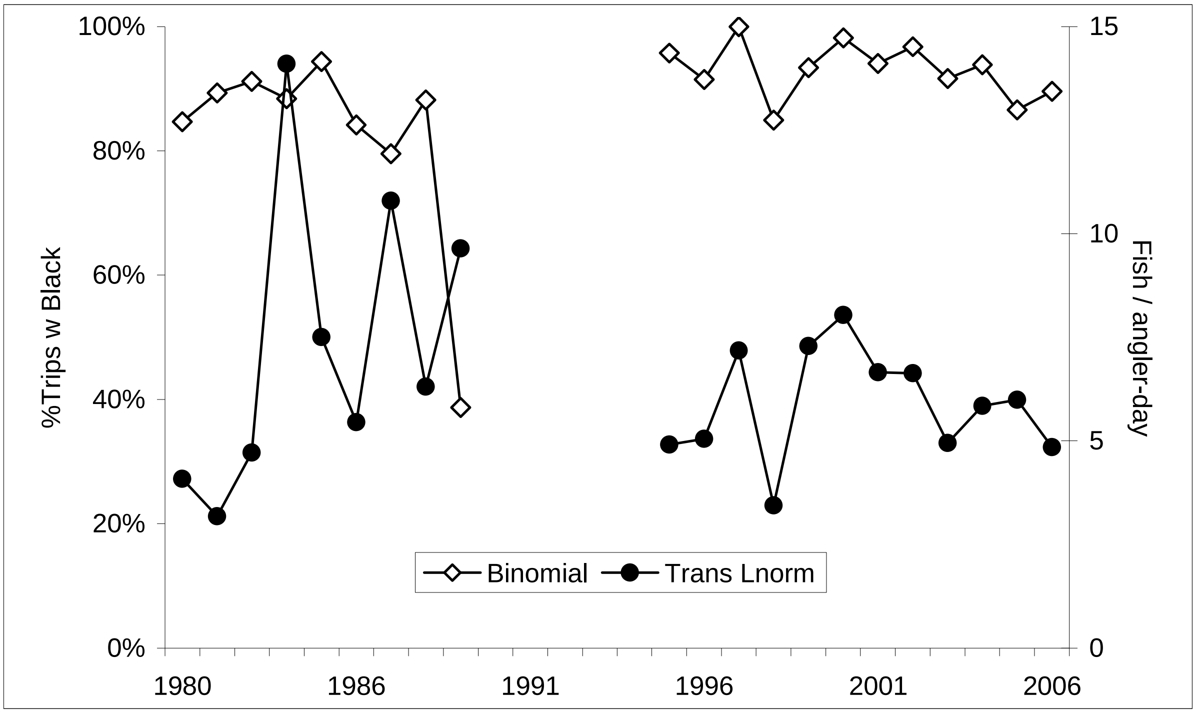


Figure 14. RecFIN CPUE abundance indices (continued).

California   Predicted RecFIN CPUE components for Mode=6, Wave=4, and County=23.



Delta-Lognormal CPUE index +/- 1.0 SE

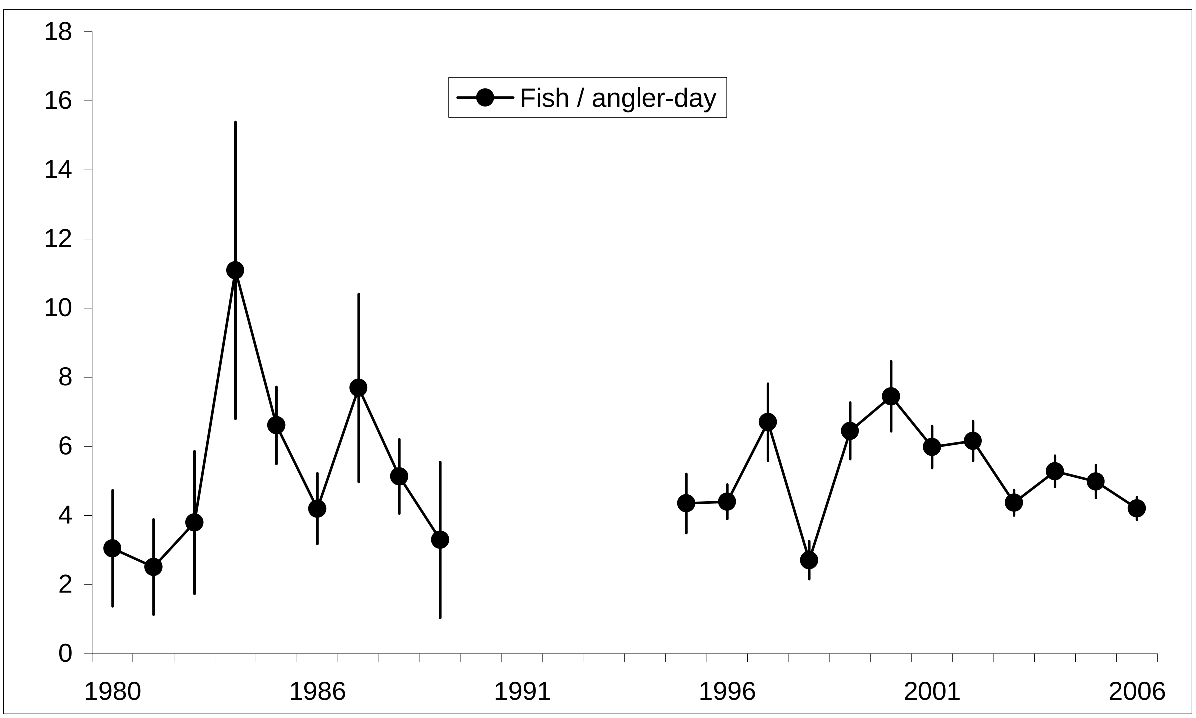


Figure 15. CPUE abundance index from the Oregon Ocean Recreation Boat Survey.

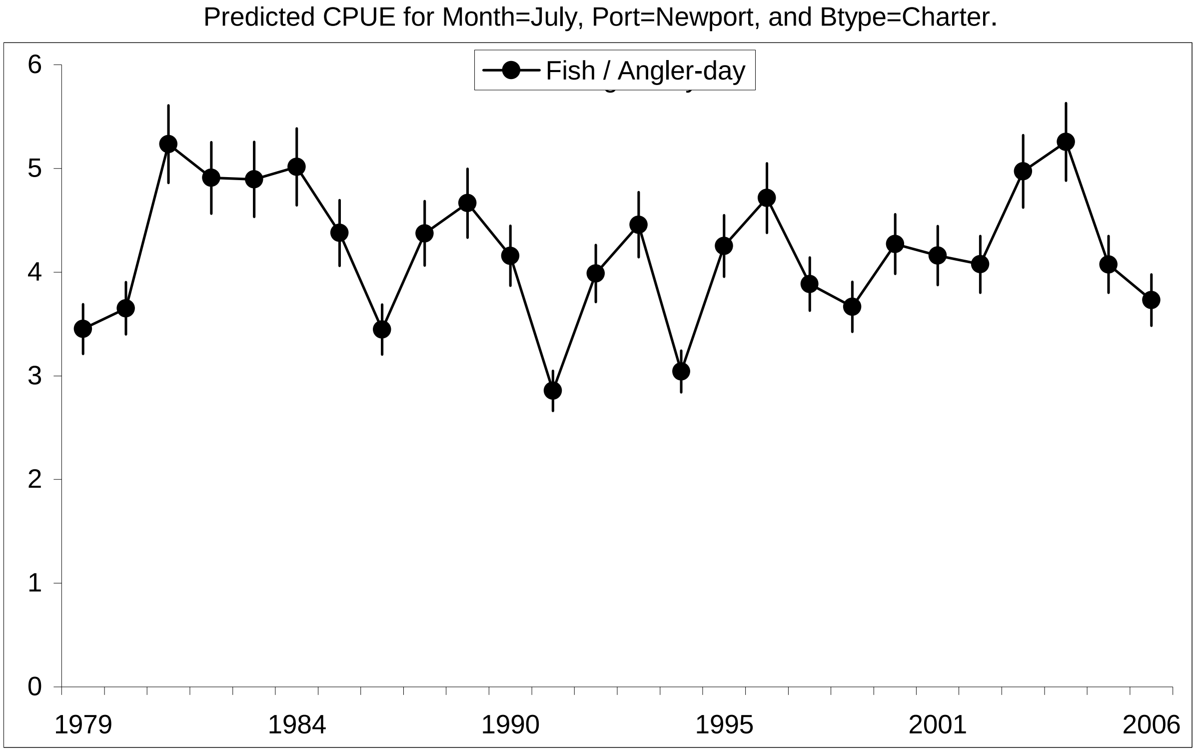


Figure 16. CPUE abundance index from the California CPFV Observer database.

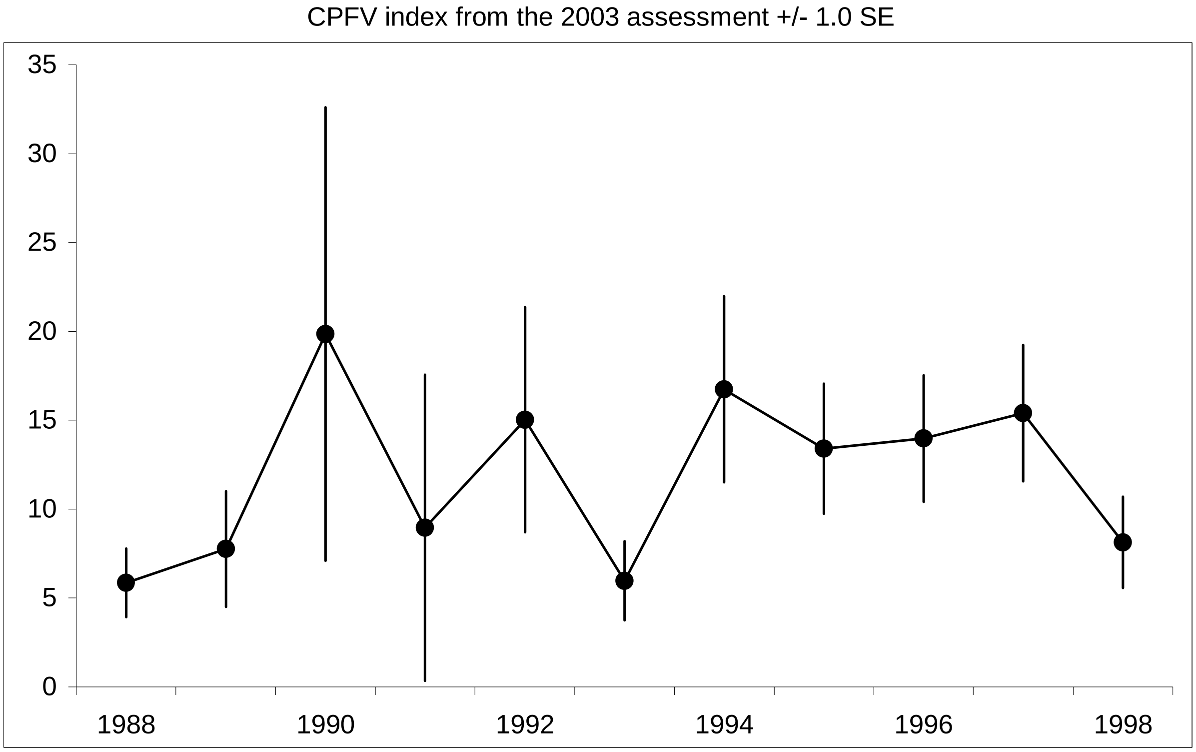
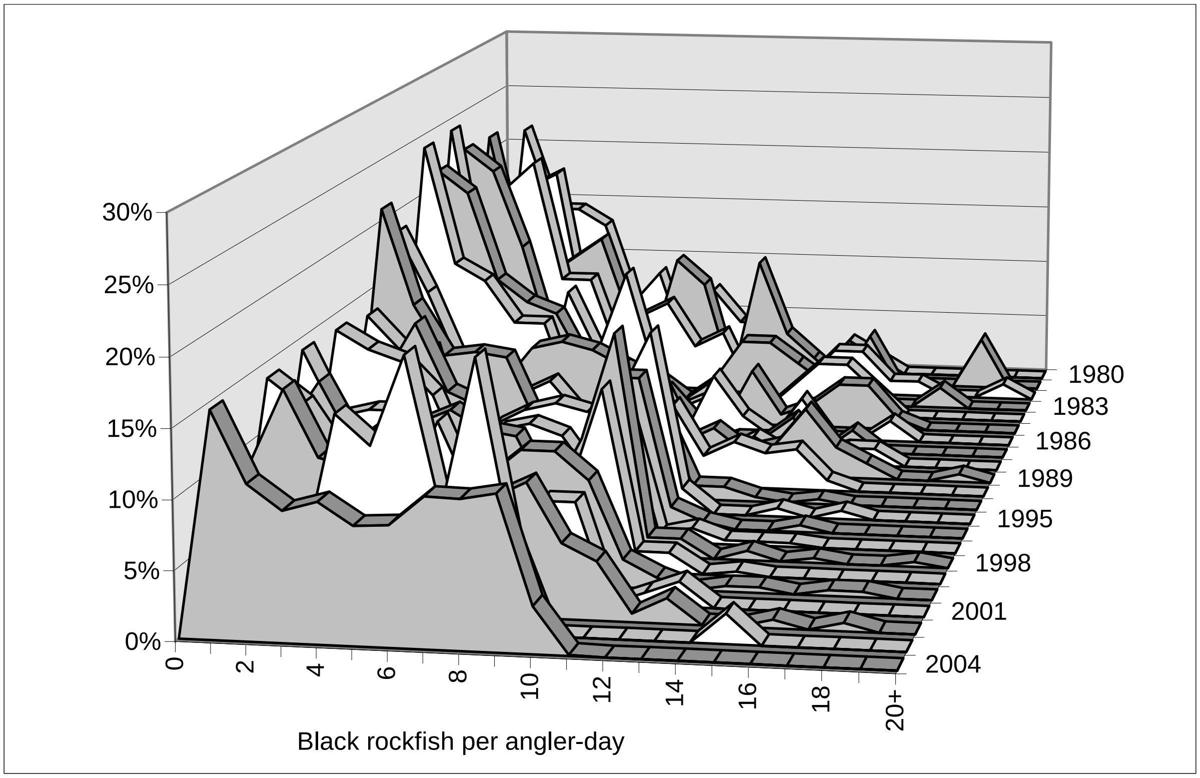


Figure 17. Frequency of black rockfish catch-per-angler from RecFIN.

Area A - Northern Oregon



Area B - Southern Oregon.

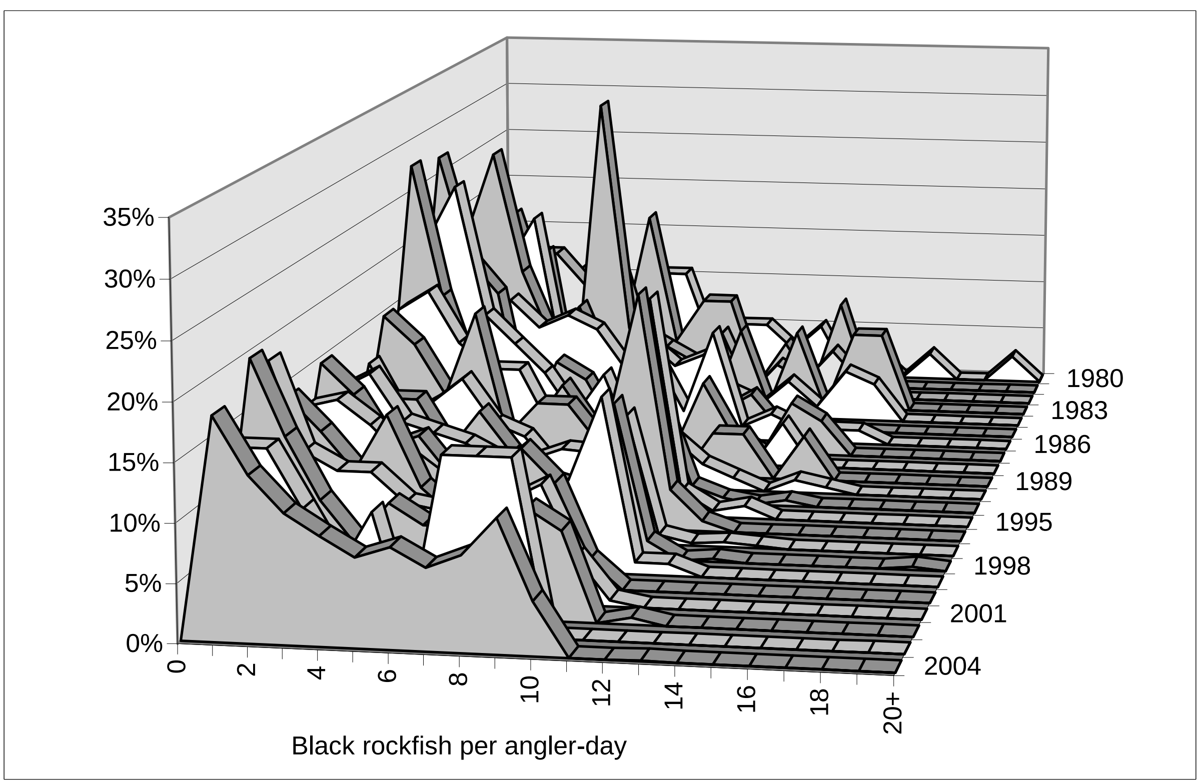
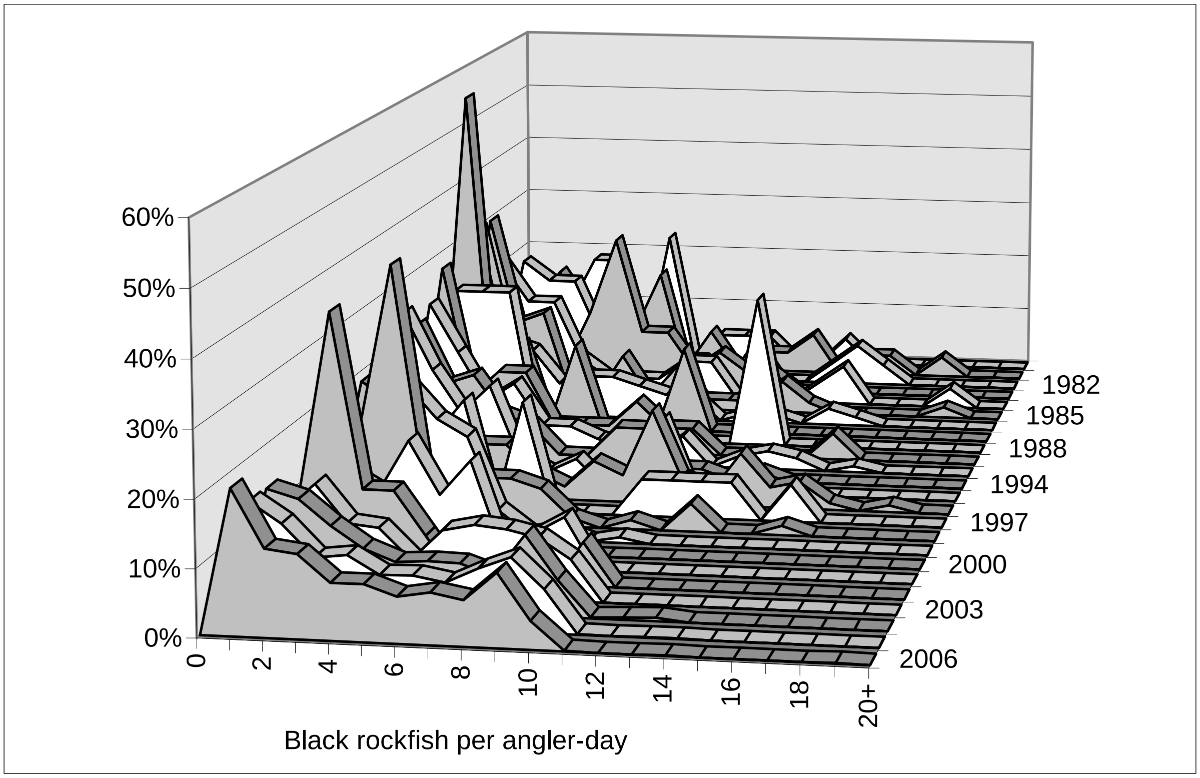


Figure 17. Frequency of black rockfish catch-per-angler from RecFIN (continued).

Area C - Northern California.



Area D - Central California.

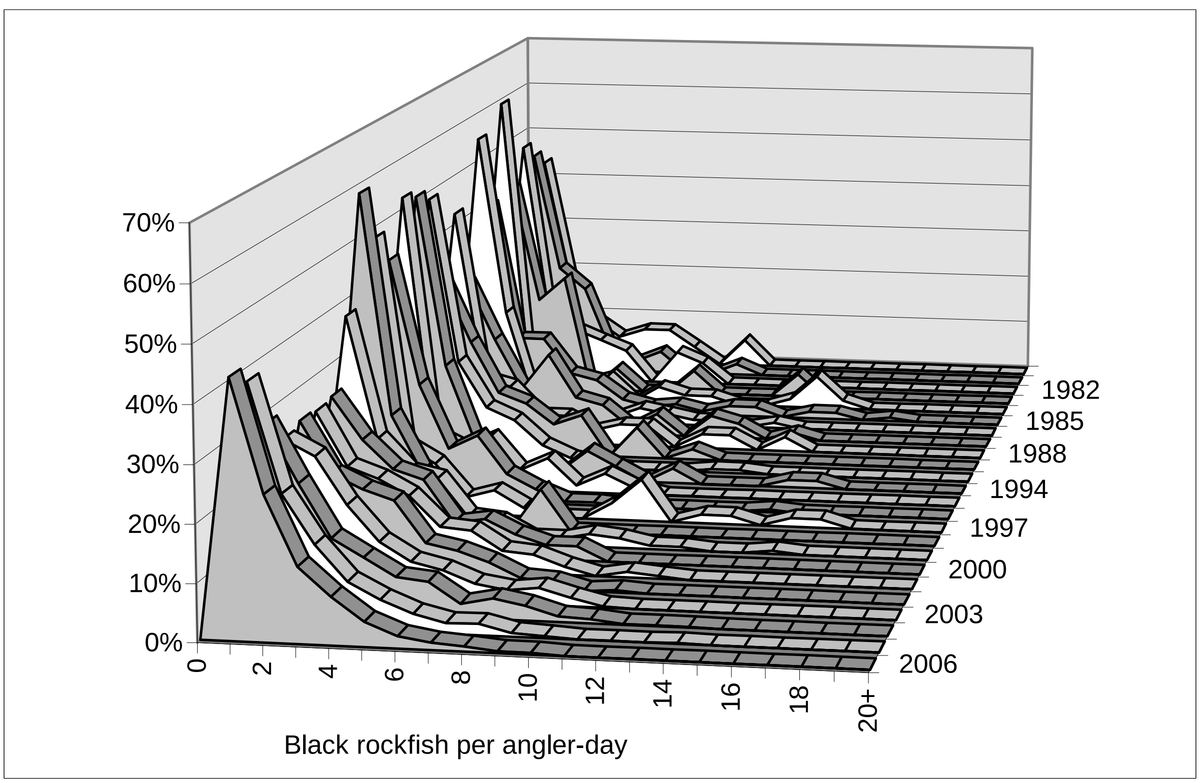


Figure 18. SWFSC juvenile rockfish survey index of black rockfish recruitment.

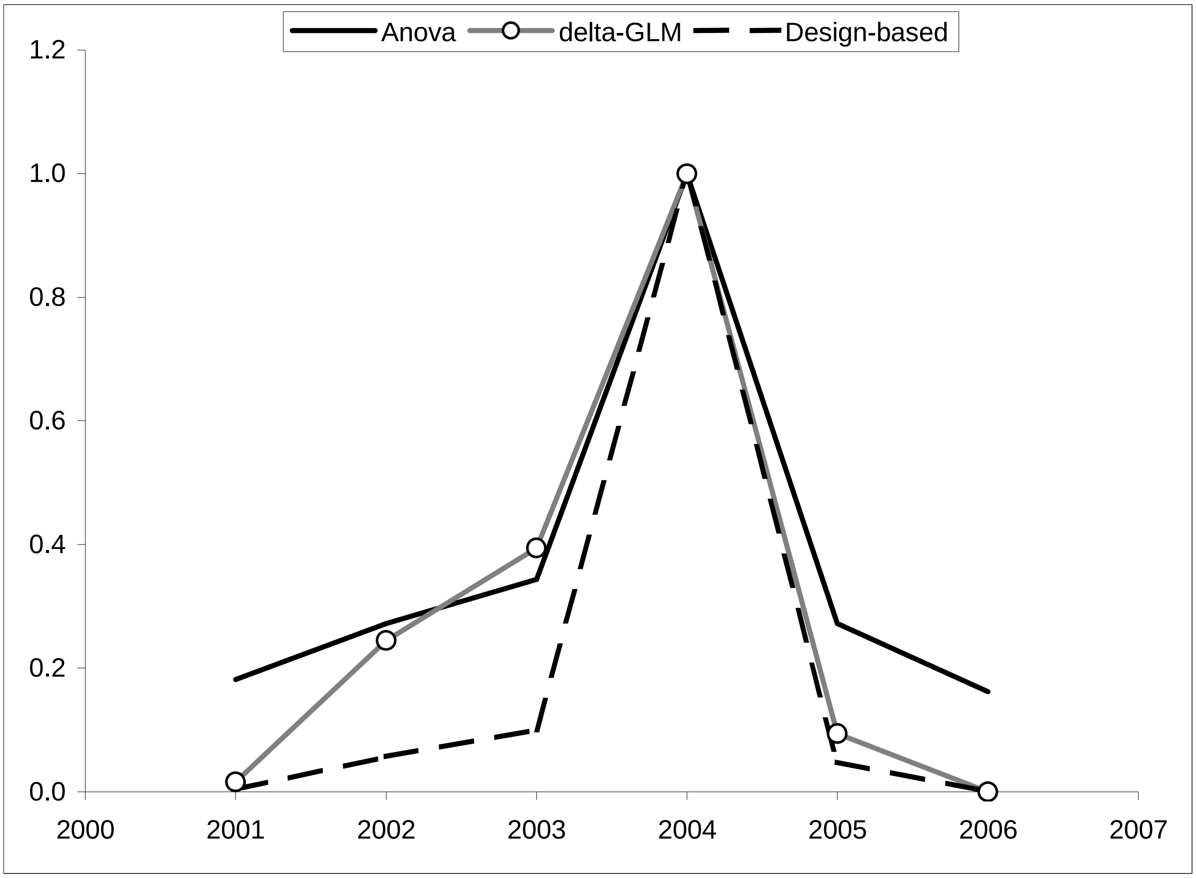


Figure 19. Cumulative landings for the current assessment versus the 2003 assessment.

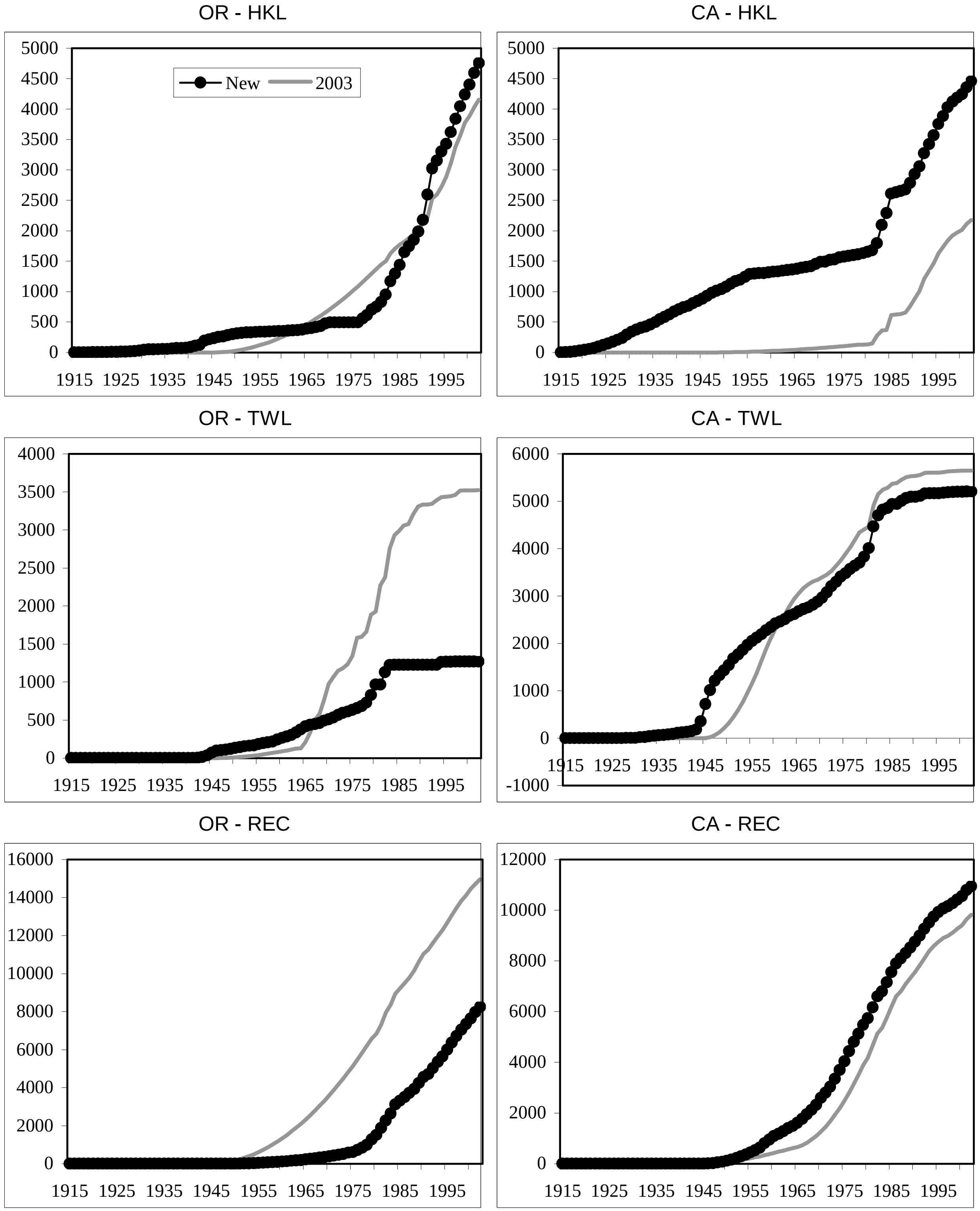
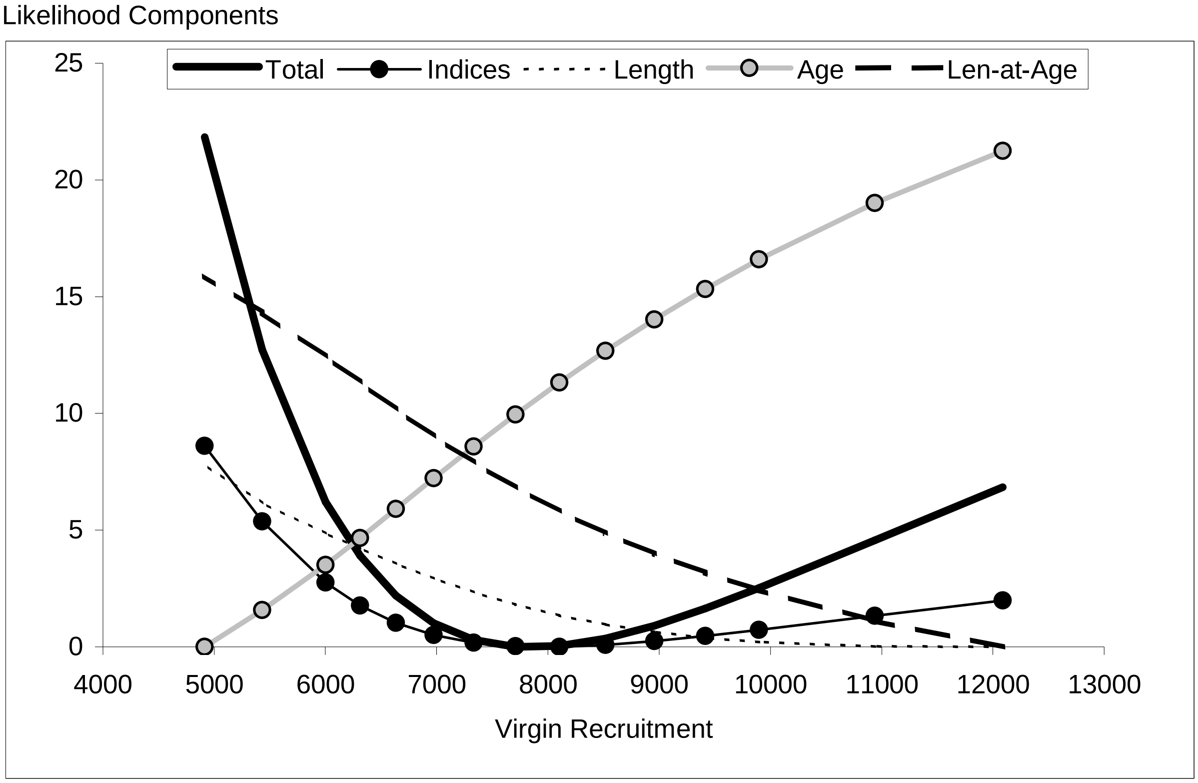


Figure 20. Final base-run model likelihood profile over virgin recruitment (R0).



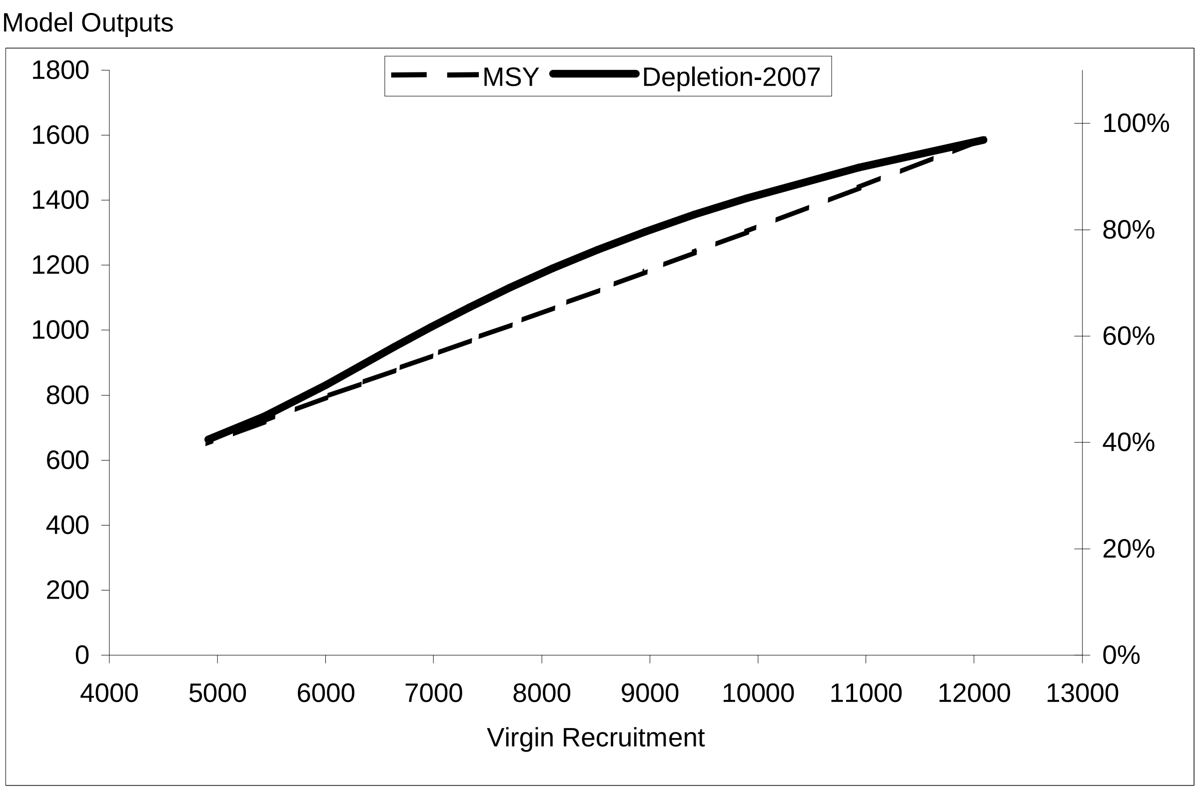
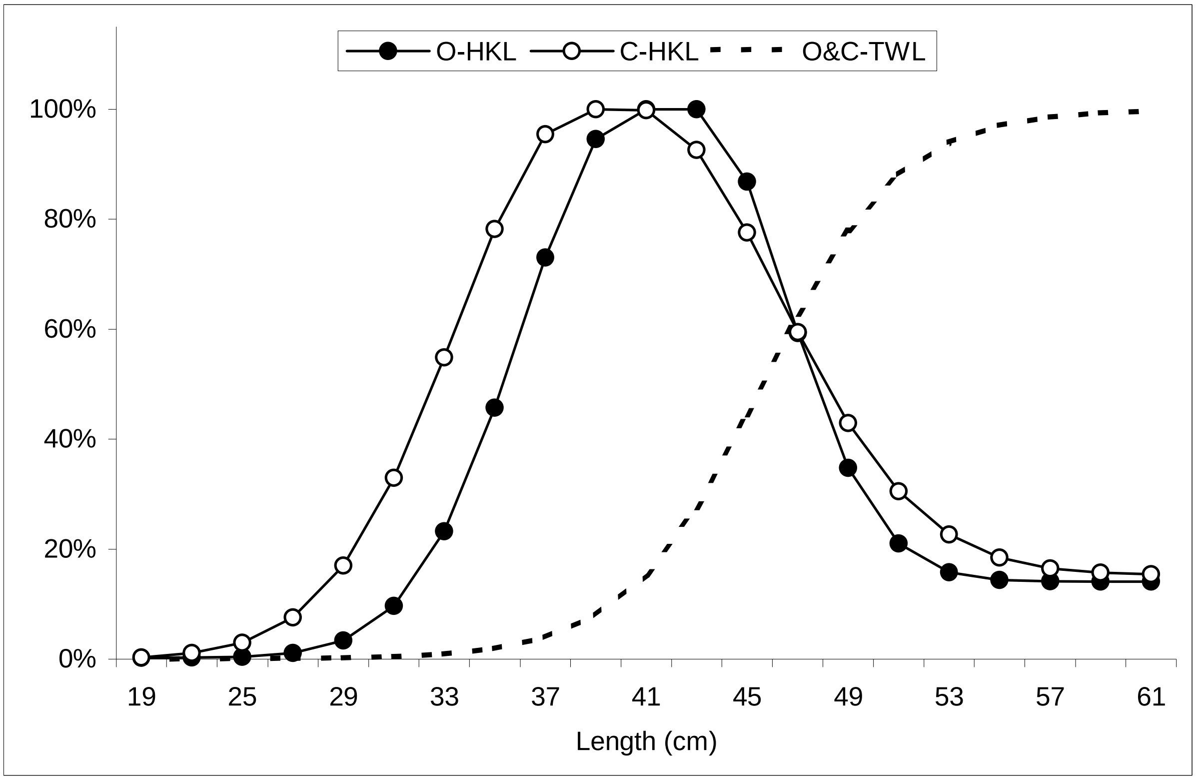


Figure 21. Estimated selection curves for the final base-run model.

Length selection curves - commercial fisheries



Length selection curves - recreational fisheries and surveys

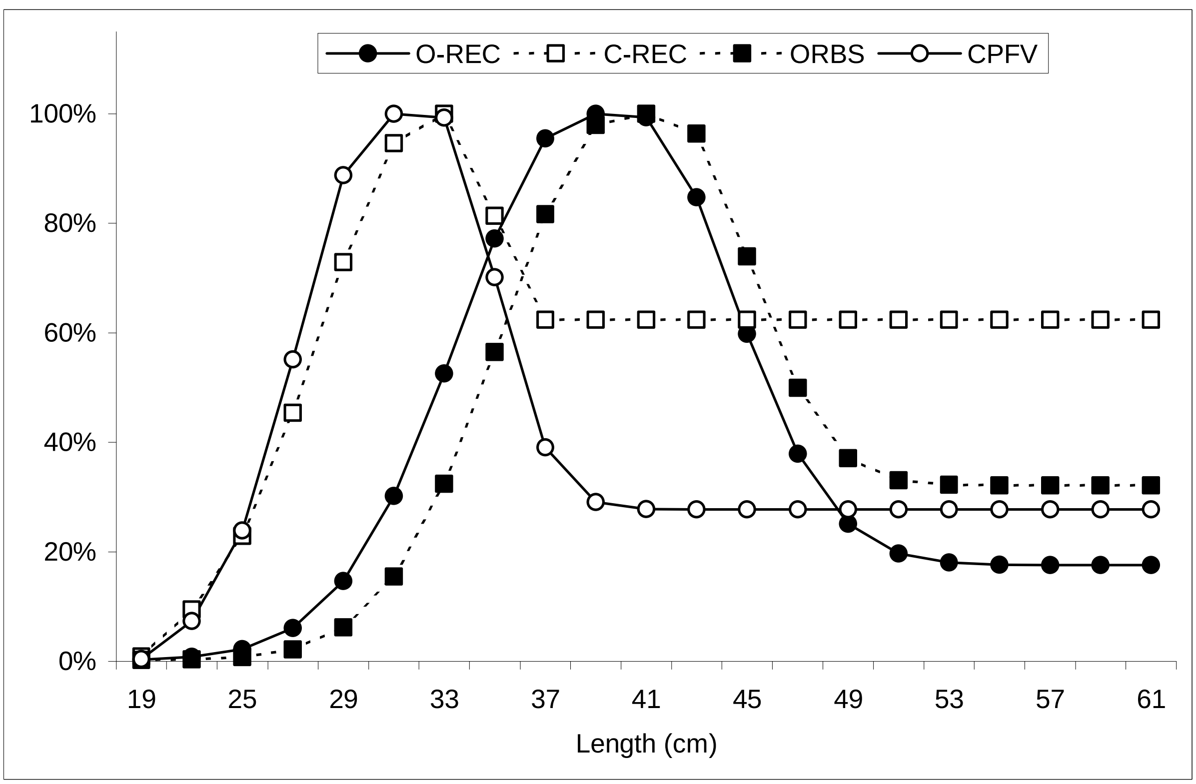
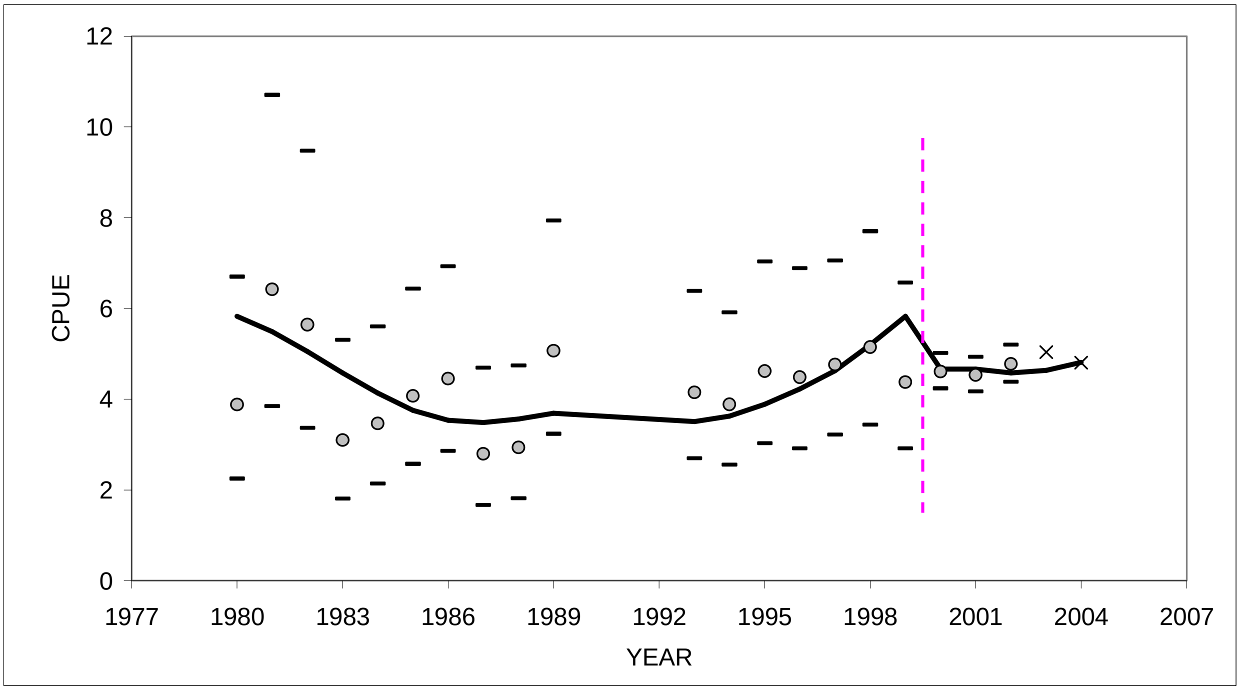


Figure 22. Final base-run model fit to indices.

Oregon RecFIN CPUE – break in series between 1999 and 2000.



Oregon ORBS – breaks in series between 1999 and 2000, and between 2004 and 2005.

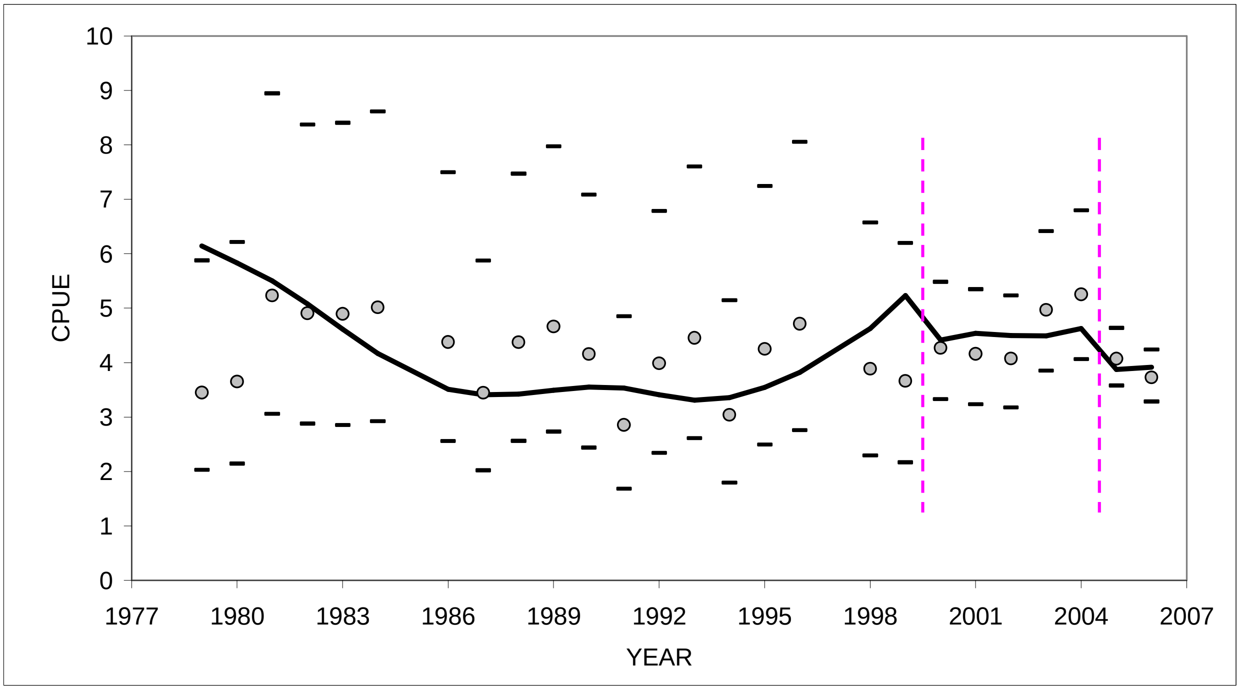
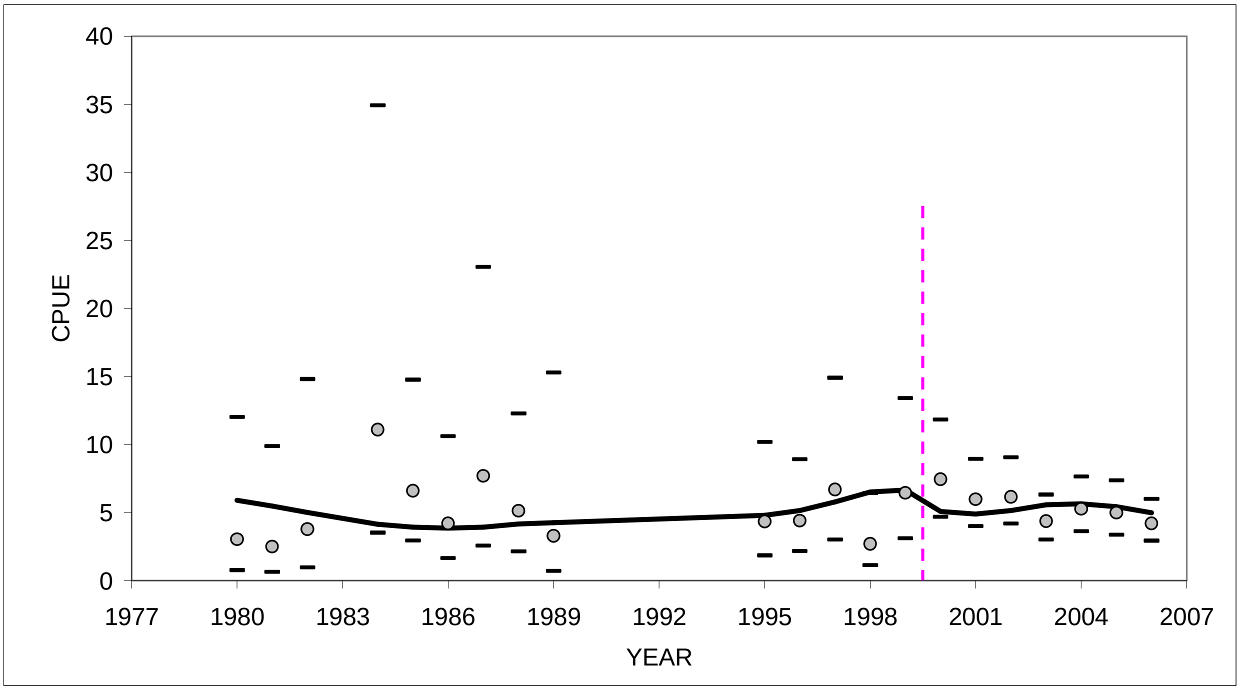


Figure 22. Final base-run model fit to indices (continued).

California RecFIN CPUE – break in series between 1999 and 2000.



California CPFV CPUE – continuous series.

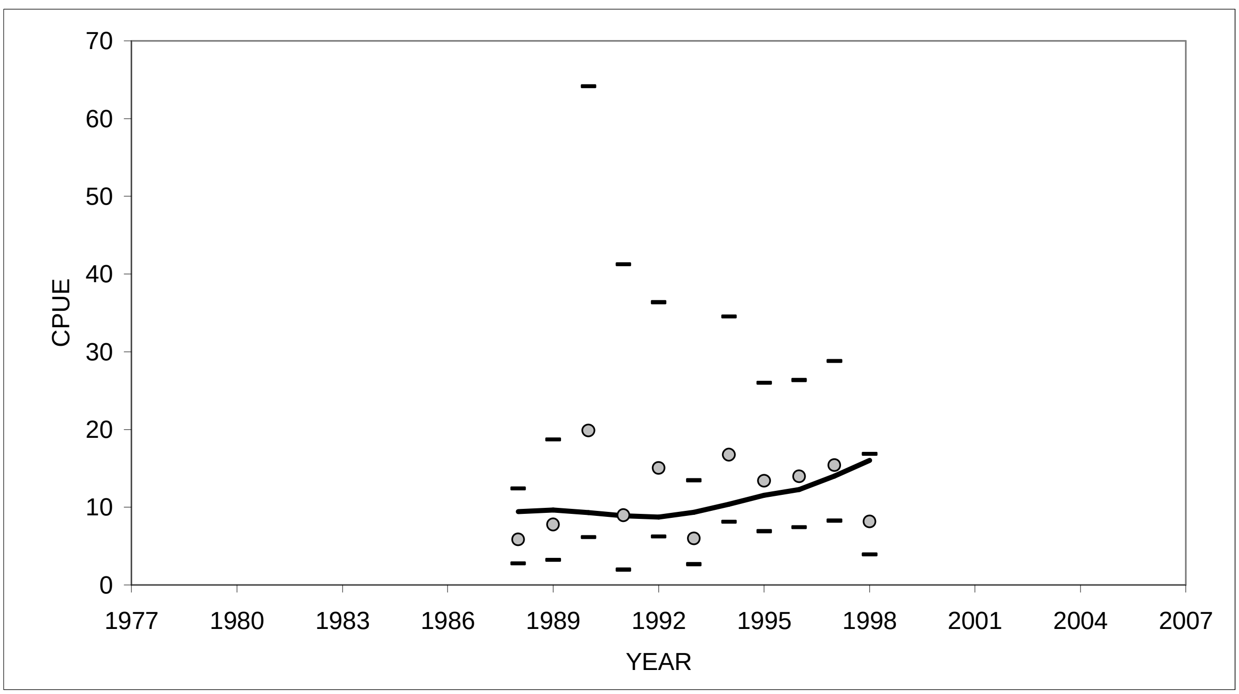
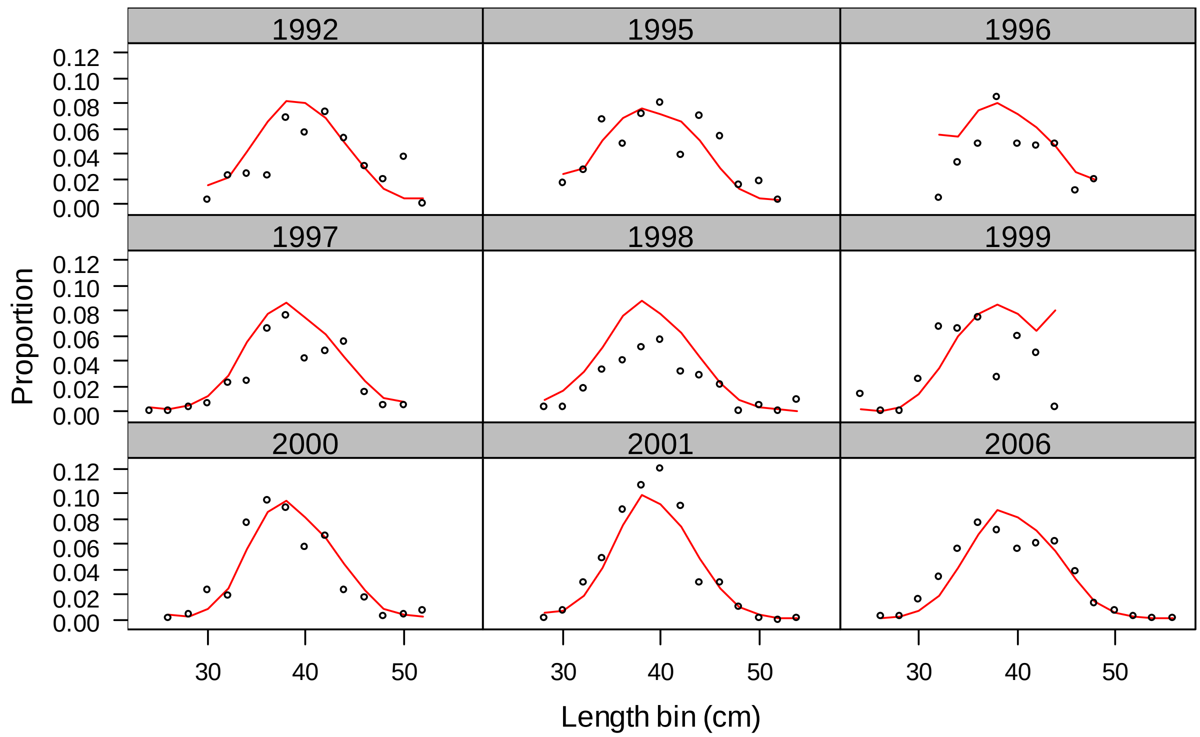


Figure 22. Final base-run model fit to indices (continued).

Oregon Tagging Study Abundance

SWFSC Pre-recruit Index

Figure 23. Final base-run model fit to length composition data from the Oregon HKL fishery, females (top panel) and males (bottom panel).



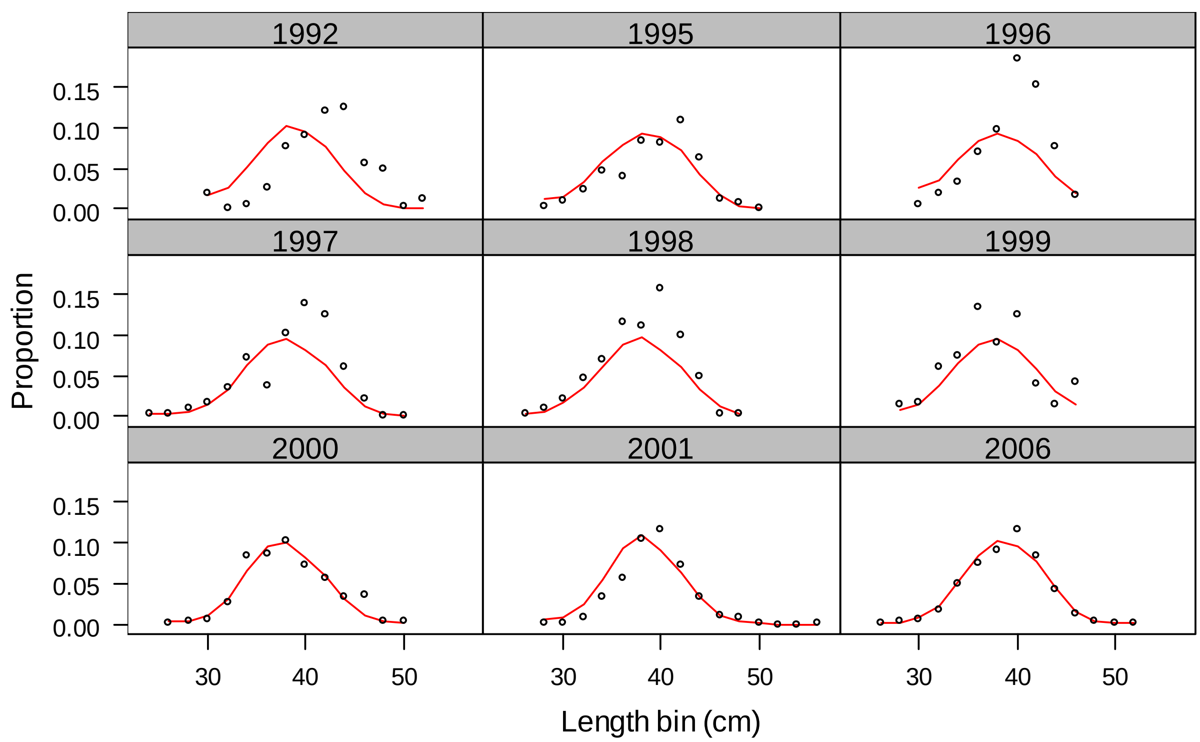
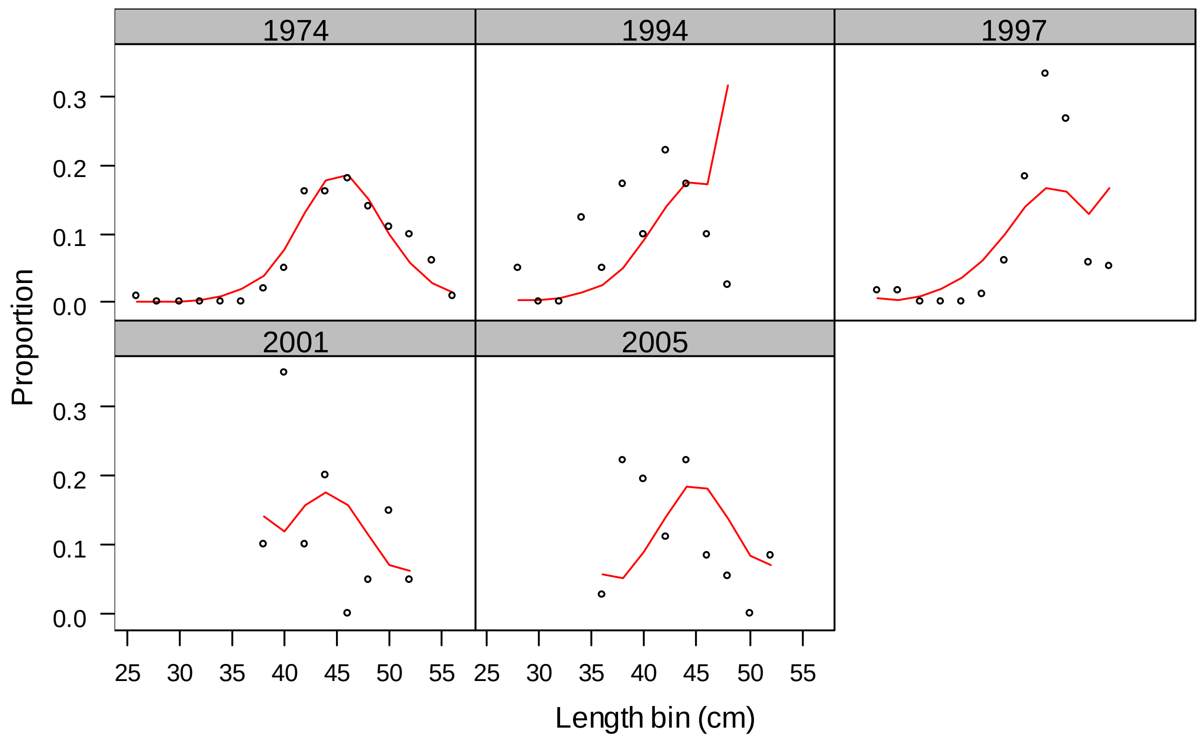


Figure 23. Final base-run model fit to length composition data (sexes combined) from the Oregon TWL (top panel) and REC (bottom panel) fisheries.



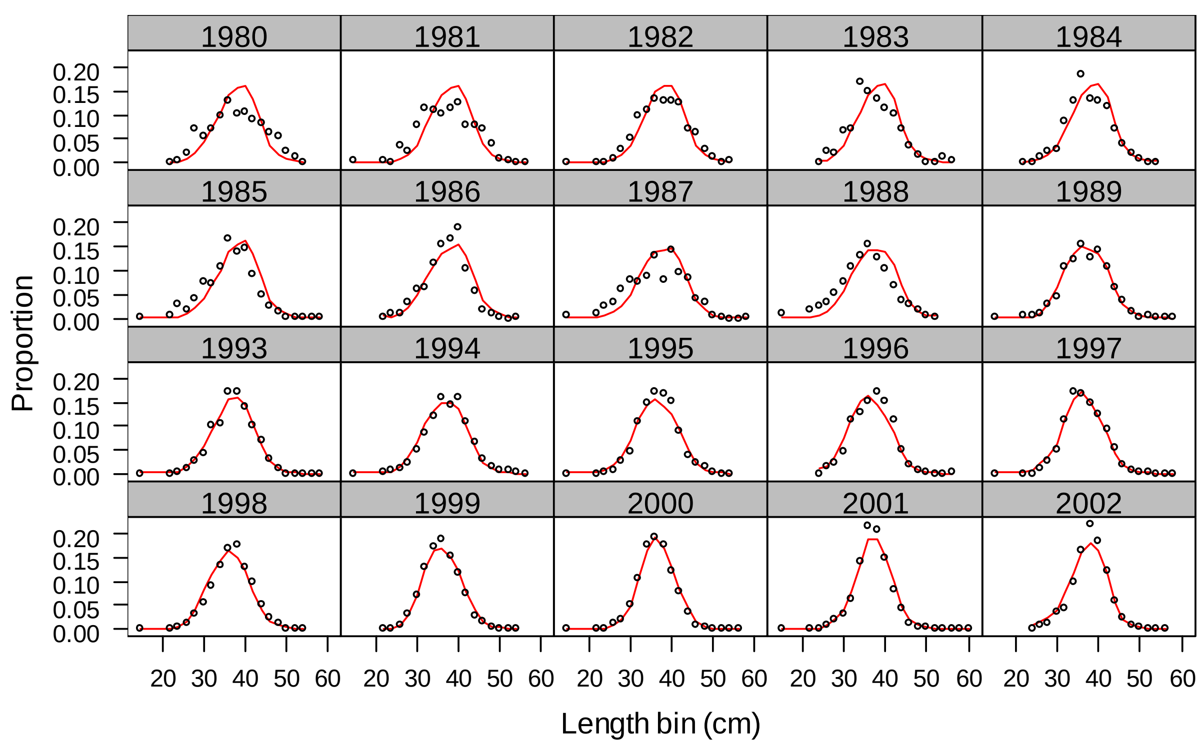
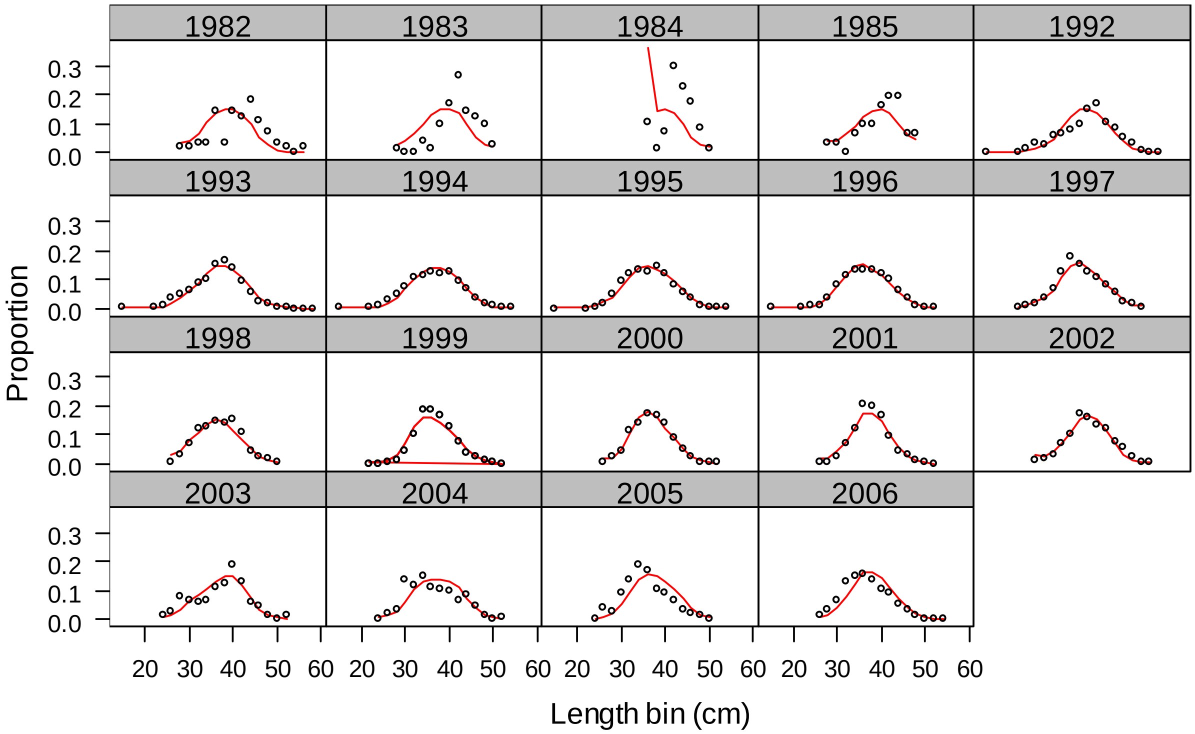


Figure 23. Final base-run model fit to length composition data (sexes combined) from the California HKL (top panel) and TWL (bottom panel) fisheries.



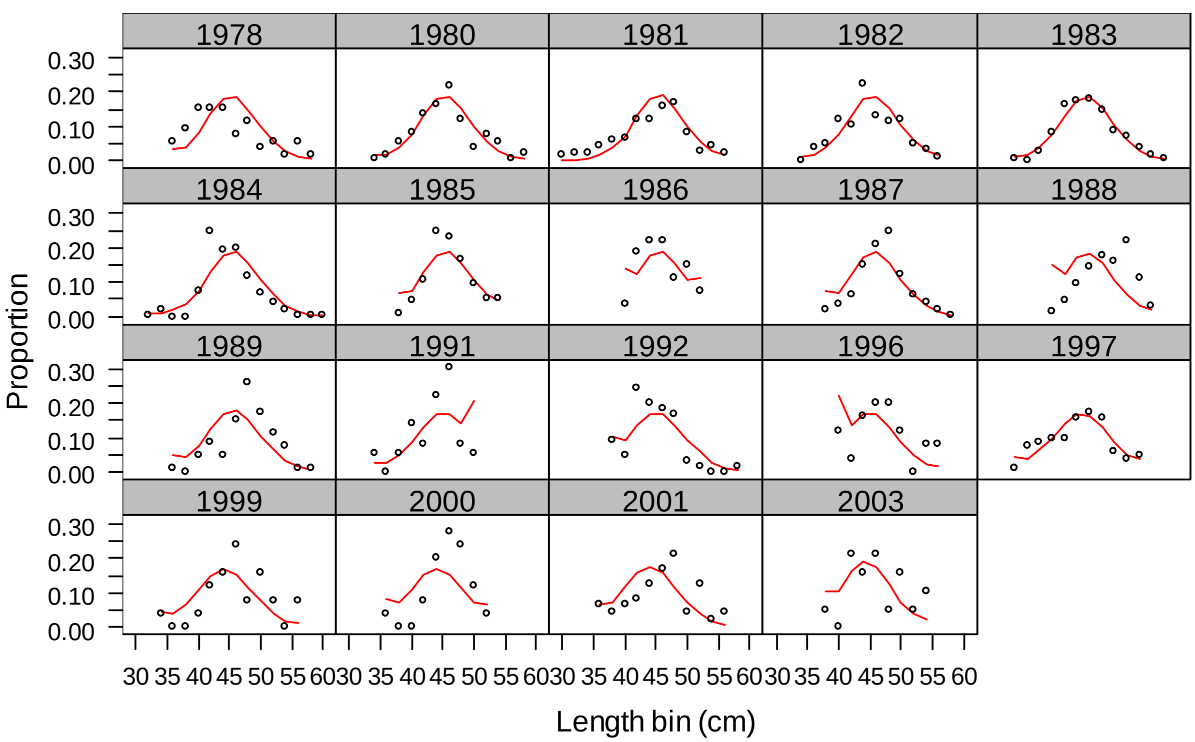


Figure 23. Final base-run model fit to length composition data (sexes combined) from the California REC fishery.

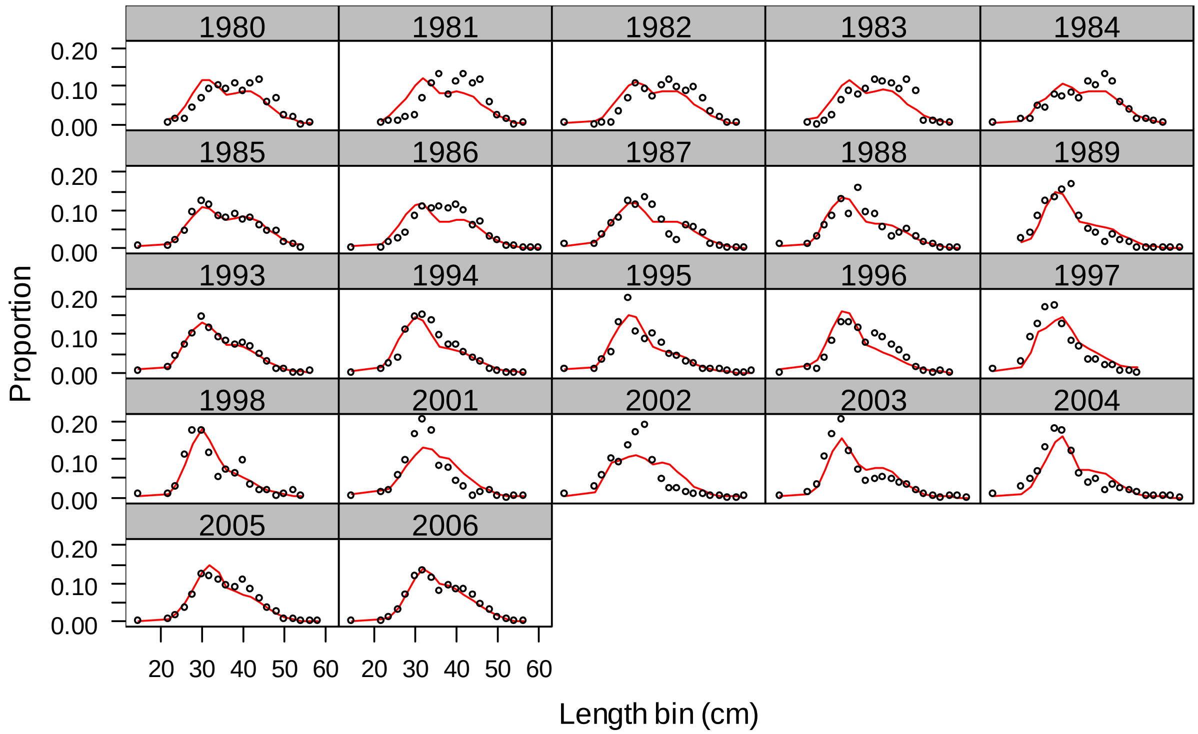


Figure 23. Final base-run model fit to length composition data (sexes combined) from the Oregon ORBS survey.

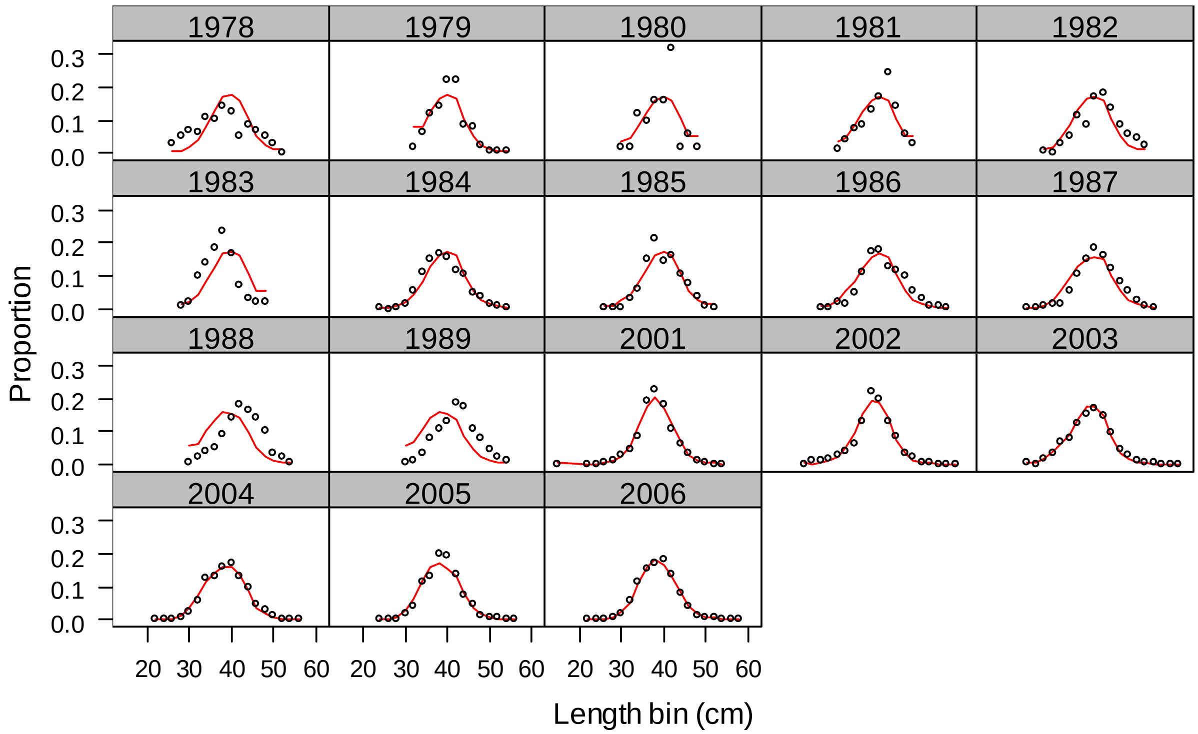


Figure 23. Final base-run model fit to length composition data from the Oregon ORBS survey, females (top panel) and males (lower panel).

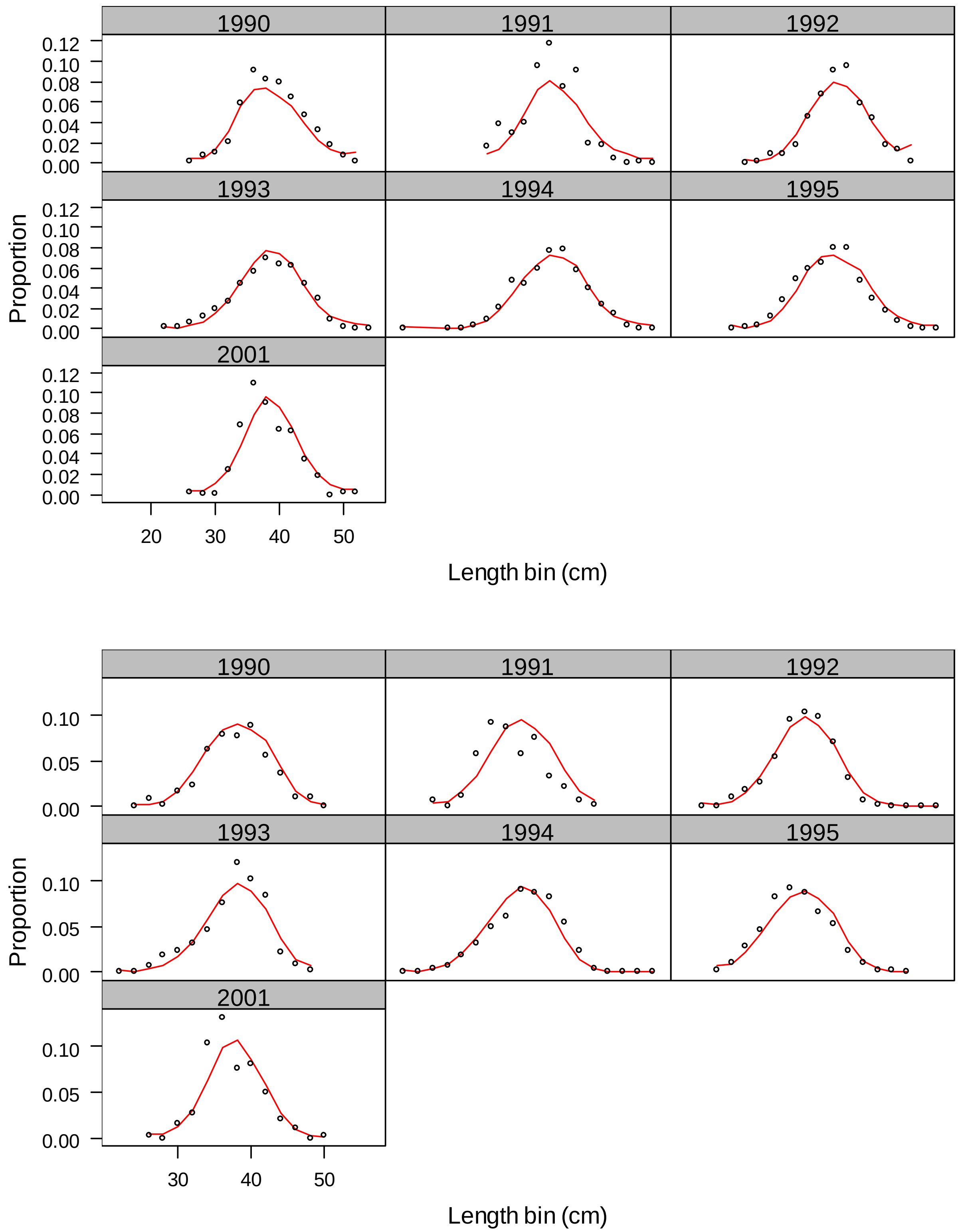


Figure 23. Final base-run model fit to length composition data (sexes combined) from the California CPFV survey.

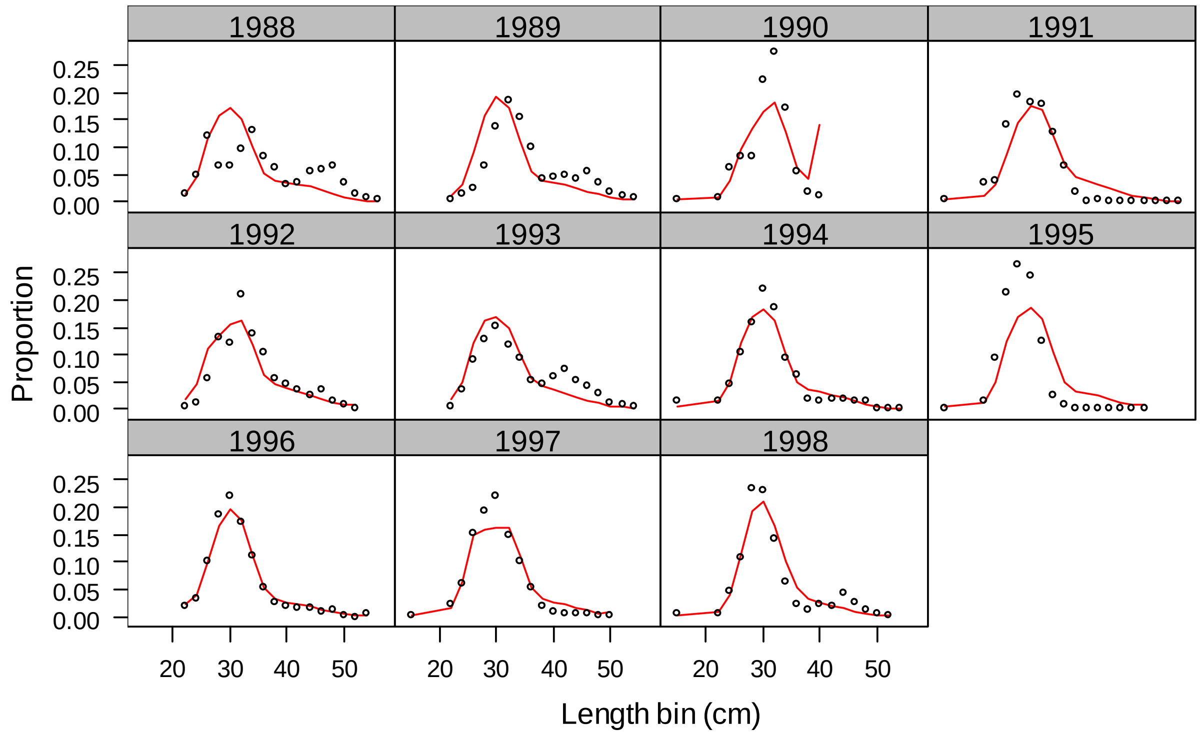
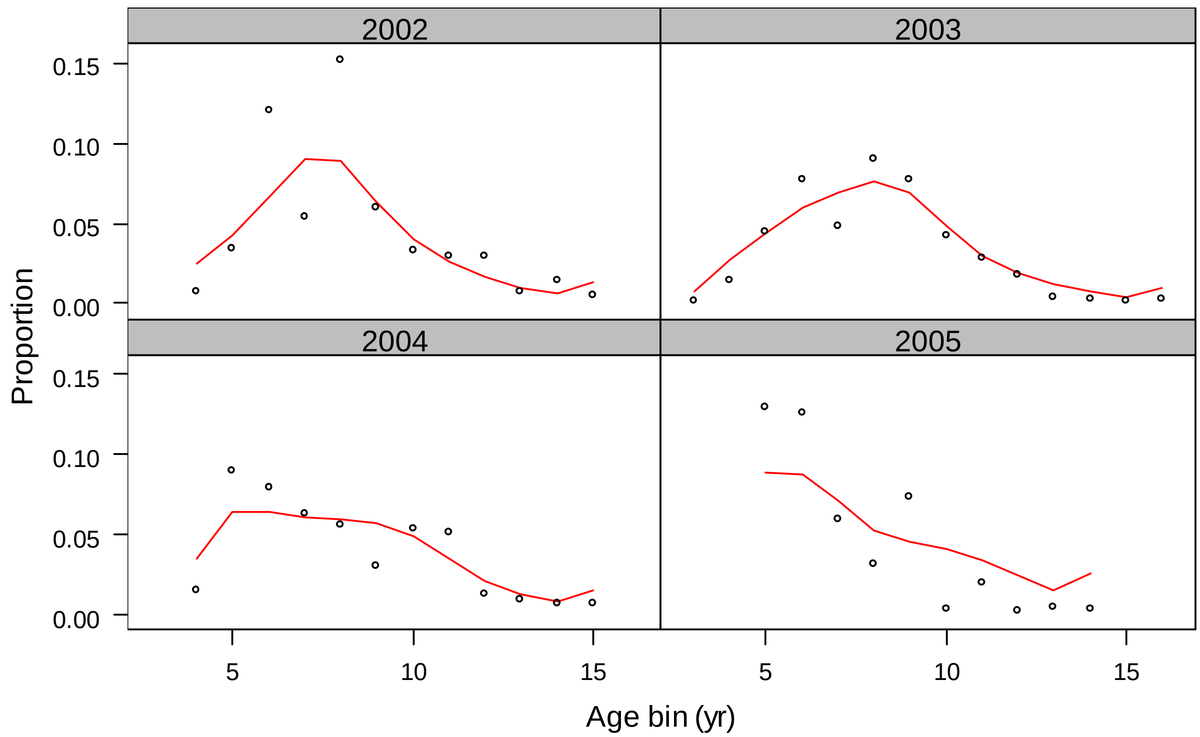


Figure 24. Final base-run model fit to age composition data from the Oregon HKL fishery, females (top panel) and males (bottom panel).



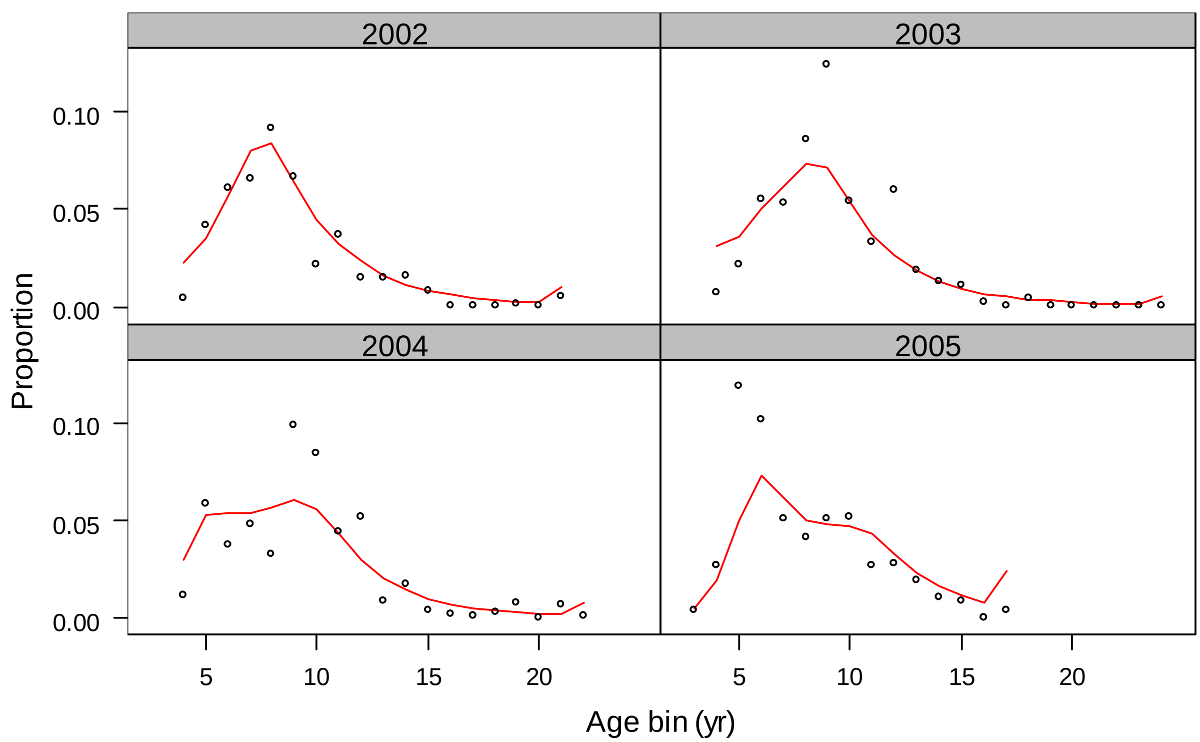


Figure 24. Final base-run model fit to age composition data from the Oregon ORBS survey, females (top panel) and males (bottom panel).

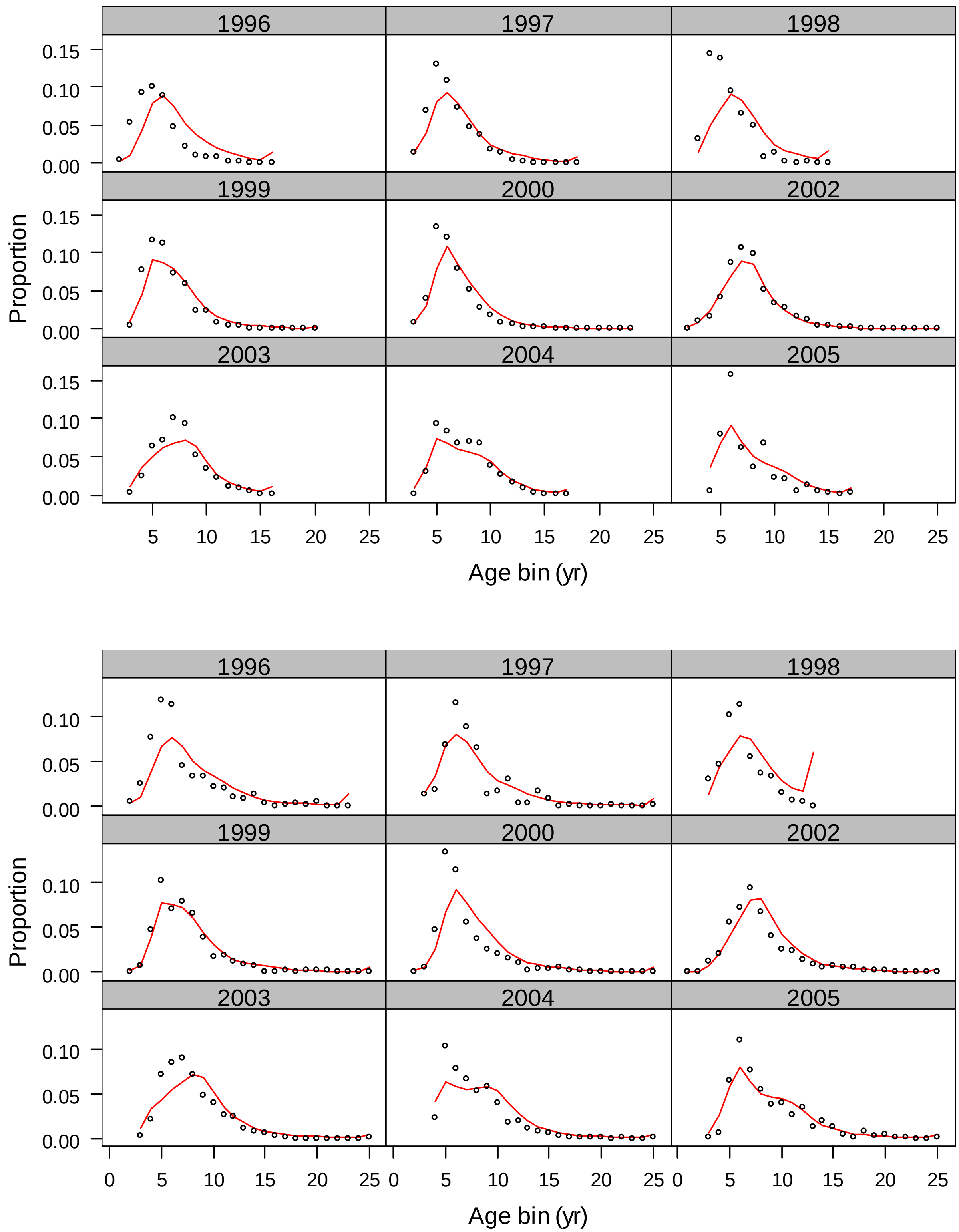


Figure 25. Final base-run model fit to mean length-at-age data from the Oregon ORBS survey, females (top panel) and males (bottom panel). In the final base-run model the length-at-age data from 2003 to 2005 were combined and assigned to 2004.

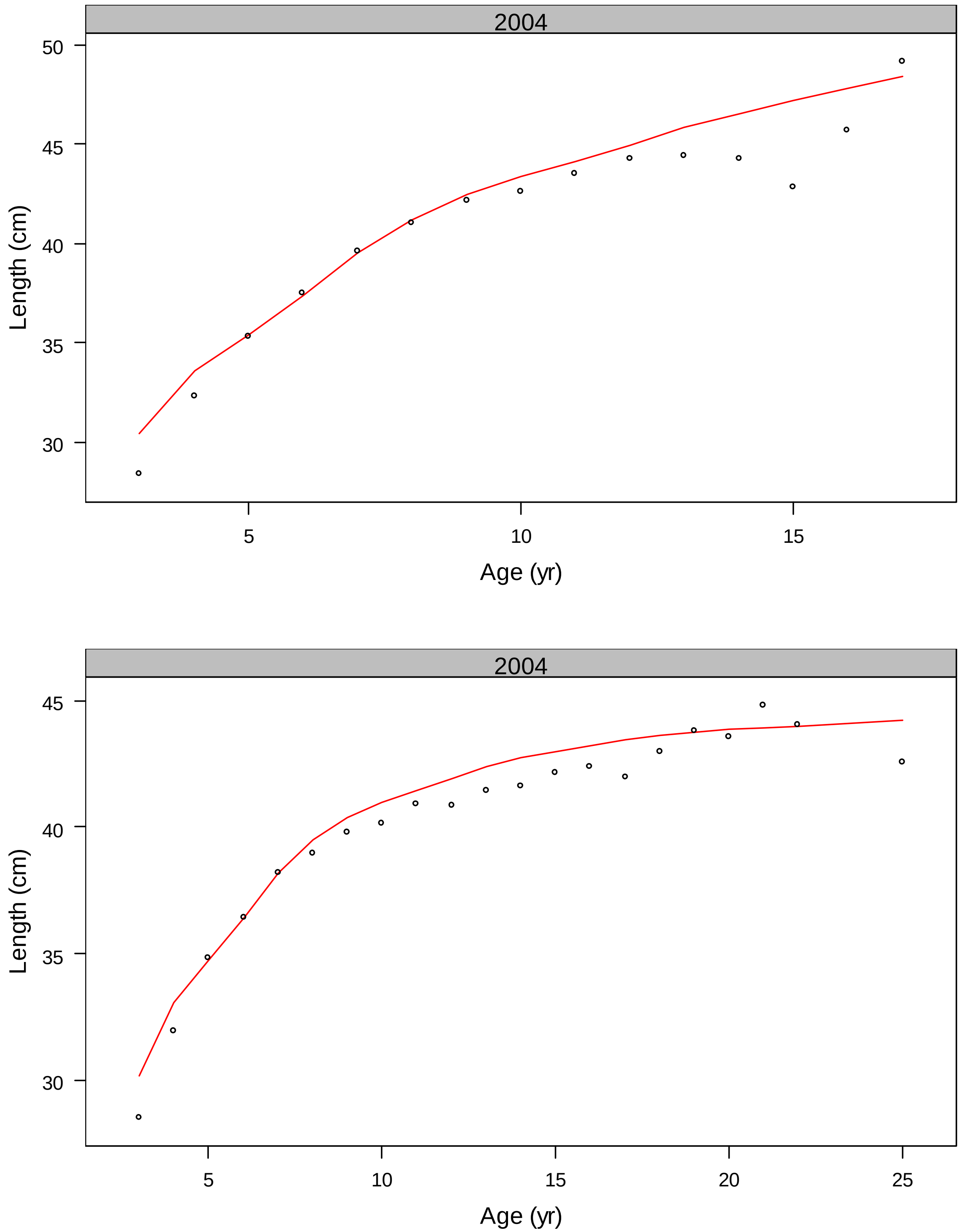


Figure 26. Residuals from the final base-run model fit to .the Oregon HKL fishery length composition data, females (top panel) and males (bottom panel).

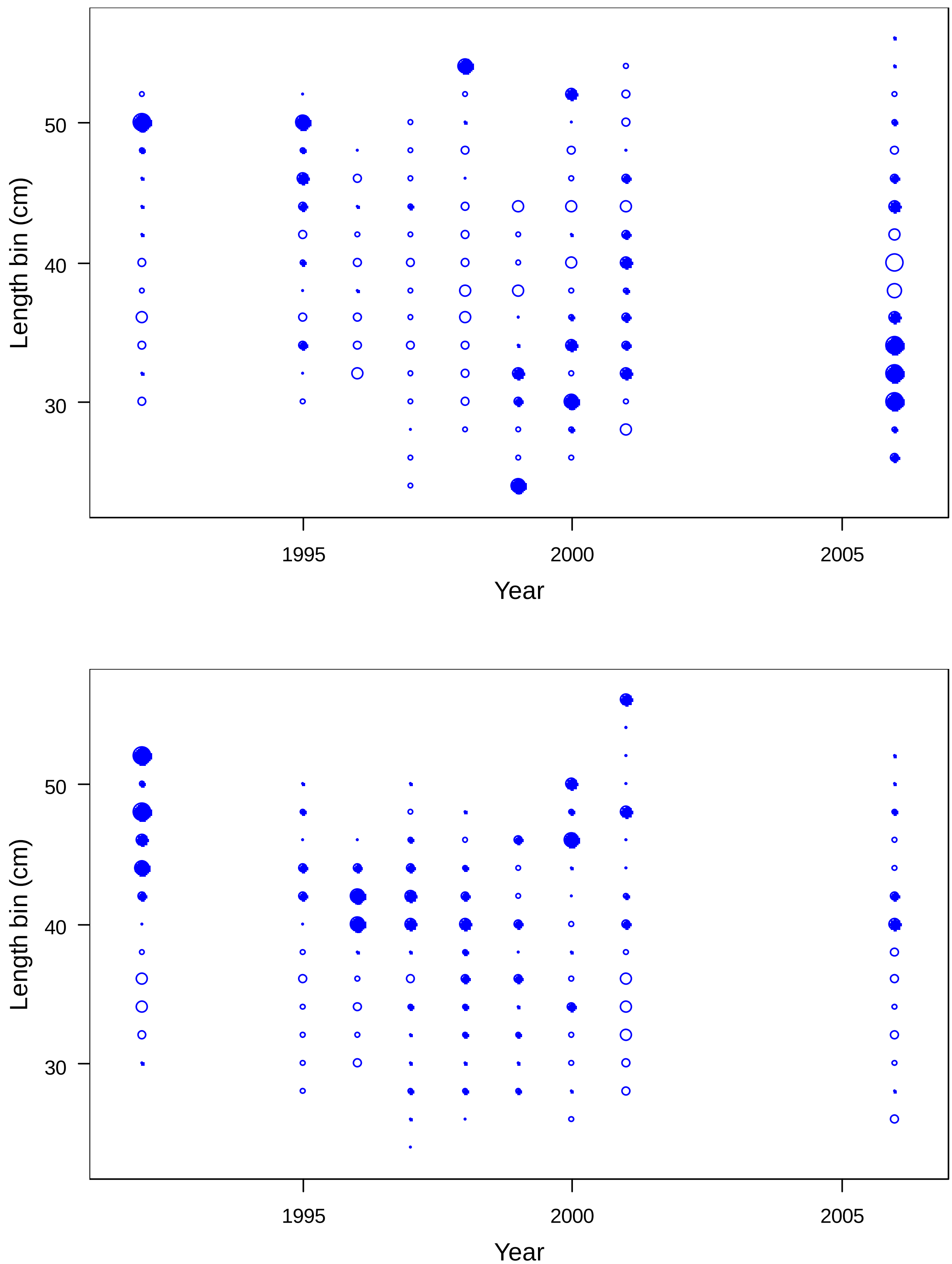


Figure 26. Residuals from the final base-run model fit to Oregon TWL (top panel) and REC (bottom panel) fisheries length composition data, sexes combined.

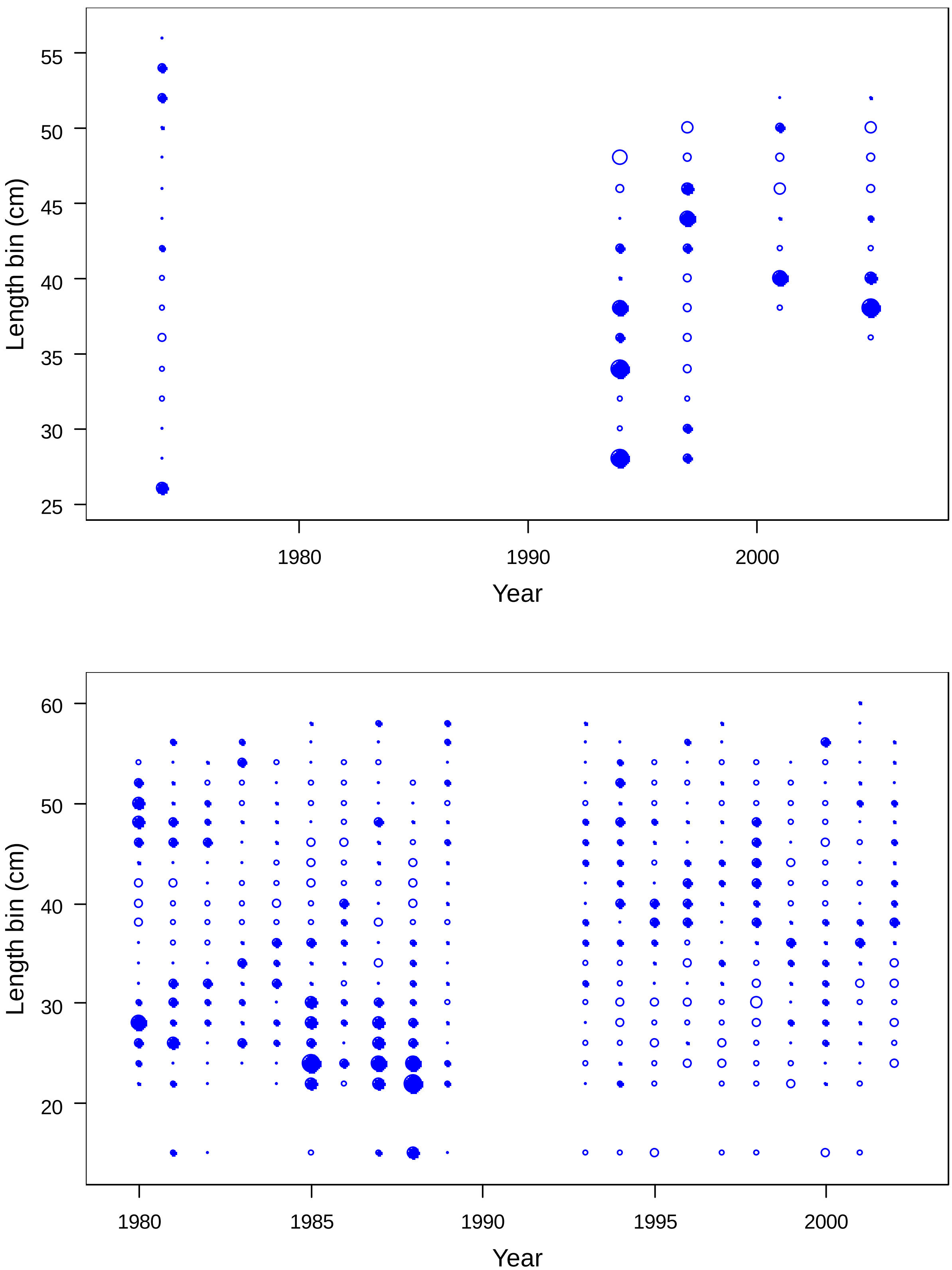
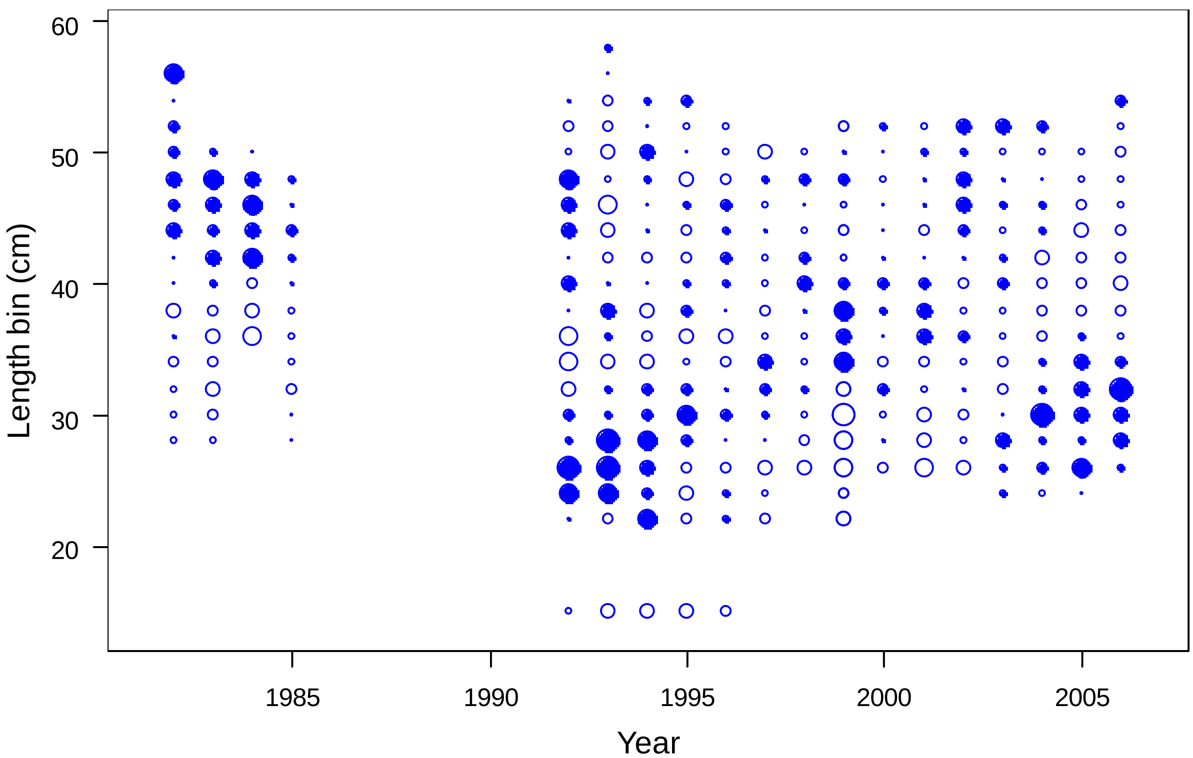


Figure 26. Residuals from the final base-run model fit to the California HKL (top panel) and TWL (bottom panel) fisheries length composition data, sexes combined.



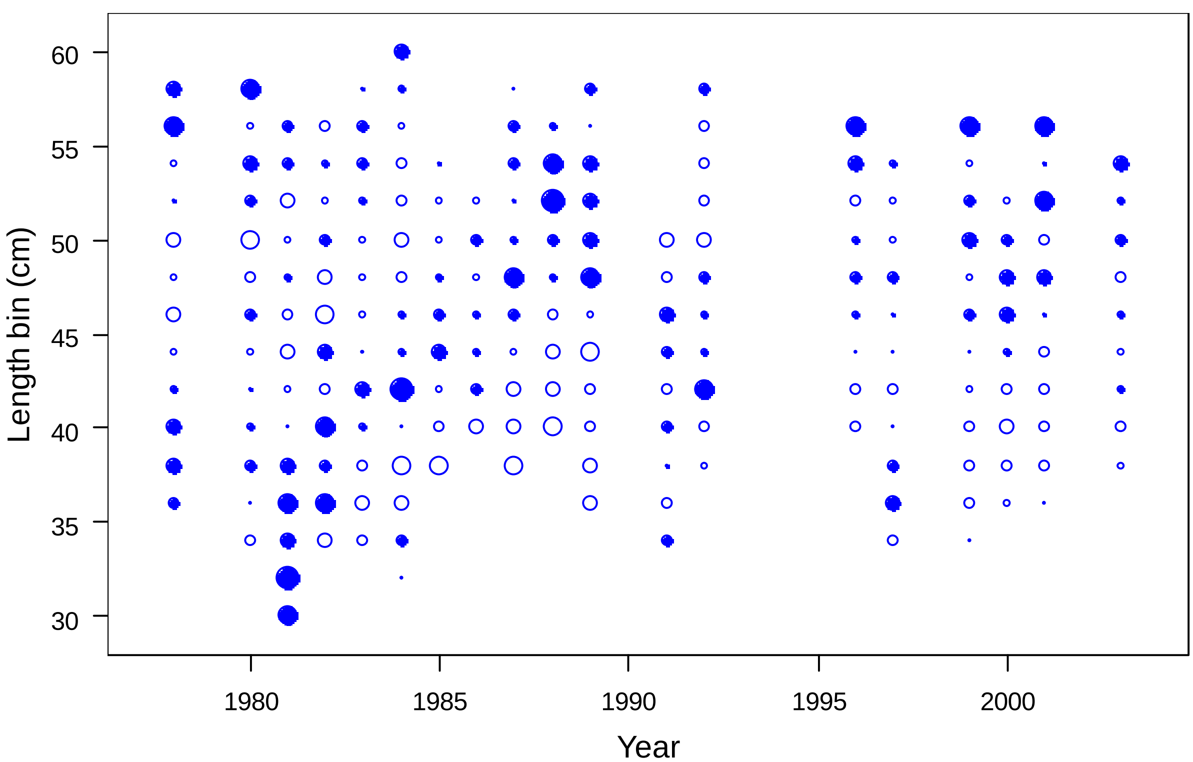


Figure 26. Residuals from the final base-run model fit to the California REC fishery length composition data, sexes combined.

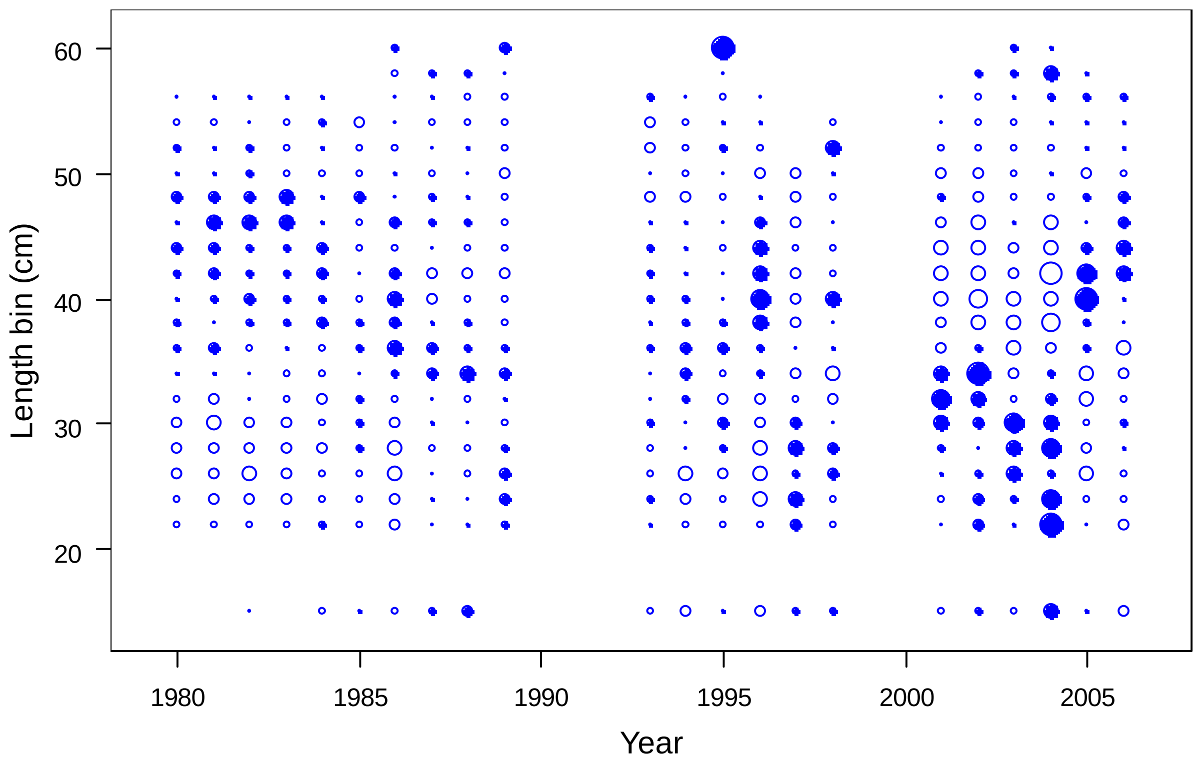


Figure 26. Residuals from the final base-run model fit to the Oregon ORBS survey length composition data, sexes combined.

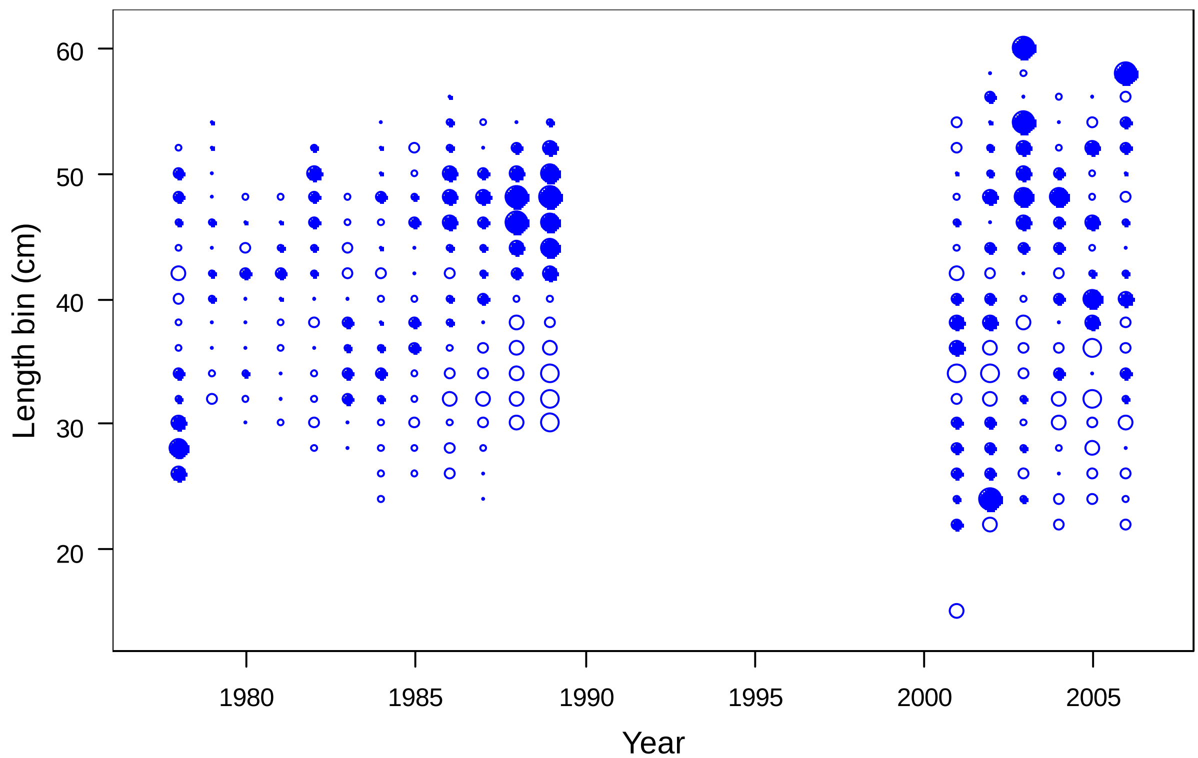


Figure 26. Residuals from the final base-run model fit to the Oregon ORBS survey length composition data, females (top panel) and males (lower panel).

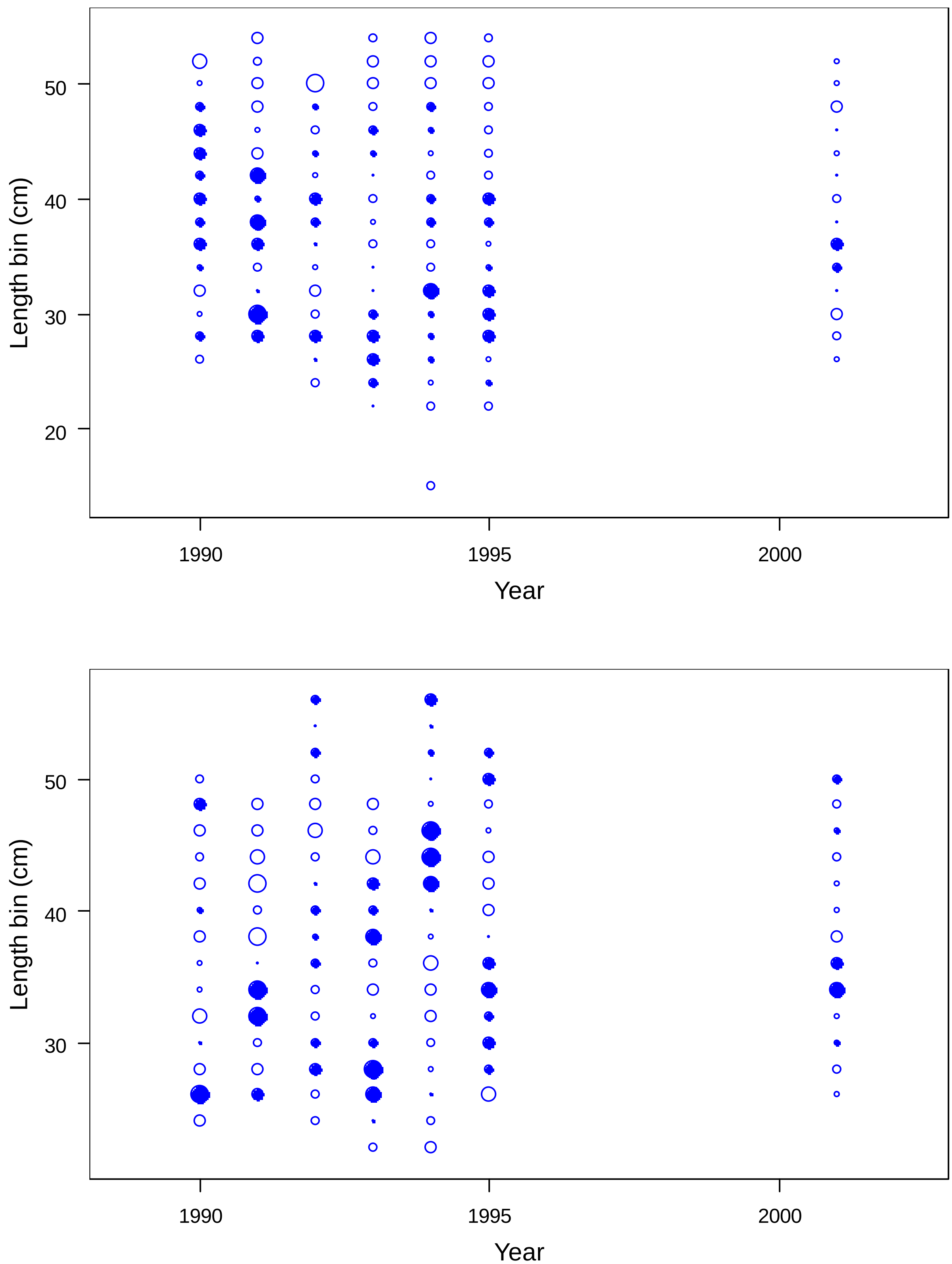


Figure 26. Residuals from the final base-run model fit to .the California CPFV survey length composition data, sexes combined

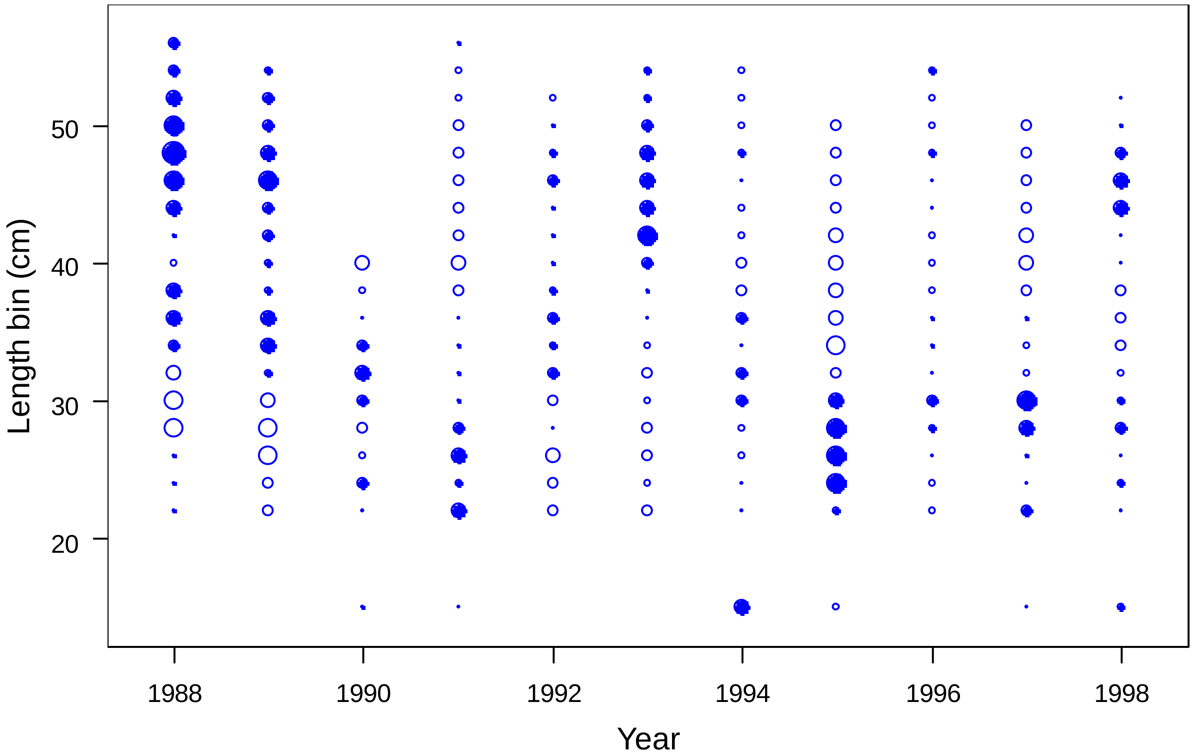


Figure 27. Residuals from the final base-run model fit to the Oregon HKL fishery age composition data, females (top panel) and males (bottom panel).

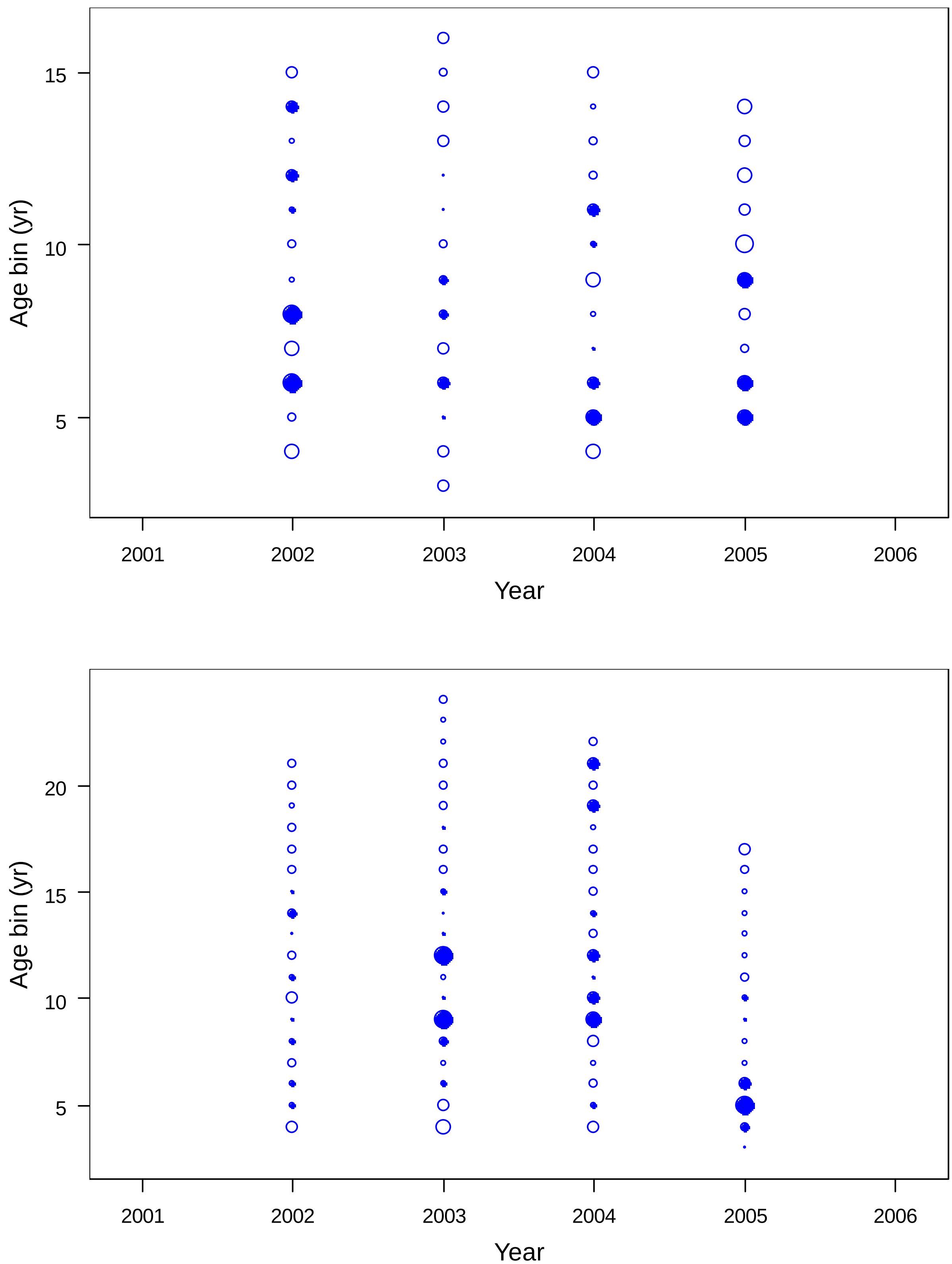
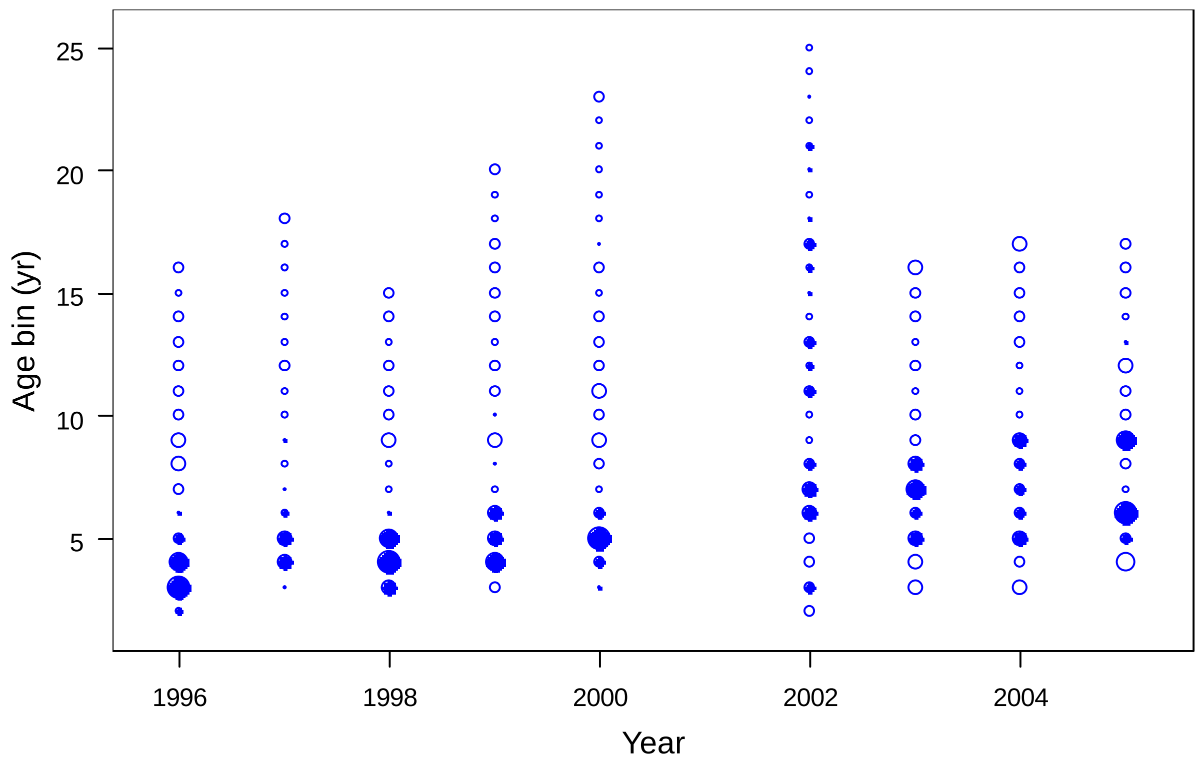


Figure 27. Residuals from the final base-run model fit to the Oregon ORBS survey age composition data, females (top panel) and males (bottom panel).



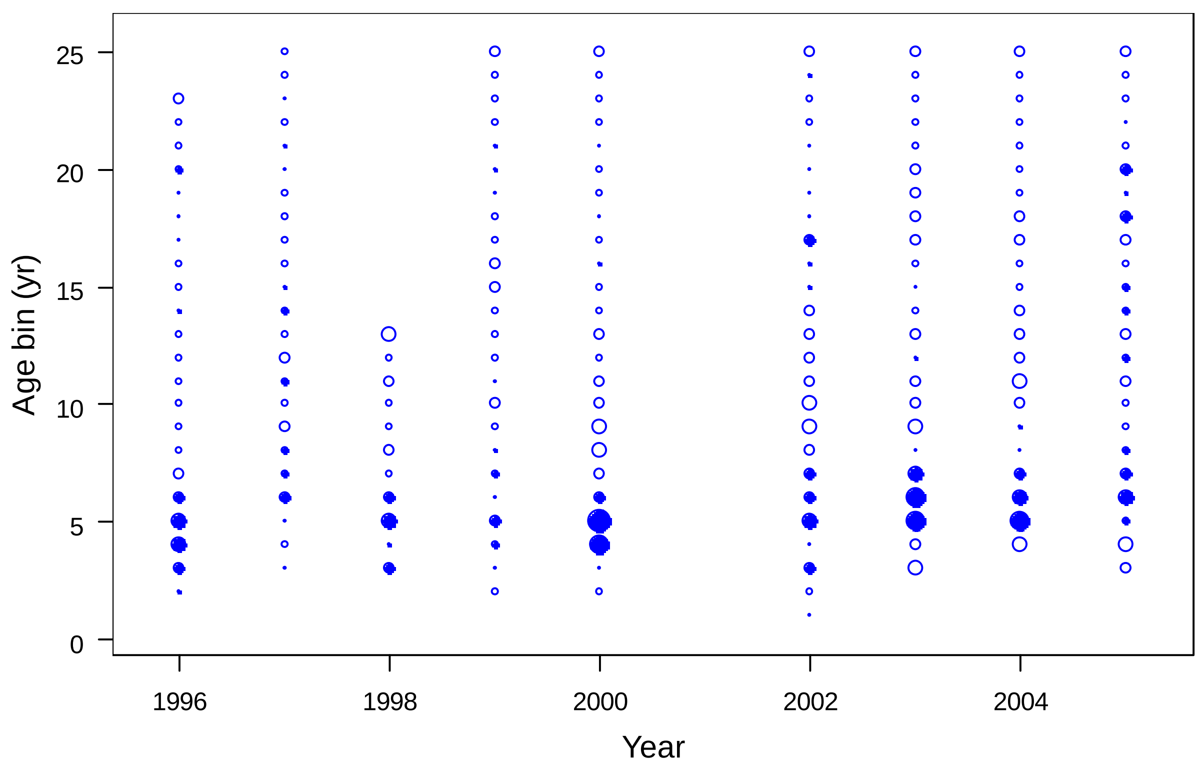


Figure 28. Final base-run model estimates of spawning output (millions of larvae).

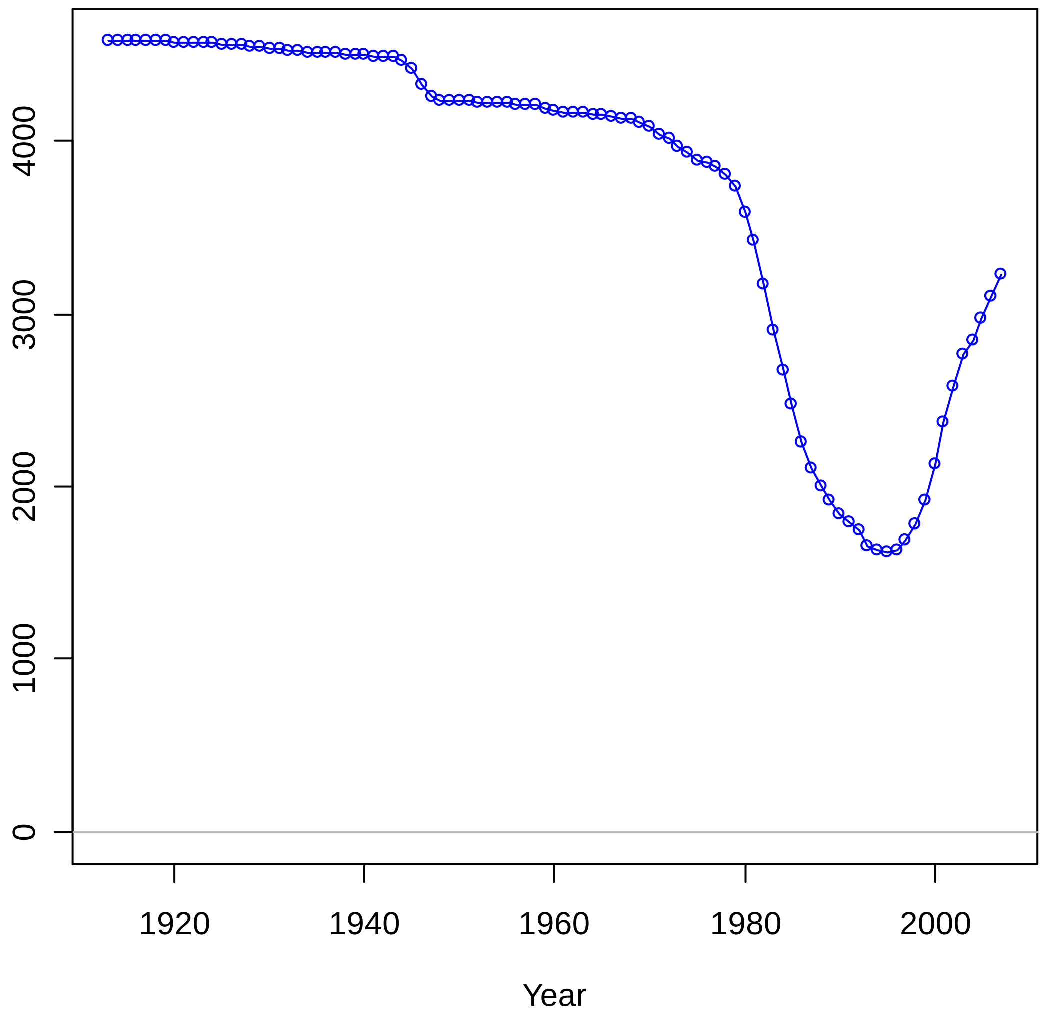


Figure 29. Final base-run model estimates of age-2+ biomass (mt).

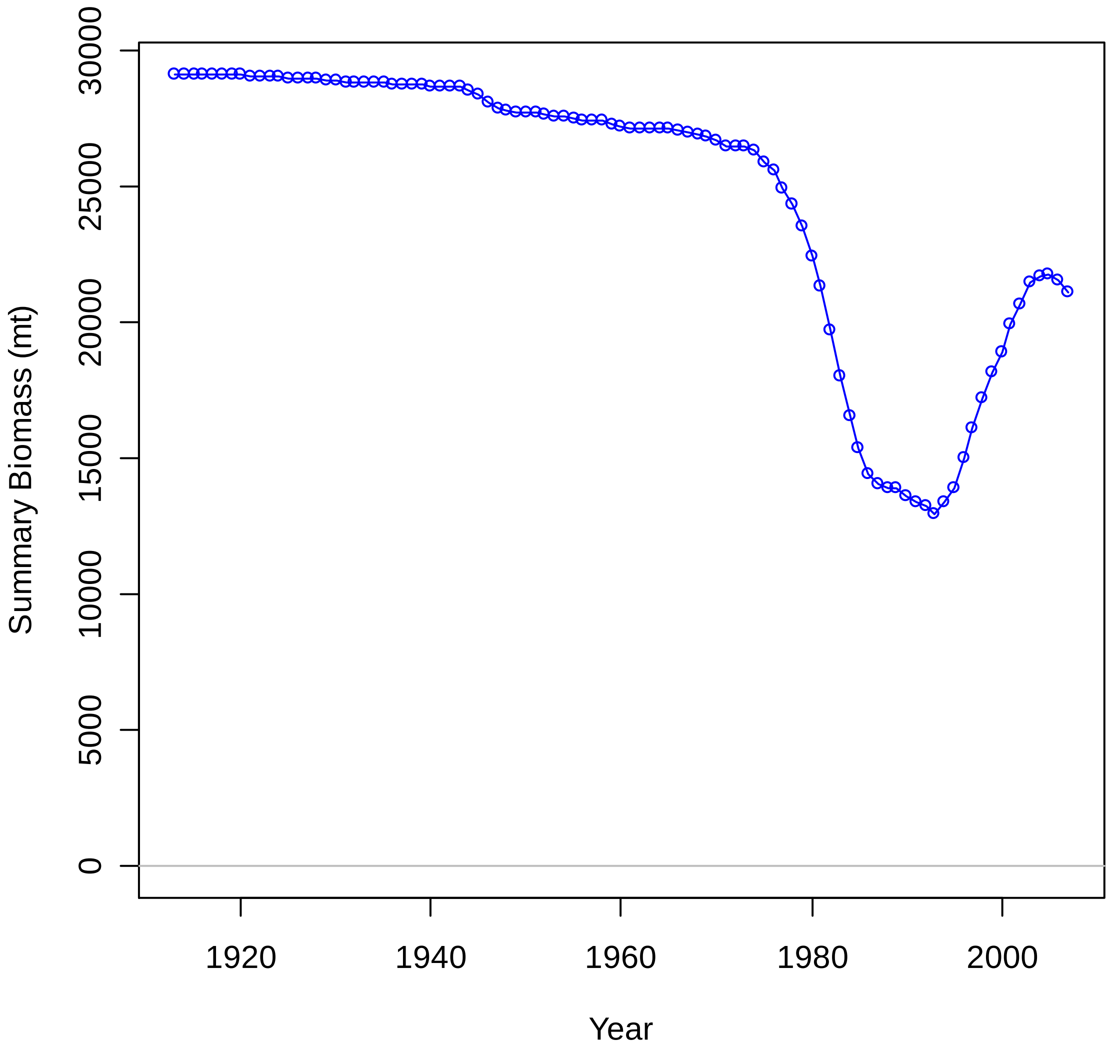


Figure 30. Final base-run model estimates of age-0 recruitment.

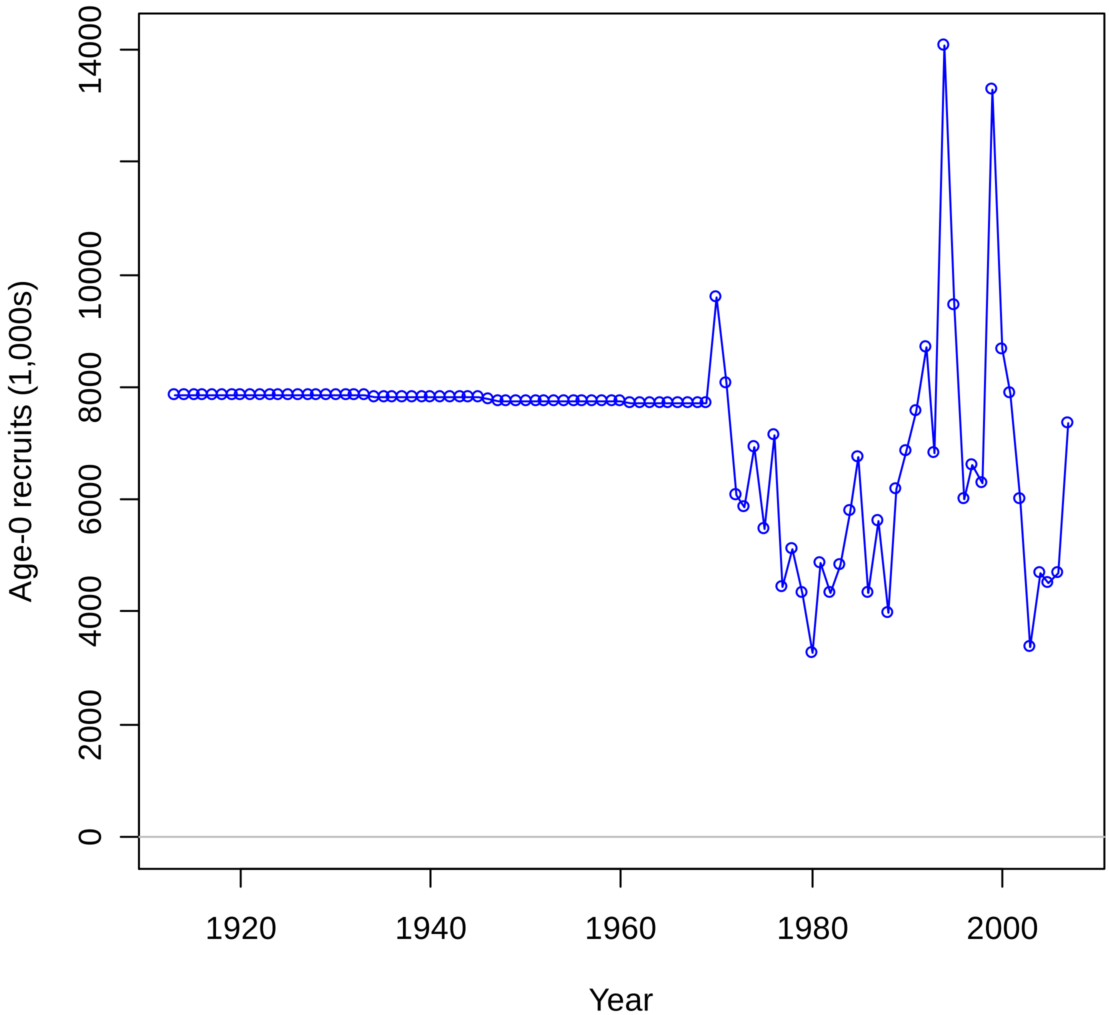


Figure 31. Final base-run model estimates of depletion (spawning output over unexploited).

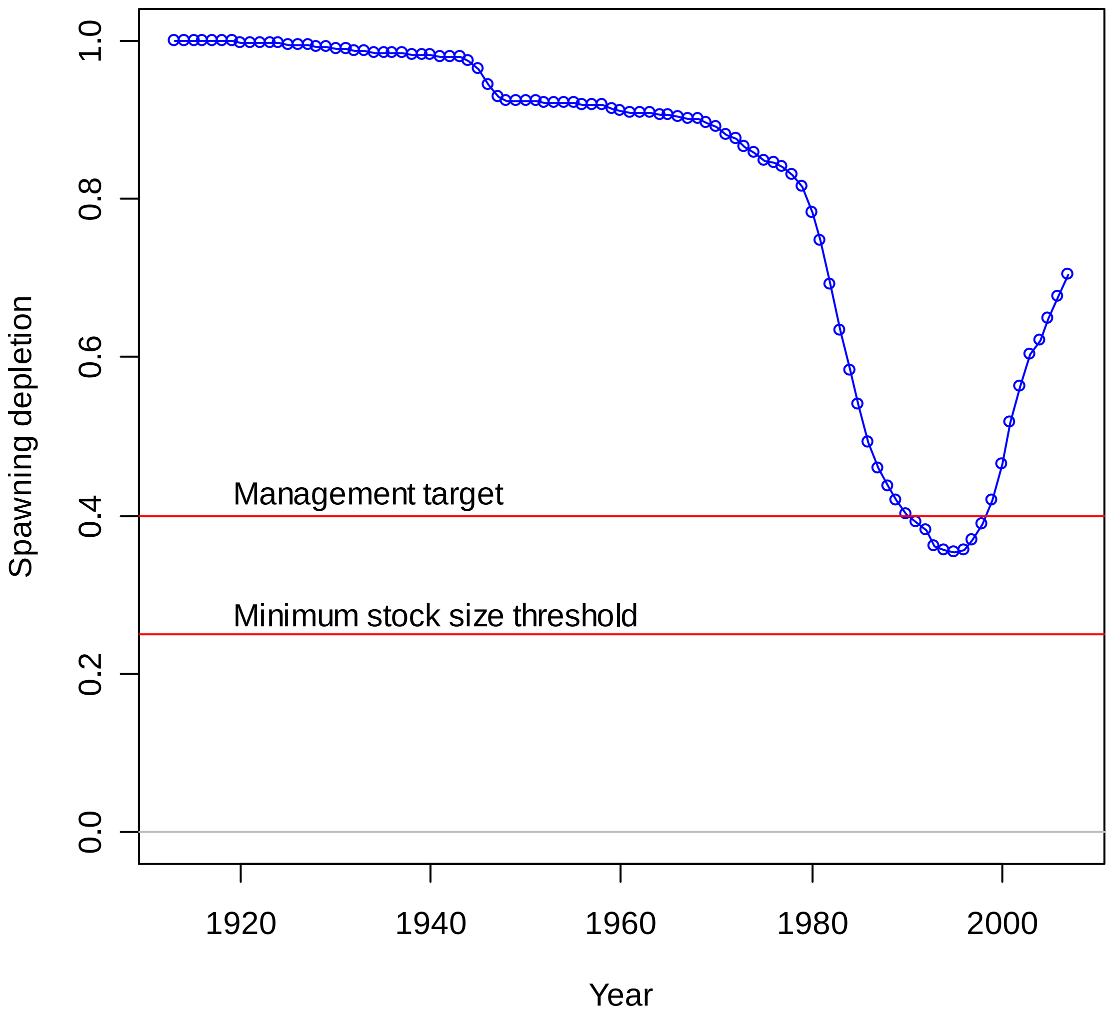


Figure 32. Final base-run model estimates of the total exploitation rate.

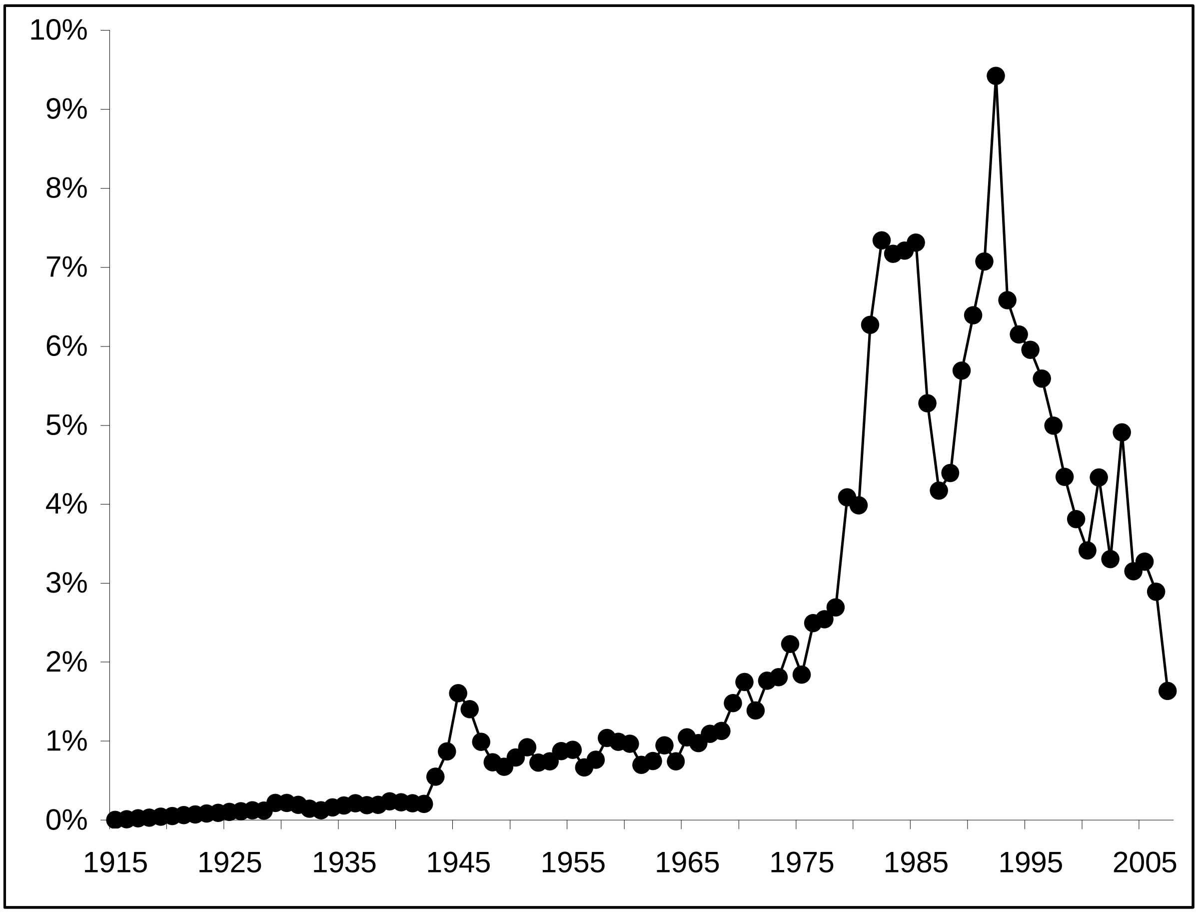
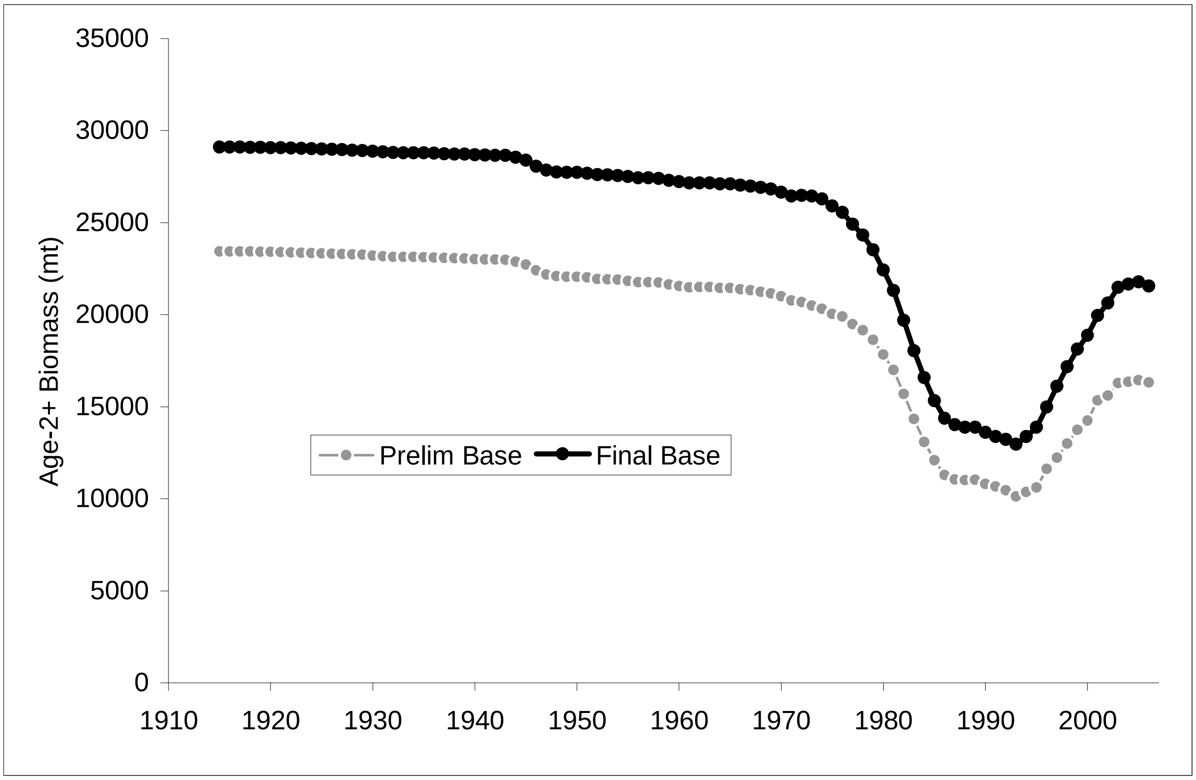


Figure 33. Comparison of the final base-run model with the preliminary base model.



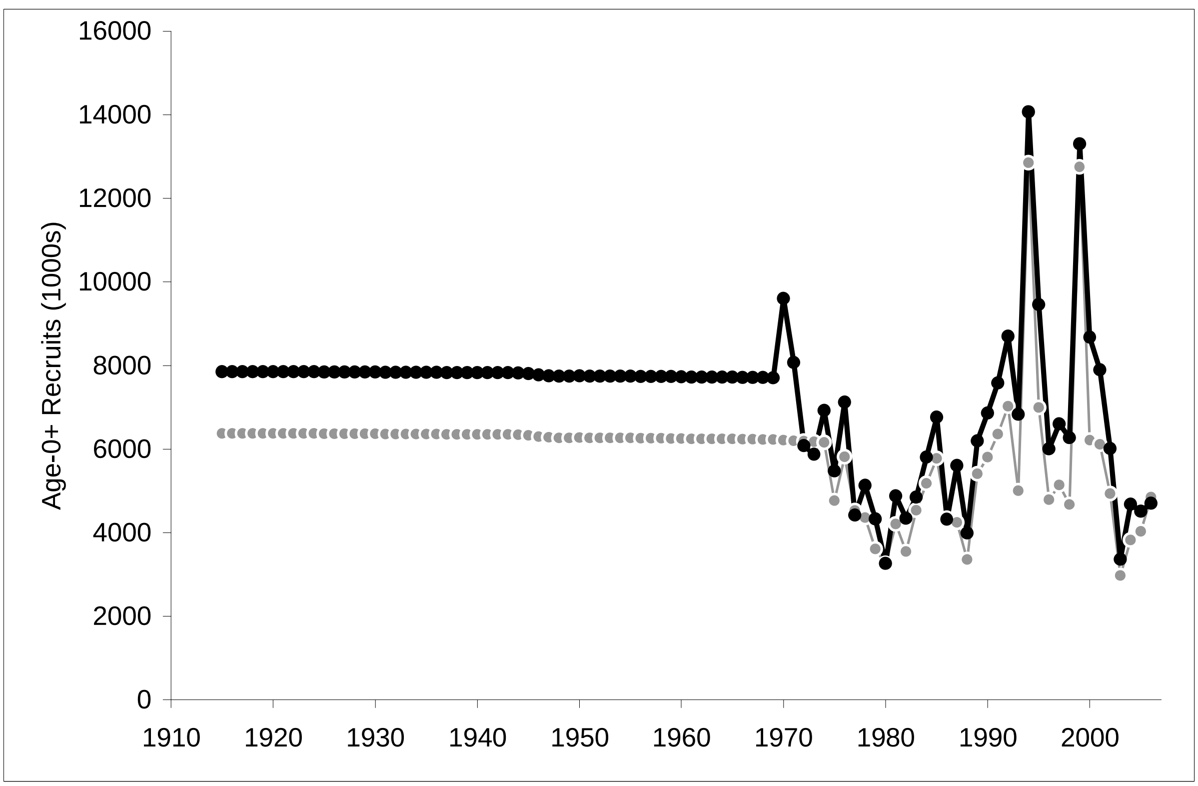
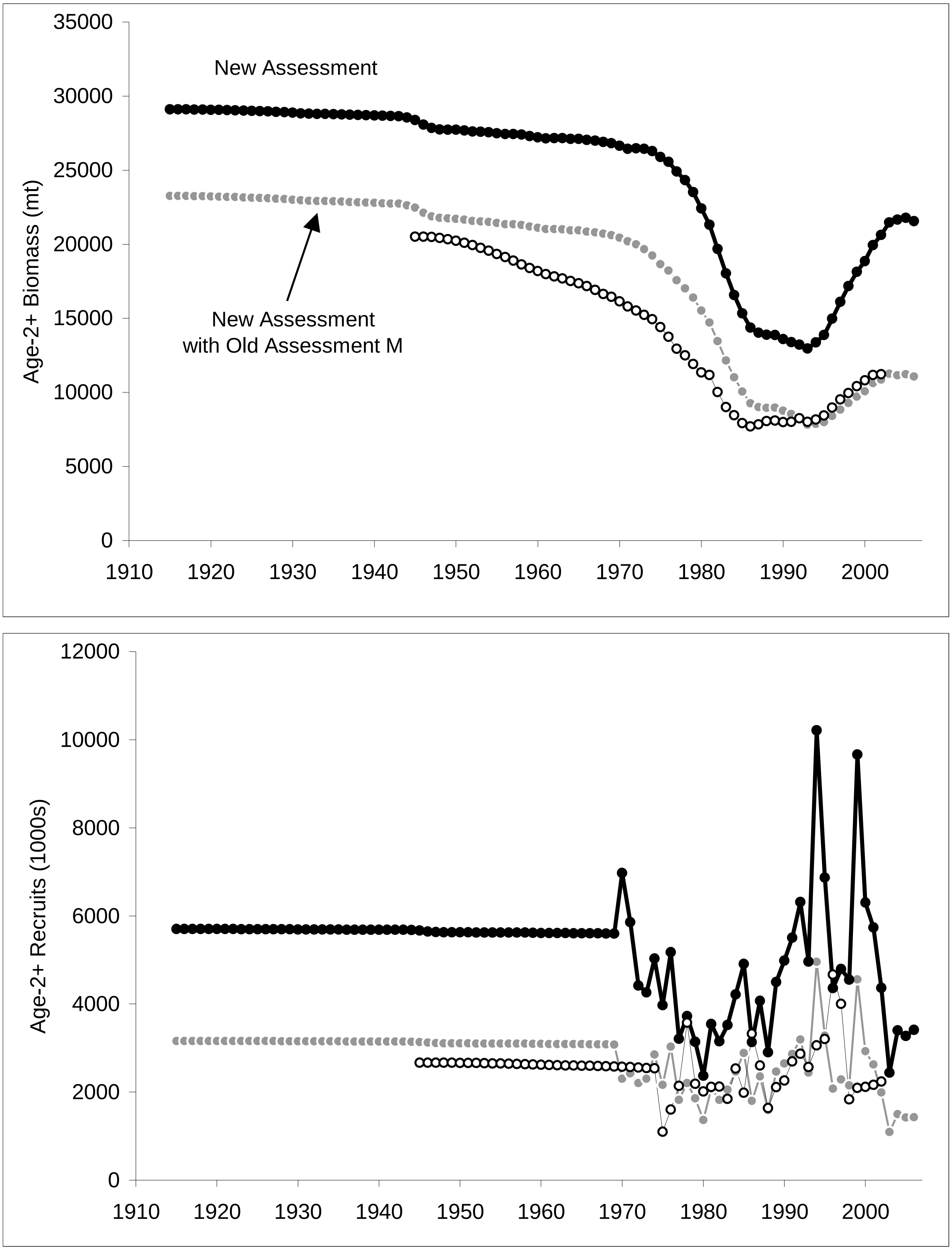


Figure 34. Comparison of the final base-run model with the 2003 assessment.



Appendix A.

Estimation of black rockfish (*Sebastes melanops*) population parameters from recreational fisheries mark-recovery data off Newport, Oregon

Troy V. Buell, Robert W. Hannah, and Steven J. Parker

Oregon Department of Fish and Wildlife
Marine Resources Program
2040 SE Marine Science Drive
Newport, OR 97367
(541) 867-4741

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Introduction

Assessments of the status of black rockfish (*Sebastes melanops*) populations have historically relied on trends in recreational catch-per-unit-effort (CPUE) as a relative index of abundance (Ralston and Dick 2003, Wallace et al. 1999). However, these data are not robust to changes in fishing effort distribution, the species targeted, or daily bag limits. In Oregon, daily bag limits governing the recreational take of black rockfish have been reduced from 15 fish in 1993 to 6 fish in 2006. These types of regulatory changes can dramatically reduce the utility of CPUE data as an abundance index for recent years.

Black rockfish is one of the primary target species in Oregon's recreational groundfish fishery. In 2004 and 2005, attainment of the federal harvest limit for black rockfish caused managers to close all recreational groundfish angling (except Pacific sanddab fishing) shoreward of the 40 fathom isobath (Oregon Department of Fish and Wildlife 2004 and 2005). These closures were highly controversial among resource users, and highlight the need for additional data sources to inform both stock assessments and management decisions for this important species.

In 2002, the Oregon Department of Fish and Wildlife (ODFW) initiated a mark-recovery experiment for black rockfish with the express intent of providing future stock assessments with an independent time series of estimates of exploitation rate, survival rate, and population abundance off Newport, Oregon. The Washington Department of Fish and Wildlife has conducted a similar black rockfish mark-recovery study off Westport, Washington since 1998 (Wallace et al. 1999), results of which have been used to inform assessments of black rockfish populations in Washington waters.

Field methods

Passive Integrated Transponder (PIT) tags were used to mark 2,500 to 3,000 fish per year since 2002 off Newport, OR. Specifically, we used Destron-Fearing ISO FDX-B 134.2-kHz PIT tags with dimensions of 12 x 1.2 mm. Each PIT tag is encoded with a unique number, allowing identification of individual marked fish. These marks are not visible to anglers, eliminating problems associated with non-reporting of visible marks by anglers. PIT tags were injected 1 cm deep into the hypaxial musculature just anterior of the origin of the pelvic fin. This tag location was chosen because it allows fish to be checked for PIT tags after they have been filleted, and a tag retention study found 100% retention after 49 weeks in fish tagged in this manner (Parker et. al 2003).

Fish were captured by hook and line anglers using barbless hooks aboard chartered recreational fishing vessels between statistical weeks 11 and 26 (March through June) in each year. Upon capture, fish were scanned for a pre-existing PIT tag, assessed for signs of barotrauma (injuries related to pressure changes), measured, injected with a PIT tag, re-scanned, and released. Fish with significant signs of barotrauma, such as an everted esophagus or bulging eyes, were lowered to a depth of 10-15 meters in a weighted cage prior to release. Recent studies indicate that returning black rockfish to depth quickly is the best way to mitigate barotruama related mortality (Hannah and Matteson 2007). Fish bleeding from the gills or suffering major flesh wounds from hooks or predators were not marked. Fish that were unable to remain submerged after being released at depth were recovered when possible and removed from the marked fish population. Anglers included ODFW staff, volunteers, and vessel crew. Injection of PIT tags and data recording tasks were performed by ODFW staff.

Distribution of marked fish was divided among four areas off the central Oregon coast between Yaquina Head and Alsea Bay to reflect the estimated distribution of the black rockfish population, based on the distributions of recreational fishing effort and rockfish habitat (Figure 1). Latitude and longitude were recorded every 60 seconds during marking operations by a data logging Global Positioning System (GPS). The capture location of each fish could then be plotted by matching the time of marking to the nearest time that a GPS position was recorded (Figure 1).

Marked fish were recovered by ODFW staff at dockside landing sites in Newport, OR. In 2002 and 2003, sampling for marked fish occurred from March through October. Approximately 95% of Oregon's estimated annual black rockfish landings occur during this period (Recreational Fisheries Information Network (RecFIN)). Beginning in July 2004, sampling occurred throughout the entire year. Samplers were trained to use Allflex® portable scanners to search for marked fish, and to tally the number of fish scanned. Several blind tag seeding experiments demonstrated a tag detection rate of 96.5% ± 7%. Whenever possible, interviews with the captain or crew were conducted to determine the area where most of the fishing took place. Recovery effort focused on charter boats, which are historically responsible for over 75% of recreational black rockfish landings in Newport (RecFIN). Samplers typically met charter boats at landing sites and scanned fish prior to or just after they were filleted. Fish landed by private vessels were also checked for marks by ODFW's Ocean Recreational Boat Survey (ORBS) samplers. Carcasses of marked fish were examined to determine size, sex, maturity, tag movement, and general fish condition to compare with data collected at the time of marking.

Depoe Bay, the nearest port to the north (23 Kilometers), was also sampled for marked fish in order to address model assumptions about movement and migration. The nearest port to the south, Florence, OR, is 64 kilometers south and has relatively low black rockfish landings. Therefore no fish were scanned at Florence. However, vessels from Newport occasionally fish well south of the study area at Cape Perpetua, and these fish were also checked for marks.

Analysis methods

This experiment was designed to utilize the multi-stage mark-recovery model described by Brownie et al. (1985a) to generate a time series of annual estimates of recovery ($\hat{f}_i$) and survival ($\hat{S}_i$) rates where *i*=year. With the additional inputs of an independent estimate of annual total catch ($\hat{C}_i$) and an annual census of fish sampled for marks (cs_i), the recovery rate parameter can be used to calculate annual estimates of exploitation rate ($\hat{u}_i$) and their variances as given in the following equations (Jagielo, 1994):

$$\hat{u}_i = \frac{\hat{f}_i \hat{C}_i}{cs_i}$$

with variance

$$\text{var}(\hat{u}_i) = \frac{\text{var}(\hat{C}_i)\,\hat{f}_i^{\,2} + \text{var}(\hat{f}_i)\hat{C}_i^{\,2}}{cs_i^{\,2}}$$

The annual population abundance (N_i) can then be estimated by dividing the annual estimated catch by the estimated exploitation rate:

$$\hat{N}_i = \frac{\hat{C}_i}{\hat{u}_i}$$

The Brownie model depends on several inherent assumptions about the population being modeled. ODFW has conducted extensive support studies and analyses of ancillary data generated during marking in an attempt to validate these assumptions for black rockfish populations off Newport. Table 1 summarizes the assumptions, our attempts to address each assumption, and the results of these support studies.

Based on ODFW laboratory studies (Parker et al. 2006) a capture and release mortality rate of 3.3% was applied to the number of marks released in each year. A one year recovery period was defined as statistical week 26 (approximately the fourth week of June) in year *i* through statistical week 25 in year *i*+1. Fish recovered prior to week 26 in the same year they were marked were removed from the analysis. This definition was adopted to approximate the simultaneous release of all marks within a year, which is impossible to accomplish in practice. The time period under consideration for this analysis is from week 26 in 2002 through week 25 in 2007.

Analysis of recovery rates by length bin showed that fish from 29-32 cm had lower first-year recovery rates than larger fish in every year except 2002. This observation is supported by data collected by charter boat observers which indicate 29-32 cm black rockfish are frequently discarded (Figure 2). Observer data also indicate that the average size of discarded black rockfish is increasing as bag limits decrease, presumably a result of anglers "high grading" their catches. As small marked fish fully recruit to the fishery in later years, they give the appearance of increasing recoveries over time. For this reason, fish 29-32 cm in length at time of marking were excluded from our analysis. This is a conservative measure from a management perspective since exclusion of 29-32 cm fish leads to higher estimates of exploitation rate and lower estimates of survival rate. The computer program ESTIMATE (Brownie et al. 1985b) was used to generate estimates of recovery and survival rates, and to assess model fit. ESTIMATE assesses the goodness of fit (GOF) for four predefined models (Table 2) using the Chi-square tests described in Brownie et al. (1985a), and provides tests between models.

Estimation of *q* for the Newport fishery

While exploitation and survival rates are important information for fishery managers, at this time Stock Synthesis II does not allow for the direct input of these parameters to help inform stock assessments. Estimates of abundance can be directly incorporated into the assessment model as a survey, but abundance estimates from the black rockfish PIT tag program only pertain to the population from Yaquina Head to Alsea Bay. This is a much smaller area than the Pacific States Marine Fisheries Commission's (PSMFC) management areas 2C and 2A/2B or the broader area from Cape Falcon to the Oregon/California border, which are the spatial units under consideration for assessment models. In order to allow the mark-recovery abundance estimates to be directly incorporated into assessment models, it was necessary to calculate the fraction (q) that the black rockfish population off Newport represents with respect to the entire area 2C population and the broader population from Cape Falcon to the OR/CA border. To estimate q, we used onboard observer data from charter and commercial vessels targeting nearshore rockfish to estimate the proportion of black rockfish habitat occurring within the mark-recovery study area with respect to each of the larger areas. Based on the assumption that abundance is a function of available habitat, this habitat estimate allows the estimation of a q for the Newport population survey.

The available data consisted of latitude and longitude coordinates for the start and stop points of "drifts" in the recreational fishery and "sets" in the commercial fishery, catch counts by species, and much ancillary data. Because the data described only spatial points with no inherent geographical area, it was necessary to assign some amount of area to each black rockfish catch location. We examined the average distance between the drift start and stop locations ($\bar{x}$ =190 m) in the recreational observer data to estimate the average habitat area represented by a single catch location. Based on this result, we represented each start location as a circular area with a radius of 190 meters, then merged all overlapping circles and calculated the total area of black rockfish habitat using ESRI's ArcView® software. Although this approach incorporates spatial area that is likely not black rockfish habitat, and cannot yield absolute estimates of habitat area, we felt it was useful for estimating the relative proportion of black rockfish habitat among major harvest areas.

One potentially serious bias in the above analysis results from the uneven spatial distribution of observer effort for both the commercial and recreational data. In both of these programs, observer effort is approximately proportional to fishing effort by port. This could lead to a situation where the habitat in some areas has been well defined by observer data, but habitat in areas with less effort is poorly defined, leaving spaces where habitat exists but no fishing has been observed. Since the area off of Newport has the greatest number of observed black rockfish locations (figure 3), this method is likely to overestimate the relative proportion of habitat occurring inside the PIT tag study area. Therefore, we viewed this estimate as representing the maximum proportion of total black rockfish habitat occurring inside the PIT tag study area.

In order to remove any bias associated with spatial differences in observer effort, we equalized observer effort by randomly selecting 119 locations from each of 8 port sub-areas and including all 17 locations from sub-area E (Figure 3). The number of locations randomly selected reflects the fewest locations in any sub-area except sub-area E. Port sub-areas were approximately equal in size (40 km North-South by 25 km East-West) except area E which stretched from just north of Cape Perpetua to Coos Bay and contained only 17 black rockfish locations. Again, this method is not useful for estimating absolute habitat area, only the relative proportions of black rockfish habitat between areas.

Finally, we calculated the linear kilometers of coastline for the PIT tag study area, PSMFC area 2C, and Cape Falcon to the OR/CA border. We then calculated the same black rockfish habitat proportions described above assuming habitat area was directly proportional to linear kilometers of coastline. Visual examination of maps of fishing locations clearly shows that black rockfish habitat in the PIT tag study area off Newport is less patchy than across much of the rest of the state. We therefore felt that calculating the proportions of black rockfish habitat in each area using linear miles of coastline would give a reasonable minimum for the proportion of habitat area occurring inside the PIT tag study area.

Results

From March 2002 through June 2006, a total of 14,372 black rockfish were successfully marked with PIT tags and released (an additional 3,056 marked in 2007 were not included this analysis). Through June 2007, 976 marked black rockfish were recovered from recreational fishery landings at Newport, and 2 were recovered at Depoe Bay. During this period, 272,677 black rockfish were checked for marks at Newport, and 85,282 were checked at Depoe Bay. A total of 93 marked fish were removed from the analysis because they were recovered prior to the beginning of the first recovery period for their marked fish cohort. The censure of fish less than 32 cm resulted in the removal of an additional 1,354 marked fish from the analysis. The final numbers of marked and recovered fish by year and recovery period that were used as model inputs are given in Table 3.

Based on port-specific weekly estimates of landings generated by the Recreational Fisheries Information Network (RecFIN), 79% of black rockfish landed at Newport and 34% of those landed at Depoe Bay were checked for marks during the period under consideration. Sampling rates were similar for each recovery period (Table 4).

Comparisons of annual length distributions of marked fish with annual length distributions of fish landed in the Newport fishery (from separate creel surveys) show that in 2003, 2004, and 2006 marked fish were somewhat smaller than those landed in the fishery (Figure 4). Examination of recovery rate anomalies (difference from the mean) for fish in 6 different barotrauma categories showed a statistically significant relationship between level of barotruama and probability of recovery ($p=0.02$, Kruskal-Wallis test), with lower recovery rates for fish having the fewest signs of barotrauma (Figure 5). This effect is the opposite of what would be expected if visible signs of barotrauma led to increased tagging mortality. It is probable that in this case the level of barotrauma is correlated with some other effect on recovery rate such as location or depth and is not the direct cause of differences in recovery rate.

Comparison of the geographic distribution of marked fish showed that fish were marked at most reefs each year, although the number of fish marked at any specific reef was variable from year to year. Interviews with boat operators and deckhands indicated that the majority of fish are recovered in the same area that they were initially marked (Table 5). Additionally, 26 of 33 fish that were recaptured during marking operations were within 1 km of the initial point of capture.

Goodness of fit statistics generated using ESTIMATE indicate that model 0, in which first year recovery rates are assumed to be independent of other years, is the only model which adequately describes the data considered (Table 6). Model 0 has a large number of parameters, some of which are not separately estimable. For a five year dataset, f is not estimable for period 5, and S is not estimable for periods 4 or 5. While f' is estimable for all periods, it is based on minimal information and should be treated with caution. Model 0 estimates of f_i ranged from 2.6% to 3.8% and estimates of S_i ranged from 57% to 106% (Table 7). Using estimates of f_i from model 0, estimates of u_i ranged from 3.1% to 5.5% and estimates of N_i ranged from 1.3 to 2.1 million fish from 2003 to 2006 (Table 8). Measures of the variance of the estimated catch are not currently available, therefore the CVs given for u and N in table 8 assume that catch is known without error. Because catch is treated as a constant in this case, the CVs for the estimate of N are approximately equivalent to the CVs for the corresponding estimate of u. Figure 6 shows the effect of increasing CV($\hat{C}$) on CV($\hat{u}$).

In our estimation of q for the Newport population survey, we found that the amount of black rockfish habitat inside the PIT tag study area as a proportion of that inside either larger area was greatest when calculated using all available observer data, least when calculated using linear km of coastline, and somewhere between these values when observer effort was equalized (Table 9). We feel that the estimate obtained using equalized observer effort is the most accurate, and that the estimates using the other two methods may be viewed as reasonable upper and lower bounds for this estimate. It is important to note that this analysis only attempts to account for habitat that is fished, and ignores habitat which may be too shallow to safely fish from vessels. Also noteworthy is the apparent lack of black rockfish habitat between Cape Perpetua and Coos Head. While this could be an artifact of a long coastline with few good ocean access points for vessels, reports from various operators of fishing vessels indicate this area is largely devoid of fishable rocky reef habitat.

Discussion

Selecting a model that adequately describes the data in the most parsimonious manner possible is an important step in the analysis of mark-recovery data. Since all models except model 0 were rejected by the Chi-square GOF tests, it may seem logical to conclude that model 0 is the proper model to use. However, model 0 is confounded with another model where both first year survival and first year recovery rates are independent of previously marked cohorts, in which case only the products of survival and recovery rates are estimable (Brownie et al. 1985a). This situation may arise from marking-induced mortality or from a failure of newly marked fish to thoroughly mix with previously marked fish.

Proper use of model 0 is limited to situations in which it can reasonably be assumed that first year recovery rates are different from recovery rates for previously marked cohorts, while survival rates are equal for all cohorts within a year. A priori information from support studies indicates marking-induced mortality is probably quite low (Table 1), and the widespread distribution of release sites for marked fish in all years should minimize non-mixing problems. On the other hand, it is plausible that the marking process affects the catchability of the fish for some period after marking, leading to lower recovery rates for newly marked fish. Based on this assumption, we selected model 0 as the best available model for the analysis of these data. In practice, the use of model 0 gives higher estimates of exploitation rates and lower estimates of survival rates, and is therefore conservative from a fishery management perspective.

Annual exploitation rates calculated using the results of model 0 are quite low considering the large annual black rockfish catch for the Newport recreational fishery ($\bar{x}$ =66,162 fish). However, the estimates are reasonably precise (CV<20%) and we feel it is unlikely that actual annual exploitation rates regularly exceed 6% for black rockfish populations off Newport. Annual survival rates as estimated by Model 0 are highly variable with wide confidence intervals. This could be a reflection of a true difference in cohort survival due to between-cohort differences in the spatial or size distribution of marked fish. Brownie et al. (1985a) suggest that a study duration of five years is minimal to generate reasonable estimates of survival and recovery rates. We expect both model fit and the precision of parameter estimates to improve as the duration of the study is extended and field methods are fine-tuned based on experience and the ongoing analysis of data. Development of a customized model including factors such as emigration and immigration, length-based fishery selectivity, or non-mixing may be desirable but is not currently funded.

Acknowledgements
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Table 1. Evaluation of model assumptions

Model Assumption	Evaluation method	Results
The marked population is representative of the population under study	1. Compare marked fish length distributions to fishery length distributions 2. Acoustic telemetry study to assess spatial mixing of marked and unmarked fish (Parker et al. 2007)	1. Smaller fish may have been disproportionately marked in 2003, 2004, and 2006 2. Small home range (55 ha), 43% re-located to nearby reefs or moved outside telemetry study area. Indicates moderate levels of mixing.
There is no tag loss	Tag retention study (Parker and Rankin, 2003)	100% retention for 49 weeks
Survival rates are not affected by the marking itself	1. Tag retention study 2. Barotrauma induced mortality study (Parker et al. 2006) 3. Visual observations of black rockfish released at depth after hook and line capture (Hannah and Matteson, 2007) 4. Comparison of recovery rates by severity of barotrauma signs	1. No mortality from tag injection 2. 3.3% mortality for simulated capture and release from 30.5 meters water depth 3. Black rockfish showed little behavioral impairment when released at depth 4. Fish with severe barotrauma signs are recovered at higher rates than fish with little or no barotruama

Table 2. Predefined Brownie models assessed for goodness of fit using program ESTIMATE. *S*=survival rate, *f*=recovery rate, *f'*=1st year recovery rate. (t) indicates time dependent variable, (.) indicates constant.

Model	Description	Parameterization
Model 0	Time dependent survival and recovery rates, 1st year recovery rate independent of recovery rate for previously marked cohorts	*S*(t), *f*(t), *f'*(t)
Model 1	Time dependent survival and recovery rates	*S*(t), *f*(t)
Model 2	Constant survival rate, time dependent recovery rate	*S*(.), *f*(t)
Model 3	Constant survival and recovery rate	*S*(.), *f*(.)

Table 3. The number of marked and recovered black rockfish by release year and recovery period for fish ≥ 32 cm at the time of marking, representing final model inputs.

		Recovery Period				
Release year	Number marked	1	2	3	4	5
2002	2312	51	51	41	27	16
2003	2461		41	51	54	52
2004	2527			59	73	60
2005	2622				55	58
2006	2574					89

Table 4. Percent of total landings of black rockfish (from RecFin) checked for marks by recovery period and port

	Recovery period				
Port	1	2	3	4	5
Newport	81%	69%	75%	84%	87%
Depoe Bay	38%	32%	24%	35%	40%

Table 5. Area of release and reported area of recovery of marked fish

Reported recovery area	Release area			
	1	2	3	4
1	17	4	5	
2	1	56	46	3
3	4	18	159	47
4	1	2	19	89
Depoe Bay			2	
Unknown	5	78	298	124

Table 6. Results of Goodness of Fit tests generated by ESTIMATE

Null Hypothesis	p-value	Result
Data fit Model 0 (time dependent S and f, first-year recoveries independent)	0.0509	Accept H_0: Model 0 adequately fits data
Data fit Model 1 (time dependent S and f)	0.0012	Reject H_0: Model 1 does not adequately fit data
Data fit Model 2 (constant S, time dependent f)	0.0002	Reject H_0: Model 2 does not adequately fit data
Data fit Model 3 (constant S and f)	<0.0001	Reject H_0: Model 3 does not adequately fit data

Table 7. Parameter estimates (%), standard errors (SE), and 95% confidence intervals (CI) for model 0.

	Recovery period				
	1	2	3	4	5
Recovery rate f_i	-------------	3.83	3.23	2.64	-------------
SE f_i	-------------	0.74	0.51	0.47	-------------
Lower 95% CI f_i	-------------	2.38	2.23	1.73	-------------
Upper 95% CI f_i	-------------	5.28	4.22	3.55	-------------
First year recovery rate f'_i	2.21	1.67	2.34	2.10	3.46
SE f'_i	0.31	0.26	0.30	0.28	0.36
Lower 95% CI f'_i	1.61	1.60	1.75	1.55	2.75
Upper 95% CI f'_i	2.81	2.17	2.92	2.65	4.16
Survival rate S_i	56.6	74.4	106.2	-------------	-------------
SE S_i	7.5	9.3	17.9	-------------	-------------
Lower 95% CI S_i	42.0	56.2	71.2	-------------	-------------
Upper 95% CI S_i	71.3	92.7	141.2	-------------	-------------

Table 8. Estimates of annual exploitation rate and abundance with corresponding coefficients of variation (CVs).

	Recovery period				
	1	2	3	4	5
Exploitation rate (*u*)	------------	0.0553	0.0428	0.0313	------------
CV(*u*)	------------	0.1938	0.1572	0.1765	------------
Abundance (N)	------------	1,305,793	1,375,807	2,130,612	------------
CV(N)	------------	0.1938	0.1572	0.1765	------------

Table 9. Proportion of black rockfish habitat occurring inside PIT tag study area

Analysis	Proportion of Area 2C habitat occurring inside PIT tag study area	Proportion of Falcon to OR/CA border habitat occurring inside PIT tag study area
Using all available observer data	42%	21%
Random re-sampling of 119 locations per port sub-area	34%	16%
Linear kilometers of coastline	24%	9%

Figure 1. Tagging area boundaries and release locations of individual tagged fish, 2002-2006

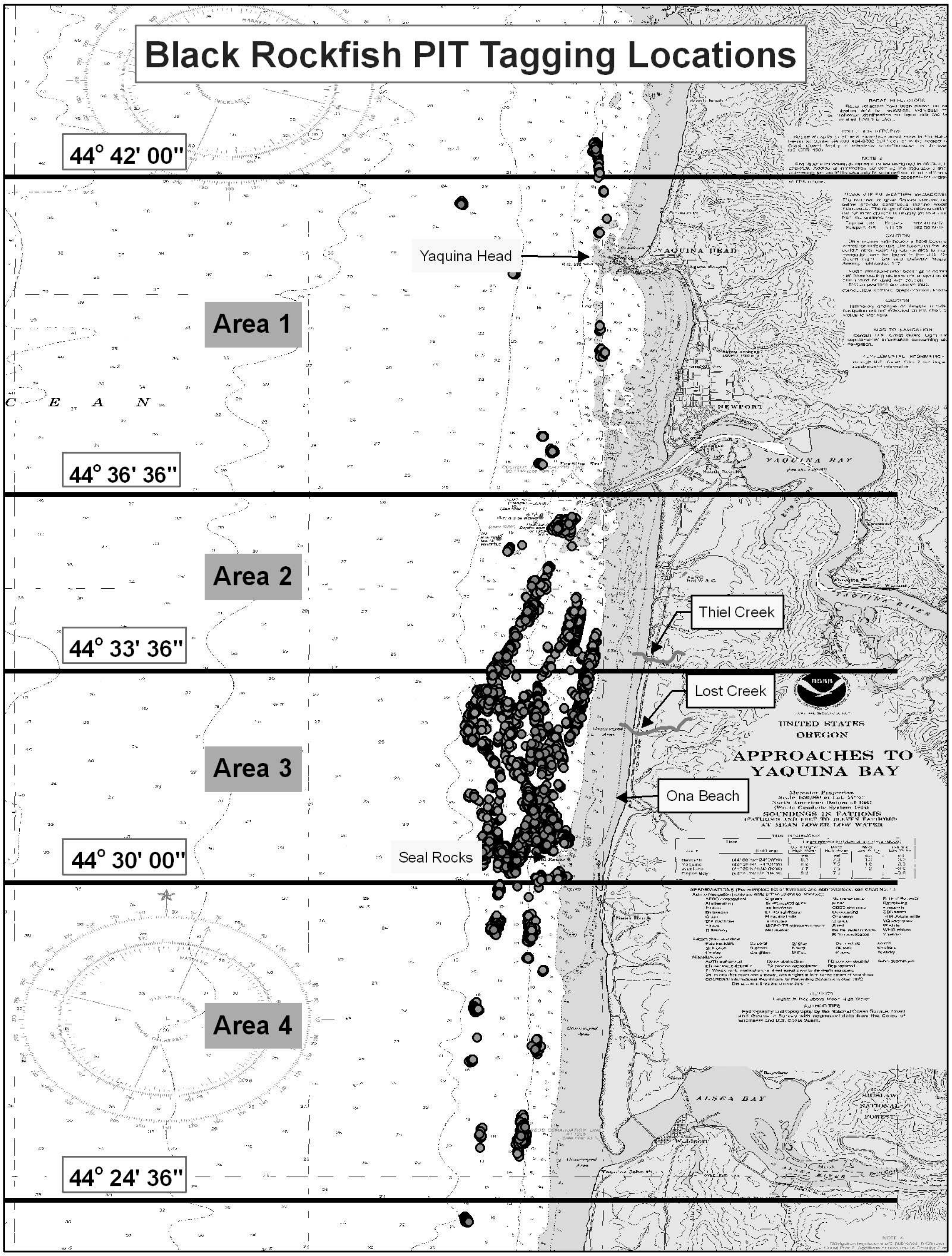


Figure 2. Length distribution of size-based black rockfish discards (excludes limit driven discards) from 54 observed Newport charter boat trips, 2003-2005

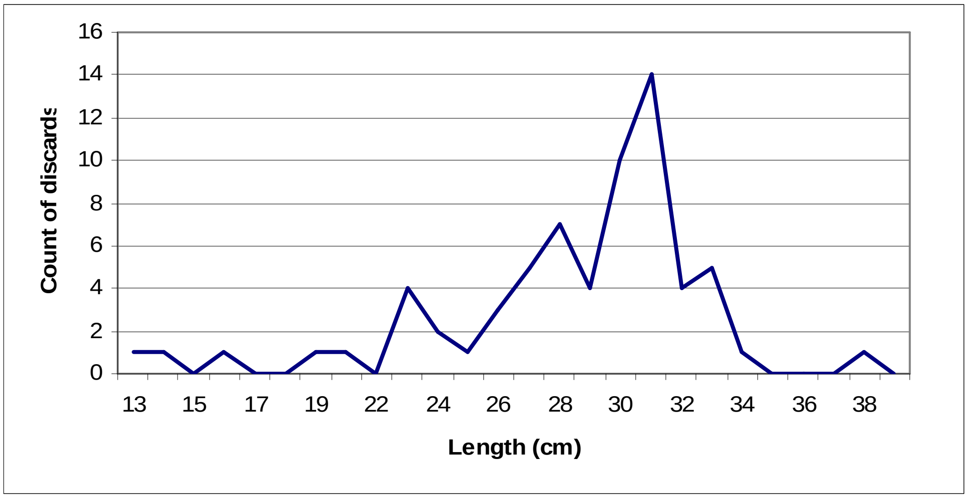


Figure 3. Port sub-areas used in random re-sampling and the number of black rockfish locations recorded in each.

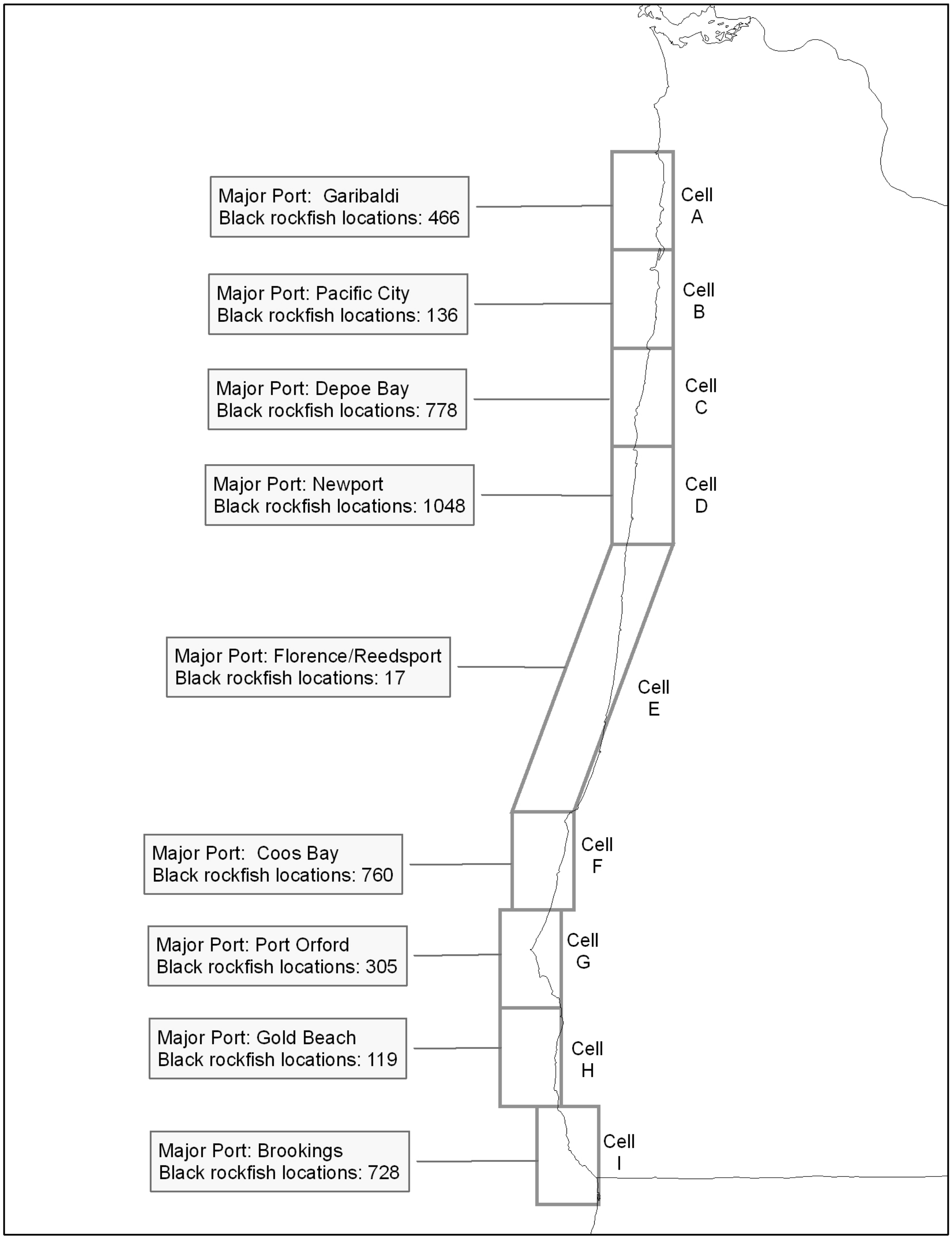


Figure 4. Comparison of the length distributions of marked fish and length distributions of fish sampled from fishery landings at Newport in each year

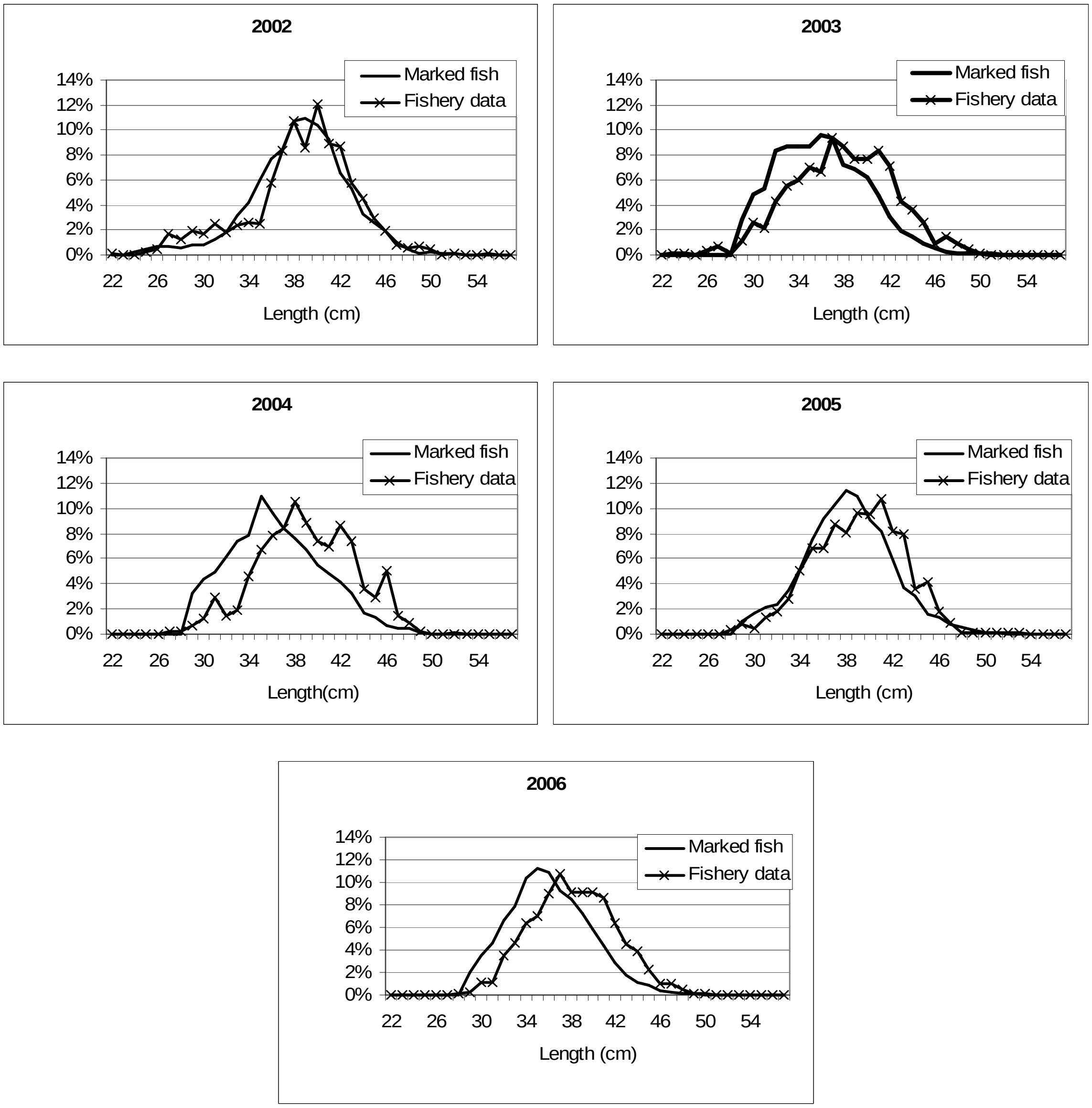


Figure 5. Recovery rate anomalies (difference from mean recovery rate) by year for 6 commonly observed classes of barotruama. 0000=no signs of barotrauma; 1000= body tight from expanded gas; 1010=body tight, branchiostegal membrane bulging or with visible gas bubbles (membrane signs); 1100=body tight, esophagus everted; 1110=body tight, membrane signs, esophagus everted; 1111=body tight, membrane signs, esophagus everted, eyes exopthalmic or with visible gas bubbles. Kruskal-Wallis test showed significant difference between barotruama categories (p=0.02).

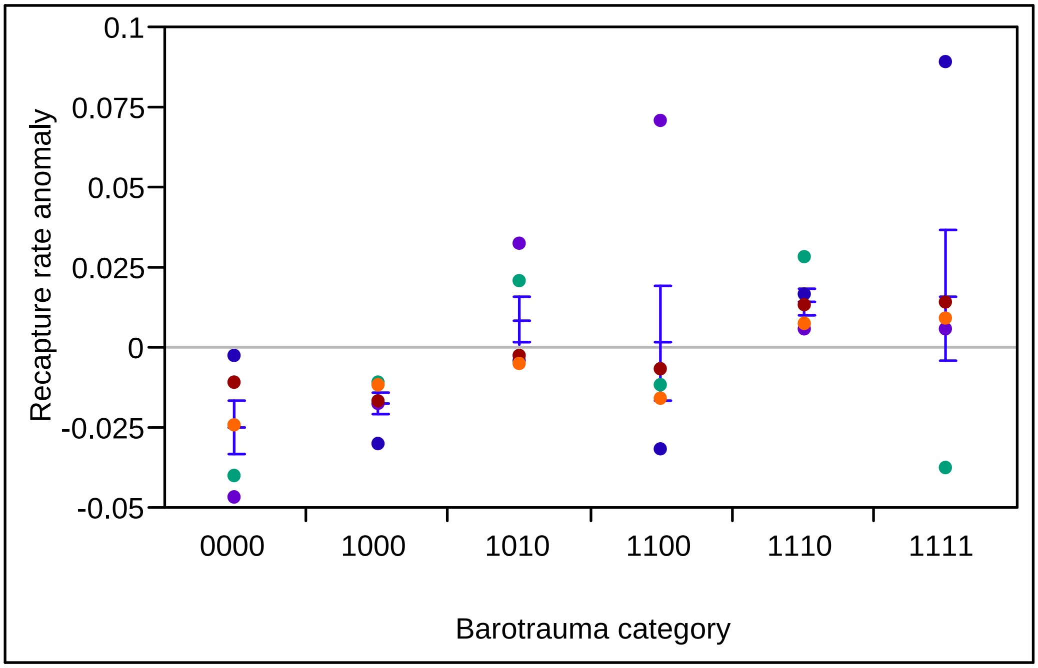
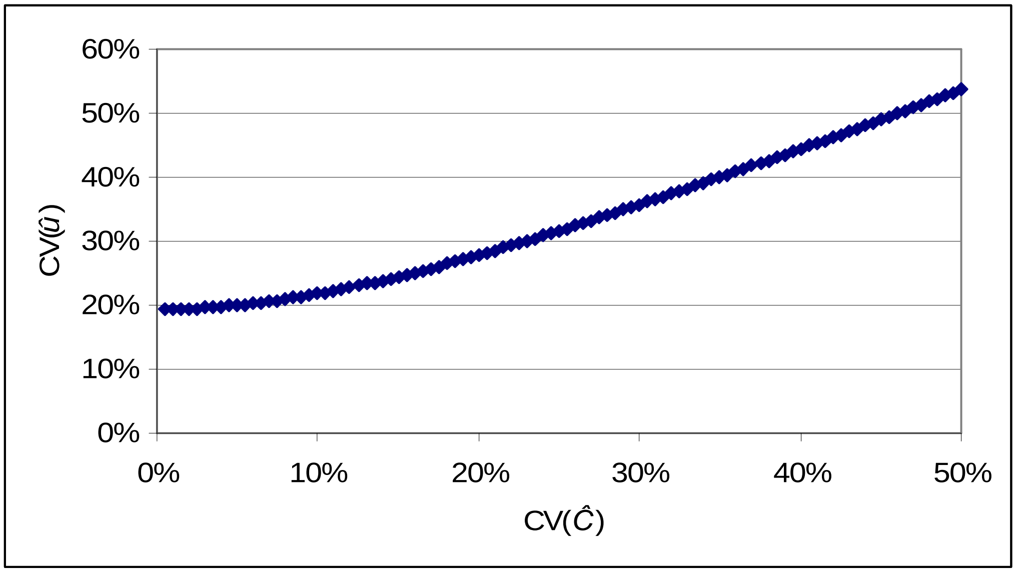


Figure 6. Effect of increasing CV of catch estimate ($\hat{C}$) on CV of exploitation rate estimate ($\hat{u}$) for recovery period 2.



Appendix B. Stock Synthesis control file.

```
## Black_Rockfish_Assessment_for_Oregon_&_California,_1-area_model
## SS2_Version_2.00        Final_Base-run_Model
1  #_Morphs
1  #_Sub-Morphs
1  #_Areas
#_Type_1 2  3  4  5  6  7  8  9  10 11 12 13 14 15 16
#_OHKL   OTWL  OREC  CHKL  CTWL  CREC  OCE1a OCE1c OCE2a OCE2c OCE2d TAGS
   CCE1a CCE1b CCE2  JUV
1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1
#_Recruitment_Distribution_Pattern
1
0  #_Allow_Seasonal_Recruitment_Interaction
0  #_Allow_Migration
#_movement_among_the_areas,0=no_movement
0  1  1  #_area_1_to_1

1  #_N_block_patterns
2  #_N_Blocks_for_each_Design
1915  1999  2000  2006  #_Bag-limit_changes_in_2000

0.5   #_Recruit_Fraction_Female
1  #_Sub-Morph_Ratio_Between/Within
#_Sub-Morph_Distribution
1
#_Natural_Mortality_&_Maturity
10 #_natM_amin
15 #_natM_amax
1  #_Growth_Age_for_L1
20 #_Growth_Age_for_L2
0  #_SD_add_to_LAA
0  #_CV_Growth_Pattern:_0=CV=f(L@A)
1  #_maturity_option:_1=f(Length)
4  #_First_Mature_Age
3  #_parameter_offset_approach:_3_=_expo_offset_from_values@Amin
2  #_env/block/dev_adjust_method       2=use_logistic_to_maintain_base_bounds
-4 #_MGparm_Dev_Phase

#_Maturity_&_Growth_Parameters
#_LO  HI INIT  PRIOR PR_type  SD_Prior PHASE env-var  use_dev  dev_minyr
   dev_maxyr   STD_4_Dev_Vec  Block Block_Fxn
#_Female_length-at-age
0.05  0.18  0.16  0.16  -1 0.8   -9 0  0  0  0  0.5   0  0  #_M1_natM_young
-3 3  0.40547  0.539 -1 0.8   -3 0  0  0  0  0.5   0  0  #_M1_natM_old
10 35 15.000   22.6722  -1 10 4  0  0  0  0  0.5   0  0
   #_M1_Lmin_Body_length_at_Amin
40 55 49.5345  49.5345  -1 10 4  0  0  0  0  0.5   0  0
   #_M1_Lmax_Body_length_at_Amax
0.05  0.3   0.197714 0.197714 -1 0.8   4  0  0  0  0  0.5   0  0  #_M1_VBK
0.05  0.25  0.07  0.11  -1 0.8   -3 0  0  0  0  0.5   0  0  #_M1_CV-young
-3 3  0  -0.451985   -1 0.8   -3 0  0  0  0  0.5   0  0  #_M1_CV-
old_as_expo_offset_rel_yng_female
#_Male_growth
-3 3  0  0  -1 0.8   -3 0  0  0  0  0.5   0  0
   #_M1_natM_young_as_expo_offset_rel_fem
-3 3  0  0  -1 0.8   -3 0  0  0  0  0.5   0  0
   #_M1_natM_old_as_expo_offset_rel_yng_male
-3 3  0  0  -1 0.8   -3 0  0  0  0  0.5   0  0  #_M1_Lmin_Body_length_at_Amin
```

```
-3 3  -0.0936  -0.0936  -1 0.8   4  0  0  0  0  0.5   0  0
   #_M1_Lmax_Body_length_at_Amax
-3 3  0.11122  0.11122  -1 0.8   4  0  0  0  0  0.5   0  0
   #_M1_VBK_as_expo_offset_rel_fem
-3 3  0  0  -1 0.8   -3 0  0  0  0  0.5   0  0  #_M1_CV-
young_as_expo_offset_rel_fem
-3 3  0  -0.788457   -1 0.8   -3 0  0  0  0  0.5   0  0  #_M1_CV-
old_as_expo_offset_rel_yng_male
#_Female_weight-length,_maturity,_and_fecundity
-3 3  1.68E-05 1.68E-05 -1 0.8   -3 0  0  0  0  0.5   0  0  #_Female_wt-
len_alpha
-3 3  3  3  -1 0.8   -3 0  0  0  0  0.5   0  0  #_Female_wt-len_exponent
-3 3  39.53 39.53 -1 0.8   -3 0  0  0  0  0.5   0  0
   #_Female_maturity_logistic_inflection
-3 3  -0.4103  -0.4103  -1 0.8   -3 0  0  0  0  0.5   0  0
   #_Female_maturity_logistic_slope
-3 3  0.28941  1  -1 0.8   -3 0  0  0  0  0.5   0  0
   #_Female_eggs/gm_intercept
-3 3  0.10311  0  -1 0.8   -3 0  0  0  0  0.5   0  0  #_Female_eggs/gm_slope
#_Male_weight-length
-3 3  1.68E-05 1.68E-05 -1 0.8   -3 0  0  0  0  0.5   0  0  #_Male_wt-
len_alpha
-3 3  3  3  -1 0.8   -3 0  0  0  0  0.5   0  0  #_Male_wt-len_exponent

0  0  0  0  -1 0  -4 0  0  0  0  0  0  0
   #_recr_distribution_by_growth_pattern
0  0  0  0  -1 0  -4 0  0  0  0  0  0  0
   #_recr_distribution_dummy_parm_for_one_area
0  0  0  0  -1 0  -4 0  0  0  0  0  0  0
   #_recr_distribution_dummy_parm_for_one_season
0  0  0  0  -1 0  -4 0  0  0  0  0  0  0  #_cohort_growth_deviation

0  #_Environmental_Custom_Flag
0  #_TimeBlock_Custom_Flag

3  #_Recruitment_Function:_3_=_Std_B&H
#_Recruitment_Parms
#_LO  HI INIT  PRIOR PR_type  SD PHASE
6  12 9  9  -1 10 1  #_log(R0)
0.2   1  0.6   0.6   -1 0.2   -9 #_steepness
0  2  0.5   0.8   -1 0.8   -3 #_sigma-r
-5 5  0.1   0  -1 1  -3 #_env-link_recruitment
-5 5  0  0  -1 1  -4 #_log(R1)_offset_for_initial_equil_recr
0  0  0  0  -1 0  -99   #_reserved_for_future_autocorr_parm

1  #_SR_env_link
1  #_SR_env_target
1  #_do_Rec_dev
1970  #_begin_year
2006  #_end_year
-5 #_min_Dev
5  #_max_Dev
2  #_phase
0  #_first_yr_fullbias_adj_in_MPD

#_Initial_Fishing_Mortality_Parameters
0  1  0  0.01  -1 99 -1
0  1  0  0.01  -1 99 -1
0  1  0  0.01  -1 99 -1
0  1  0  0.01  -1 99 -1
```

```
0  1  0  0.01  -1 99 -1
0  1  0  0.01  -1 99 -1

#_Catchability_Specification        Q_type:_0=no_parm-med-
unbiased;_2=parm_for_ln(Q)
#_do_powr   do_env   do_xtra_sd  Q_type   0=N,1=B  err_type    Type
0  0  0  0  1  0  #_01  OHKL
0  0  0  0  1  0  #_02  OTWL
0  0  0  0  1  0  #_03  OREC
0  0  0  0  1  0  #_04  CHKL
0  0  0  0  1  0  #_05  CTWL
0  0  0  0  1  0  #_06  CREC
0  0  0  0  0  0  #_07  OCE1a
0  0  0  0  0  0  #_08  OCE1c
0  0  0  0  0  0  #_09  OCE2a
0  0  0  0  0  0  #_10  OCE2c
0  0  0  0  0  0  #_11  OCE2d
0  0  0  2  0  0  #_12  TAGS
0  0  0  0  0  0  #_13  CCE1a
0  0  0  0  0  0  #_14  CCE1b
0  0  0  0  0  0  #_15  CCE2
0  0  0  0  0  0  #_16  JUV

#_Catchability_Parameters
#_LO  HI INIT  PRIOR PR_type  SD PHASE       Segment
-3 -0.05 -1.374   -2.3434  0  0.2   1  #_11_TAGS

#_Selectivity_Specification
#_length_selection
24 0  0  0  #  OHKL  #_24=double_normal
1  0  0  0  #  OTWL  #_1=simple_logistic
24 0  0  0  #  OREC
24 0  0  0  #  CHKL
5  0  0  2  #  CTWL  #_mirror_OTWL
24 0  0  0  #  CREC
5  0  0  3  #  OCE1a #_mirror_OREC
5  0  0  3  #  OCE1c #_mirror_OREC
24 0  0  0  #  OCE2a
5  0  0  9  #  OCE2c #_mirror_OCE2a
5  0  0  9  #  OCE2d #_mirror_OCE2a
5  0  0  9  #  TAGS  #_mirror_OCE2a
5  0  0  6  #  CCE1a #_mirror_CREC
5  0  0  6  #  CCE1b #_mirror_CREC
24 0  0  0  #  CCE2
32 0  0  0  #  JUV   #_32=rec_before_dens_dep
#_age_selection
10 0  0  0  #  OHKL  #_10=Age_sel=1_for_all_but_0s
10 0  0  0  #  OTWL
10 0  0  0  #  OREC
10 0  0  0  #  CHKL
10 0  0  0  #  CTWL
10 0  0  0  #  CREC
10 0  0  0  #  OCE1a
10 0  0  0  #  OCE1c
10 0  0  0  #  OCE2a
10 0  0  0  #  OCE2c
10 0  0  0  #  OCE2d
10 0  0  0  #  TAGS
10 0  0  0  #  CCE1a
10 0  0  0  #  CCE1b
```

```
10 0  0  0  #  CCE2
10 0  0  0  #  JUV

#
#_LO  HI INIT  PRIOR PR_type  SD_Prior PHASE env-var  use_dev  dev_minyr
   dev_maxyr   STD_4_Dev_Vec  Block Block_Fxn
#_Selectivity_Parms
#_size_sel:_1     OHKL
11.11 58 40.268   39.1294  -1 0.05  3  0  0  0  0  0.5   0  0  #_Peak_(in_cm)
-6 4  -4.17109 -4.53129 -1 0.05  3  0  0  0  0  0.5   0  0
   #_top_(_logistic_between_Peak_and_MaxLen_)
-2 9  3.59611  3.41656  -1 0.05  3  0  0  0  0  0.5   0  0
   #_ln(_ascending_width_)
-2 9  3.48402  3.69353  -1 0.05  3  0  0  0  0  0.5   0  0
   #_ln(_decending_width_)
-6 9  -6 -6 -1 0.05  -9 0  0  0  0  0.5   0  0  #_Sel_at_1st_bin_(logistic)
-6 9  -1.94773 -1.45578 -1 0.05  4  0  0  0  0  0.5   0  0
   #_Sel_at_last_bin_(logistic)
#
#_size_sel:_2     OTWL
20 50 45.824   50 -1 0.05  3  0  0  0  0  0.5   0  0  #_Simple_logistic
0  15 8.22837  9.71724  -1 0.05  3  0  0  0  0  0.5   0  0
#
#_size_sel:_3     OREC
11.11 58 38.2881  37.7831  -1 0.05  3  0  0  0  0  0.5   0  0  #_Peak_(in_cm)
-6 4  -6 -6 -1 0.05  -9 0  0  0  0  0.5   0  0
   #_top_(_logistic_between_Peak_and_MaxLen_)
-2 9  3.7789   3.74197  -1 0.05  3  0  0  0  0  0.5   0  0
   #_ln(_ascending_width_)
-2 9  3.32151  2.96266  -1 0.05  3  0  0  0  0  0.5   0  0
   #_ln(_decending_width_)
-6 9  -6 -6 -1 0.05  -9 0  0  0  0  0.5   0  0  #_Sel_at_1st_bin_(logistic)
-6 9  -1.46583 -0.999446   -1 0.05  4  0  0  0  0  0.5   0  0
   #_Sel_at_last_bin_(logistic)
#
#_size_sel:_4     CHKL
11.11 58 38.2544  37.5029  -1 0.05  3  0  0  0  0  0.5   0  0  #_Peak_(in_cm)
-6 4  -6 -6 -1 0.05  -9 0  0  0  0  0.5   0  0
   #_top_(_logistic_between_Peak_and_MaxLen_)
-2 9  3.85971  3.76884  -1 0.05  4  0  0  0  0  0.5   0  0
   #_ln(_ascending_width_)
-2 9  4.17183  3.37891  -1 0.05  3  0  0  0  0  0.5   0  0
   #_ln(_decending_width_)
-6 9  -6 -6 -1 0.05  -9 0  0  0  0  0.5   0  0  #_Sel_at_1st_bin_(logistic)
-6 9  -1.66545 -0.466063   -1 0.05  3  0  0  0  0  0.5   0  0
   #_Sel_at_last_bin_(logistic)
#
#_size_sel:_5     CTWL
20 60 -1 -1 -1 99 -9 0  0  0  0  0.5   0  0  #_mirror
0.01  30 -1 -1 -1 99 -9 0  0  0  0  0.5   0  0
#
#_size_sel:_6     CREC
11.11 58 32.0296  31.3018  -1 0.05  3  0  0  0  0  0.5   0  0  #_Peak_(in_cm)
-6 4  -5.99941 -6 -1 0.05  -9 0  0  0  0  0.5   0  0
   #_top_(_logistic_between_Peak_and_MaxLen_)
-2 9  3.35799  3.18476  -1 0.05  3  0  0  0  0  0.5   0  0
   #_ln(_ascending_width_)
-2 9  0.239708 1.83867  -1 0.05  3  0  0  0  0  0.5   0  0
   #_ln(_decending_width_)
```

```
-6 9  -4.85633 -4.91165 -1 0.05  3  0  0  0  0  0.5   0  0
   #_Sel_at_1st_bin_(logistic)
-6 9  0.499791 -0.0259862  -1 0.05  3  0  0  0  0  0.5   0  0
   #_Sel_at_last_bin_(logistic)
#
#_size_sel:_7     OCE1a
20 60 -1 -1 -1 99 -9 0  0  0  0  0.5   0  0  #_mirror
0.01  30 -1 -1 -1 99 -9 0  0  0  0  0.5   0  0
#
#_size_sel:_8     OCE1c
20 60 -1 -1 -1 99 -9 0  0  0  0  0.5   0  0  #_mirror
0.01  30 -1 -1 -1 99 -9 0  0  0  0  0.5   0  0
#
#_size_sel:_9     OCE2a
11.11 58 39.8003  39.2744  -1 0.05  3  0  0  0  0  0.5   0  0  #_Peak_(in_cm)
-6 4  -6 -6 -1 0.05  -9 0  0  0  0  0.5   0  0
   #_top_(_logistic_between_Peak_and_MaxLen_)
-2 9  3.71955  3.72437  -1 0.05  3  0  0  0  0  0.5   0  0
   #_ln(_ascending_width_)
-2 9  2.95891  2.26633  -1 0.05  3  0  0  0  0  0.5   0  0
   #_ln(_decending_width_)
-6 9  -6 -6 -1 0.05  -9 0  0  0  0  0.5   0  0  #_Sel_at_1st_bin_(logistic)
-6 9  -0.654804   -0.20489 -1 0.05  4  0  0  0  0  0.5   0  0
   #_Sel_at_last_bin_(logistic)
#
#_size_sel:_10    OCE2c
20 60 -1 -1 -1 99 -9 0  0  0  0  0.5   0  0  #_mirror
0.01  30 -1 -1 -1 99 -9 0  0  0  0  0.5   0  0
#
#_size_sel:_11    OCE2d
20 60 -1 -1 -1 99 -9 0  0  0  0  0.5   0  0  #_mirror
0.01  30 -1 -1 -1 99 -9 0  0  0  0  0.5   0  0
#
#_size_sel:_12    TAGS
20 60 -1 -1 -1 99 -9 0  0  0  0  0.5   0  0  #_mirror
0.01  30 -1 -1 -1 99 -9 0  0  0  0  0.5   0  0
#
#_size_sel:_13    CCE1a
20 60 -1 -1 -1 99 -9 0  0  0  0  0.5   0  0  #_mirror
0.01  30 -1 -1 -1 99 -9 0  0  0  0  0.5   0  0
#
#_size_sel:_14    CCE1b
20 60 -1 -1 -1 99 -9 0  0  0  0  0.5   0  0  #_mirror
0.01  30 -1 -1 -1 99 -9 0  0  0  0  0.5   0  0
#
#_size_sel:_15    CCE2
11.11 58 30.3749  29.46 -1 0.05  3  0  0  0  0  0.5   0  0  #_Peak_(in_cm)
-6 4  -5.99999 -3.85288 -1 0.05  3  0  0  0  0  0.5   0  0
   #_top_(_logistic_between_Peak_and_MaxLen_)
-2 9  2.85207  2.6764   -1 0.05  3  0  0  0  0  0.5   0  0
   #_ln(_ascending_width_)
-2 9  2.45206  2.69477  -1 0.05  3  0  0  0  0  0.5   0  0
   #_ln(_decending_width_)
-6 9  -5.59217 -5.96791 -1 0.05  3  0  0  0  0  0.5   0  0
   #_Sel_at_1st_bin_(logistic)
-6 9  -0.997155   -1.75581 -1 0.05  3  0  0  0  0  0.5   0  0
   #_Sel_at_last_bin_(logistic)
#_end_Selection_parameters
   1
```

```
0  #_Environmental_Custom_Flag

0  #_TimeBlock_Custom_Flag

1
#_Variance_Adjustment_Factors
#_HKL TWL   REC   HKL   TWL   REC   CPUE_1   CPUE_1   CPUE_2   CPUE_2
   CPUE_2   TAGS  CPUE_1   CPUE_1   CPUE_2   JUV
0  0  0  0  0  0  0.1661   0.0000   0.1991   0.0598   0.0000   0.0473
   0.2461   0.1041   0.0900   0.3680   #_add_to_survey_CV
0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  #_add_to_discard_SD
0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  #_add_to_av_body_wt_SD
0.9098   5.5968   0.7116   1.6377   3.3032   0.3747   1.0000   1.0000
   0.7873   1.0000   1.0000   1.0000   1.0000   1.0000   0.9891   1.0000
   #_multiply_len_comp_input_N
1.5815   1.0000   1.0000   1.0000   1.0000   1.0000   1.0000   1.0000
   0.5280   1.0000   1.0000   1.0000   1.0000   1.0000   1.0000   1.0000
   #_multiply_age_comp_input_N
1  1  1  1  1  1  1  1  0.6998   1  1  1  1  1  1  1  #_multiply_len-at-
age_input_N

#_Degrees_of_Freedom_for_Discard_&_Mean_Body_Weight
30
30
#_Lambdas
1  #_Max_Lambda_Phase
1  #_SD_offset:_1=include_log(s)_terms_in_Like
#_CPUE_Lambdas:_1_for_each_Fishery/Survey
1  1  1  1  1  1  #_Fisheries
1  1  1  1  1  1  1  1  1  1  #_Surveys
#_Discard_Lambdas:_1_for_each_Fishery/Survey
1  1  1  1  1  1  #_Fisheries
1  1  1  1  1  1  1  1  1  1  #_Surveys
#_Mean_Body_Weight:_1_only
1
#_Length_Compositions:_1_for_each_Fishery/Survey
1  1  1  1  1  1  #_Fisheries
1  1  1  1  1  1  1  1  1  1  #_Surveys
#_Age_Compositions:_1_for_each_Fishery/Survey
1  1  1  1  1  1  #_Fisheries
1  1  1  1  1  1  1  1  1  1  #_Surveys
#_Mean_Size_at_Age:_1_for_each_Fishery/Survey
1  1  1  1  1  1  #_Fisheries
1  1  1  1  1  1  1  1  1  1  #_Surveys
#_Initial_Equilibrium
1
#_Recruitment_Deviations
1
#_Prior_Lambda
0
#_Deviation_Time_Series
1
#_Crash_Penalty
100
0.9   #_Max_Allowable_Harvest_Rate
999
```

Appendix C. Stock Synthesis data file.

```
## Black_Rockfish_Assessment_for_Oregon_&_California,_1-area_model
## SS2_Version_2.00        Final_Base-run_Model
1915  #_start_year
2006  #_end_year
1  #_seasons_per_year
12 #_vector_of_months_within_each_season
1  #_spawning_season
6  #_N_fishing_fleets
10 #_N_surveys
HKL%TWL%REC%HKL%TWL%REC%CPUE1%CPUE1%CPUE2%CPUE2%CPUE2%TAGS%CPUE1%CPUE1%CPUE2%
JUV
#_vector_of_fishery/survey_timing_for_catch_&_CPUE
0.5   0.5   0.5   0.5   0.5   0.5   0.5   0.5   0.5   0.5   0.5   0.5   0.5
   0.5   0.5   0.5
2  #_N_genders_FEM=1
40 #_accumulator_age
#_init_equilibrium_catch
0  0  0  0  0  0
#_ret_catch
#_OHKL   OTWL  OREC  CHKL  CTWL  CREC  #
0.00  0.00  0.00  0.00  0.00  0.00  #  1915  0.00
0.21  0.00  0.00  2.66  0.06  0.00  #  1916  2.93
0.43  0.00  0.00  5.32  0.12  0.00  #  1917  5.87
0.64  0.00  0.00  7.98  0.18  0.00  #  1918  8.80
0.85  0.00  0.00  10.64 0.25  0.00  #  1919  11.74
1.07  0.00  0.00  13.30 0.31  0.00  #  1920  14.67
1.28  0.00  0.00  15.96 0.37  0.00  #  1921  17.61
1.49  0.00  0.00  18.62 0.43  0.00  #  1922  20.54
1.70  0.00  0.00  21.28 0.49  0.00  #  1923  23.47
1.92  0.00  0.00  23.94 0.55  0.00  #  1924  26.41
2.13  0.00  0.00  26.60 0.61  0.00  #  1925  29.34
2.34  0.00  0.00  29.26 0.68  0.00  #  1926  32.28
2.56  0.00  0.00  31.92 0.74  0.00  #  1927  35.21
2.73  0.00  0.00  30.81 0.88  0.00  #  1928  34.42
7.79  0.00  0.00  54.34 0.93  0.00  #  1929  63.06
11.65 0.00  0.00  47.73 3.08  0.00  #  1930  62.46
8.13  0.00  0.00  36.15 11.18 0.00  #  1931  55.46
2.17  0.02  0.00  29.86 9.65  0.00  #  1932  41.70
4.34  0.01  0.00  16.43 14.60 0.00  #  1933  35.39
2.61  0.00  0.00  34.07 8.79  0.00  #  1934  45.47
1.65  0.01  0.00  41.85 9.79  0.00  #  1935  53.30
7.91  0.01  0.00  47.91 4.69  0.00  #  1936  60.51
5.66  0.00  0.00  37.67 10.35 0.00  #  1937  53.69
2.68  0.00  0.00  39.67 12.63 0.00  #  1938  54.98
3.80  0.03  0.00  46.73 17.36 0.00  #  1939  67.92
10.94 0.33  0.00  39.02 13.66 0.00  #  1940  63.95
18.57 0.90  0.00  30.68 10.90 0.00  #  1941  61.05
18.37 2.17  0.00  23.55 14.55 0.00  #  1942  58.65
66.13 9.11  0.00  45.97 36.46 0.00  #  1943  157.67
23.19 21.74 0.00  34.20 170.08   0.00  #  1944  249.21
18.91 36.43 0.00  36.43 366.97   0.00  #  1945  458.74
19.56 25.96 0.00  49.91 293.40   8.06  #  1946  396.89
10.82 8.00  0.00  47.53 194.84   16.12 #  1947  277.31
19.93 4.74  0.00  34.08 121.05   24.18 #  1948  203.98
16.33 9.89  0.00  29.21 100.10   32.25 #  1949  187.78
10.34 13.06 1.67  40.49 114.58   40.31 #  1950  220.45
8.06  10.33 3.34  46.42 140.67   48.37 #  1951  257.18
```

```
7.71  11.99 5.01  38.97 81.53 56.43 #  1952  201.65
2.98  5.82  6.68  27.34 98.49 64.49 #  1953  205.80
4.26  8.69  8.35  49.40 98.32 72.55 #  1954  241.57
5.26  16.56 10.02 43.06 90.77 80.61 #  1955  246.28
2.18  10.84 11.69 5.66  64.60 88.68 #  1956  183.65
4.57  9.28  13.36 10.66 76.09 96.74 #  1957  210.70
1.41  11.21 15.03 0.40  79.02 179.72   #  1958  286.79
3.67  24.21 16.70 12.08 69.61 146.25   #  1959  272.51
2.55  23.44 18.37 9.35  77.71 133.21   #  1960  264.63
5.59  18.96 20.04 7.09  43.41 95.90 #  1961  190.98
6.05  21.24 21.71 9.10  44.64 101.88   #  1962  204.62
4.97  30.95 23.38 14.96 71.62 112.21   #  1963  258.07
5.48  40.73 25.05 8.12  40.02 83.32 #  1964  202.72
18.58 40.69 26.72 11.83 56.72 131.18   #  1965  285.71
6.02  20.39 28.38 13.90 42.74 154.02   #  1966  265.45
16.26 9.41  30.05 13.93 40.07 186.97   #  1967  296.70
16.35 12.52 31.72 13.04 54.38 177.32   #  1968  305.34
40.84 31.20 33.39 35.41 65.88 192.78   #  1969  399.50
18.61 20.93 35.06 35.66 85.93 274.37   #  1970  470.56
0.66  23.70 36.73 3.63  111.27   193.72   #  1971  369.71
0.77  31.61 38.40 28.35 124.92   246.86   #  1972  470.91
0.12  25.71 40.07 8.16  94.63 311.66   #  1973  480.35
0.00  19.85 75.60 32.11 108.91   353.16   #  1974  589.63
0.48  20.35 37.64 12.27 74.52 334.32   #  1975  479.58
0.16  23.66 113.11   14.06 88.53 403.07   #  1976  642.59
62.87 24.67 113.36   10.55 64.41 361.89   #  1977  637.75
55.18 47.85 148.40   11.06 69.14 327.39   #  1978  659.02
89.72 100.86   289.04   19.99 126.15   341.28   #  1979  967.05
46.63 138.47   235.99   27.88 179.51   270.19   #  1980  898.68
80.55 0.00  362.93   22.35 457.61   421.50   #  1981  1344.95
123.09   159.73   386.57   118.48   232.94   434.51   #  1982  1455.32
216.60   95.70 373.81   299.82   120.08   197.48   #  1983  1303.49
126.77   2.27  486.83   193.41   37.80 359.79   #  1984  1206.87
139.33   0.29  194.11   320.38   81.41 399.25   #  1985  1134.78
214.93   0.00  193.84   21.55 0.75  336.35   #  1986  767.41
92.46 0.45  202.53   21.42 67.26 207.32   #  1987  591.43
105.63   0.00  217.56   25.93 57.95 209.69   #  1988  616.77
137.20   0.00  308.64   106.60   26.63 219.76   #  1989  798.83
192.41   0.27  312.32   145.81   0.33  230.96   #  1990  882.10
413.24   0.04  156.33   124.96   21.90 245.99   #  1991  962.46
431.83   0.00  308.75   217.49   50.24 261.02   #  1992  1269.32
126.77   0.18  341.90   146.52   2.29  251.23   #  1993  868.89
149.88   35.88 280.81   147.93   0.32  228.06   #  1994  842.88
128.84   2.02  350.83   186.82   2.28  176.47   #  1995  847.25
191.24   0.22  376.80   128.69   10.39 143.18   #  1996  850.53
217.81   1.72  343.56   144.12   12.19 94.88 #  1997  814.28
206.44   0.40  339.64   93.99 5.50  108.73   #  1998  754.70
196.59   0.03  282.48   65.63 3.79  154.66   #  1999  703.16
159.83   0.02  308.17   55.06 1.32  131.02   #  2000  655.41
192.49   0.01  329.32   112.41   1.30  240.44   #  2001  875.96
163.54   0.03  270.16   100.63   2.03  152.73   #  2002  689.12
150.68   0.00  341.24   68.07 0.51  500.38   #  2003  1060.89
160.68   0.16  330.82   76.32 1.23  117.29   #  2004  686.51
138.93   0.17  309.60   85.73 0.00  183.28   #  2005  717.71
112.21   0.01  259.81   71.68 0.00  183.52   #  2006  627.23
#_end_catch                      37966.9

89 #_Surveys
#_OR_RecFIN_CPUE
1980  1  7  3.883 0.1066   #  0.4370
```

```
1981  1  7  6.421 0.0896   #  0.6020
1982  1  7  5.645 0.0927   #  0.5481
1983  1  7  3.097 0.1029   #  0.3356
1984  1  7  3.464 0.0743   #  0.2671
1985  1  7  4.069 0.0633   #  0.2658
1986  1  7  4.452 0.0548   #  0.2510
1987  1  7  2.797 0.0924   #  0.2707
1988  1  7  2.936 0.0738   #  0.2247
1989  1  7  5.070 0.0581   #  0.3032
1993  1  7  4.150 0.0492   #  0.2091
1994  1  7  3.886 0.0436   #  0.1731
1995  1  7  4.617 0.0445   #  0.2101
1996  1  7  4.482 0.0487   #  0.2239
1997  1  7  4.764 0.0303   #  0.1467
1998  1  7  5.145 0.0356   #  0.1866
1999  1  7  4.377 0.0369   #  0.1646
#_OR_RecFIN_CPUE
2000  1  8  4.609 0.0422   #  0.1984
2001  1  8  4.536 0.0420   #  0.1948
2002  1  8  4.774 0.0430   #  0.2096
2003  1  8  -5.036   0.0737   #  0.3850
2004  1  8  -4.803   0.0236   #  0.1145
#_ORBS_CPUE
1979  1  9  3.452 0.0669   #  0.2389
1980  1  9  3.651 0.0667   #  0.2520
1981  1  9  5.233 0.0690   #  0.3737
1982  1  9  4.909 0.0678   #  0.3442
1983  1  9  4.894 0.0712   #  0.3612
1984  1  9  5.015 0.0714   #  0.3714
1986  1  9  4.378 0.0698   #  0.3166
1987  1  9  3.446 0.0676   #  0.2410
1988  1  9  4.374 0.0684   #  0.3097
1989  1  9  4.665 0.0687   #  0.3316
1990  1  9  4.157 0.0673   #  0.2895
1991  1  9  2.856 0.0655   #  0.1934
1992  1  9  3.987 0.0667   #  0.2749
1993  1  9  4.456 0.0680   #  0.3136
1994  1  9  3.042 0.0639   #  0.2006
1995  1  9  4.252 0.0674   #  0.2966
1996  1  9  4.714 0.0688   #  0.3358
1998  1  9  3.886 0.0638   #  0.2562
1999  1  9  3.664 0.0637   #  0.2409
#_ORBS_CPUE
2000  1  10 4.270 0.0651   #  0.2872
2001  1  10 4.160 0.0659   #  0.2834
2002  1  10 4.076 0.0649   #  0.2735
2003  1  10 4.971 0.0677   #  0.3481
2004  1  10 5.256 0.0686   #  0.3733
#_ORBS_CPUE
2005  1  11 4.074 0.0649   #  0.2733
2006  1  11 3.730 0.0639   #  0.2461
#_TAGS_off_Newport_1000s_fish
#  2003  1  12 2311.7   0.1349   #  0.1444
#  2004  1  12 2048.1   0.1098   #  0.1161
#  2005  1  12 1568.3   0.1032   #  0.1087
#  2006  1  12 2230.4   0.1337   #  0.1430
2004  1  12 1305.8   0.1770   #  0.1936
2005  1  12 1375.8   0.1460   #  0.1572
2006  1  12 2130.6   0.1625   #  0.1765
#_CA_RecFIN_CPUE
```

```
1980  1  13 3.051 0.4396   #  1.6844
1981  1  13 2.509 0.4392   #  1.3834
1982  1  13 3.794 0.4348   #  2.0662
1984  1  13 11.093   0.3272   #  4.2940
1985  1  13 6.607 0.1557   #  1.1133
1986  1  13 4.198 0.2177   #  1.0212
1987  1  13 7.692 0.3025   #  2.7173
1988  1  13 5.129 0.1907   #  1.0774
1989  1  13 3.296 0.5212   #  2.2544
1995  1  13 4.349 0.1793   #  0.8543
1996  1  13 4.400 0.1072   #  0.4979
1997  1  13 6.700 0.1537   #  1.1131
1998  1  13 2.707 0.1861   #  0.5538
1999  1  13 6.446 0.1197   #  0.8197
#_RecFIN_CPUE
2000  1  14 7.446 0.1279   #  1.0158
2001  1  14 5.982 0.0969   #  0.6088
2002  1  14 6.158 0.0890   #  0.5732
2003  1  14 4.369 0.0806   #  0.3669
2004  1  14 5.278 0.0820   #  0.4508
2005  1  14 4.985 0.0913   #  0.4764
2006  1  14 4.202 0.0740   #  0.3227
#_CA_CPFV      from_2003_assessment
1988  1  15 5.850 0.2851   #  0.3299
1989  1  15 7.760 0.3498   #  0.4188
1990  1  15 19.850   0.4964   #  0.6428
1991  1  15 8.960 0.6734   #  0.9609
1992  1  15 15.030   0.3515   #  0.4212
1993  1  15 5.970 0.3162   #  0.3719
1994  1  15 16.740   0.2719   #  0.3124
1995  1  15 13.400   0.2415   #  0.2731
1996  1  15 13.970   0.2270   #  0.2548
1997  1  15 15.400   0.2226   #  0.2494
1998  1  15 8.130 0.2747   #  0.3161
#_SWFSC_juv_rockfish_survey_ANOVA_index
2001  1  16 0.4244   0.3487   #  0.0355
2002  1  16 0.6357   0.2734   #  0.0277
2003  1  16 0.8027   0.2633   #  0.0267
2004  1  16 2.3344   0.3059   #  0.0311
2005  1  16 0.6350   0.2765   #  0.0280
2006  1  16 0.3785   0.2480   #  0.0251
#_end_Surveys

2  #_Discards_Type
0  #_Discards
68 #_Mean_Body_Wt
#_Year   Season   Type  Partition   Wgt
#_OR_HKL_av_wt
1986  1  1  2  1.0787   0.0974
1991  1  1  2  1.3082   0.0974
1992  1  1  2  1.1834   0.0974
1993  1  1  2  1.1104   0.0974
1994  1  1  2  1.1925   0.0974
1995  1  1  2  1.0991   0.0974
1996  1  1  2  1.1331   0.0974
1997  1  1  2  0.9203   0.0974
1998  1  1  2  0.9721   0.0974
1999  1  1  2  0.8804   0.0974
2000  1  1  2  0.9471   0.0974
2001  1  1  2  1.0464   0.0974
```

```
2002  1  1  2  1.1508   0.0974
2003  1  1  2  1.1000   0.0974
2004  1  1  2  1.1004   0.0974
2005  1  1  2  0.9879   0.0974
2006  1  1  2  1.0133   0.0974
#_OR_TWL_av_wt
1980  1  2  2  1.4356   0.354
1981  1  2  2  1.4651   0.354
1982  1  2  2  1.6860   0.354
1983  1  2  2  1.3445   0.354
1984  1  2  2  1.3535   0.354
1985  1  2  2  1.0818   0.354
1993  1  2  2  1.5694   0.354
1994  1  2  2  1.1403   0.354
1997  1  2  2  1.4175   0.354
2004  1  2  2  1.8235   0.354
2005  1  2  2  1.3041   0.354
#_CA_HKL_av_wt
1982  1  4  2  1.336 0.135
1983  1  4  2  1.284 0.135
1984  1  4  2  1.448 0.135
1985  1  4  2  1.302 0.135
1992  1  4  2  1.050 0.135
1993  1  4  2  1.049 0.135
1994  1  4  2  1.032 0.135
1995  1  4  2  0.971 0.135
1996  1  4  2  0.969 0.135
1997  1  4  2  0.940 0.135
1998  1  4  2  1.006 0.135
1999  1  4  2  1.007 0.135
2000  1  4  2  0.952 0.135
2001  1  4  2  1.076 0.135
2002  1  4  2  1.153 0.135
2003  1  4  2  1.121 0.135
2004  1  4  2  0.990 0.135
2005  1  4  2  0.893 0.135
2006  1  4  2  0.996 0.135
#_CA_TWL_av_wt
1978  1  5  2  1.450 0.2195
1980  1  5  2  1.370 0.2195
1981  1  5  2  1.515 0.2195
1982  1  5  2  1.549 0.2195
1983  1  5  2  1.356 0.2195
1984  1  5  2  1.421 0.2195
1985  1  5  2  1.642 0.2195
1986  1  5  2  1.588 0.2195
1987  1  5  2  1.674 0.2195
1988  1  5  2  1.587 0.2195
1989  1  5  2  1.803 0.2195
# 1990   1  5  2  0.635 0.2195
1991  1  5  2  1.437 0.2195
1992  1  5  2  1.417 0.2195
1996  1  5  2  1.851 0.2195
1997  1  5  2  1.588 0.2195
1998  1  5  2  1.663 0.2195
1999  1  5  2  1.851 0.2195
2000  1  5  2  1.778 0.2195
2001  1  5  2  1.554 0.2195
2003  1  5  2  1.910 0.2195
2004  1  5  2  1.814 0.2195
```

```
#_end_Mean_Body_Wt

#_Composition_Conditioners
0.0001
0.0001
22 #_Number_of_Length_Bins
5  15 22 24 26 28 30 32 34 36 38 40 42 44 46 48 50 52 54 56 58 60

150   #_Length_Composition_Observations
#_OR_Commercial_HKL
1992  1  1  3  0  38.8  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000
   0.00334  0.02228  0.02359  0.02253  0.06833  0.05617  0.07311  0.05288
   0.03013  0.01961  0.03759  0.00077  0.00000  0.00000  0.00000  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.01988  0.00077
   0.00560  0.02679  0.07662  0.09186  0.12153  0.12521  0.05670  0.04950
   0.00325  0.01198  0.00000  0.00000  0.00000  0.00000  #  1.00002
1995  1  1  3  0  69.8  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000
   0.01723  0.02793  0.06793  0.04817  0.07203  0.08057  0.03881  0.06982
   0.05390  0.01601  0.01803  0.00280  0.00000  0.00000  0.00000  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00388  0.01075  0.02394
   0.04740  0.04103  0.08497  0.08163  0.10885  0.06304  0.01317  0.00659
   0.00148  0.00000  0.00000  0.00000  0.00000  0.00000  #  0.99996
1996  1  1  3  0  37.5  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000
   0.00000  0.00423  0.03378  0.04736  0.08518  0.04782  0.04676  0.04734
   0.01122  0.01961  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00423  0.02017
   0.03312  0.07103  0.09712  0.18612  0.15198  0.07696  0.01594  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  #  0.99998
1997  1  1  3  0  42.9  0.00000  0.00000  0.00000  0.00115  0.00000  0.00305
   0.00649  0.02336  0.02460  0.06610  0.07574  0.04200  0.04816  0.05602
   0.01488  0.00450  0.00446  0.00000  0.00000  0.00000  0.00000  0.00000
   0.00000  0.00000  0.00000  0.00229  0.00344  0.00909  0.01723  0.03502
   0.07289  0.03727  0.10316  0.13952  0.12484  0.06143  0.02091  0.00115
   0.00115  0.00000  0.00000  0.00000  0.00000  0.00000  #  0.99991
1998  1  1  3  0  50.4  0.00000  0.00000  0.00000  0.00000  0.00000  0.00385
   0.00385  0.01803  0.03283  0.04022  0.05179  0.05740  0.03238  0.02914
   0.02096  0.00055  0.00448  0.00000  0.00963  0.00000  0.00000  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00385  0.00998  0.02146  0.04767
   0.06927  0.11665  0.11110  0.15866  0.10053  0.04938  0.00240  0.00390
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  #  0.99998
1999  1  1  3  0  28.0  0.00000  0.00000  0.00000  0.01406  0.00000  0.00000
   0.02531  0.06681  0.06538  0.07475  0.02799  0.05929  0.04670  0.00371
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00000  0.01406  0.01640  0.06063
   0.07417  0.13602  0.09185  0.12671  0.04001  0.01390  0.04217  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  #  0.99992
2000  1  1  3  0  113.2 0.00000  0.00000  0.00000  0.00000  0.00063  0.00440
   0.02254  0.01886  0.07638  0.09469  0.08862  0.05707  0.06686  0.02301
   0.01656  0.00292  0.00318  0.00743  0.00000  0.00000  0.00000  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00063  0.00343  0.00509  0.02640
   0.08441  0.08659  0.10386  0.07380  0.05575  0.03338  0.03550  0.00435
   0.00372  0.00000  0.00000  0.00000  0.00000  0.00000  #  1.00008
2001  1  1  3  0  209.0 0.00000  0.00000  0.00000  0.00000  0.00000  0.00045
   0.00604  0.02883  0.04877  0.08657  0.10686  0.11977  0.08927  0.02860
   0.02927  0.00898  0.00045  0.00000  0.00045  0.00000  0.00000  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00046  0.00236  0.00723
   0.03248  0.05627  0.10514  0.11684  0.07283  0.03307  0.01020  0.00748
   0.00044  0.00000  0.00000  0.00091  0.00000  0.00000  #  1.00001
2002  1  1  3  0  -260.8   0.00000  0.00000  0.00000  0.00000  0.00000
   0.00133  0.00894  0.02270  0.04397  0.05983  0.09745  0.09179  0.08903
```

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   0.07618  0.03186  0.02101  0.00827  0.00000  0.00000  0.00000  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00316
   0.01284  0.02243  0.05153  0.08975  0.12290  0.09282  0.03730  0.01396
   0.00087  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  #  0.99992
2003  1  1  3  0  -304.3   0.00000  0.00170  0.00000  0.00000  0.00170
   0.00206  0.01409  0.02973  0.05034  0.03790  0.07370  0.08065  0.08590
   0.05698  0.02411  0.00893  0.00172  0.00000  0.00000  0.00000  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00733  0.02200
   0.02379  0.02704  0.06961  0.13456  0.11630  0.07949  0.02965  0.01169
   0.00868  0.00038  0.00000  0.00000  0.00000  0.00000  0.00000  #  1.00004
2004  1  1  3  0  -705.4   0.00000  0.00000  0.00000  0.00000  0.00000
   0.00185  0.01800  0.04759  0.06873  0.07344  0.05295  0.05353  0.06901
   0.06208  0.03817  0.01141  0.00412  0.00023  0.00023  0.00000  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00110  0.00872
   0.03147  0.05916  0.06902  0.08247  0.10987  0.09246  0.02986  0.01036
   0.00422  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  #  1.00004
2005  1  1  3  0  -405.9   0.00000  0.00000  0.00000  0.00000  0.00000
   0.00035  0.01056  0.04614  0.07897  0.07876  0.05852  0.04669  0.04965
   0.05380  0.02343  0.01097  0.00180  0.00000  0.00000  0.00000  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00033  0.00218  0.00965
   0.04532  0.09376  0.06801  0.08408  0.12525  0.07805  0.02575  0.00659
   0.00142  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  #  1.00003
2006  1  1  3  0  808.9 0.00000  0.00000  0.00000  0.00000  0.00253  0.00226
   0.01563  0.03284  0.05620  0.07610  0.07043  0.05511  0.06048  0.06194
   0.03757  0.01219  0.00618  0.00162  0.00098  0.00046  0.00000  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00038  0.00258  0.00627  0.01675
   0.04930  0.07619  0.09212  0.11618  0.08494  0.04188  0.01333  0.00451
   0.00064  0.00014  0.00000  0.00000  0.00000  0.00000  #  0.99772
#
#_OR_Commercial_TWL
1974  1  2  0  0  7.1   0.00000  0.00000  0.00000  0.00000  0.01000  0.00000
   0.00000  0.00000  0.00000  0.00000  0.02000  0.05000  0.16000  0.16000
   0.18000  0.14000  0.11000  0.10000  0.06000  0.01000  0.00000  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  #  1.00000
1994  1  2  0  0  6.7   0.00000  0.00000  0.00000  0.00000  0.00000  0.04878
   0.00000  0.00000  0.12195  0.04878  0.17073  0.09756  0.21951  0.17073
   0.09756  0.02439  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  #  1.00001
1997  1  2  0  0  11.0  0.00000  0.00000  0.00000  0.00000  0.00000  0.01722
   0.01722  0.00000  0.00000  0.00000  0.01336  0.06118  0.18354  0.33087
   0.26583  0.05730  0.05344  0.00000  0.00000  0.00000  0.00000  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  #  0.99997
2001  1  2  0  0  3.8   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000
   0.00000  0.00000  0.00000  0.00000  0.10005  0.34992  0.10005  0.19959
   0.00000  0.04977  0.14982  0.04977  0.00000  0.00000  0.00000  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  #  0.99896
2005  1  2  0  0  6.0   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000
   0.00000  0.00000  0.00000  0.02779  0.22233  0.19454  0.11117  0.22233
   0.08338  0.05558  0.00000  0.08338  0.00000  0.00000  0.00000  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  #  1.00050
```

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#
#_OR_RecFIN
1980  1  3  0  0  228.8 0.00000  0.00000  0.00277  0.00617  0.01910  0.07004
   0.05758  0.07158  0.09814  0.12940  0.10446  0.10735  0.09289  0.08385
   0.06345  0.05467  0.02619  0.01177  0.00058  0.00000  0.00000  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  #  1.00000
1981  1  3  0  0  135.1 0.00000  0.00294  0.00294  0.00107  0.03440  0.02594
   0.07770  0.11488  0.11104  0.10134  0.11344  0.12547  0.08044  0.07948
   0.07009  0.04076  0.00881  0.00570  0.00089  0.00267  0.00000  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  #  1.00000
1982  1  3  0  0  282.0 0.00000  0.00058  0.00063  0.00155  0.00699  0.02653
   0.05138  0.09989  0.10938  0.13448  0.13027  0.12940  0.12825  0.07307
   0.06254  0.02885  0.01170  0.00097  0.00354  0.00000  0.00000  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  #  1.00000
1983  1  3  0  0  97.1  0.00000  0.00000  0.00000  0.00168  0.02290  0.01886
   0.06724  0.07330  0.16766  0.15152  0.13509  0.11315  0.10429  0.07156
   0.03738  0.01852  0.00000  0.00000  0.01094  0.00589  0.00000  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  #  1.00000
1984  1  3  0  0  402.9 0.00000  0.00000  0.00259  0.00279  0.01253  0.02360
   0.03014  0.08844  0.12882  0.18594  0.13558  0.12887  0.11733  0.06969
   0.04041  0.01970  0.00977  0.00286  0.00093  0.00000  0.00000  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  #  1.00000
1985  1  3  0  0  542.3 0.00000  0.00102  0.00600  0.02879  0.01743  0.04297
   0.07813  0.07193  0.10698  0.16581  0.14105  0.14777  0.09331  0.04984
   0.02459  0.01584  0.00411  0.00174  0.00159  0.00042  0.00072  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  #  1.00000
1986  1  3  0  0  375.3 0.00000  0.00000  0.00034  0.00929  0.00988  0.03216
   0.06220  0.06488  0.11536  0.15664  0.16571  0.18939  0.10484  0.05780
   0.01618  0.01067  0.00406  0.00000  0.00058  0.00000  0.00000  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  #  1.00000
1987  1  3  0  0  304.4 0.00000  0.00458  0.00929  0.02725  0.03415  0.05976
   0.08123  0.07492  0.08696  0.13259  0.08128  0.14286  0.09766  0.08350
   0.03985  0.03203  0.00628  0.00376  0.00000  0.00000  0.00205  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  #  1.00000
1988  1  3  0  0  464.2 0.00000  0.01064  0.01601  0.02674  0.03208  0.05387
   0.07577  0.10631  0.13256  0.15706  0.12674  0.10577  0.06696  0.03820
   0.02820  0.01734  0.00521  0.00053  0.00000  0.00000  0.00000  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  #  1.00000
1989  1  3  0  0  269.5 0.00000  0.00152  0.00455  0.00803  0.01046  0.02952
   0.04616  0.10760  0.12274  0.15432  0.12929  0.14410  0.10991  0.06327
   0.03836  0.01530  0.00304  0.00698  0.00061  0.00243  0.00182  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000
```

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   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  #  1.00000
1993  1  3  0  0  579.9 0.00000  0.00141  0.00094  0.00191  0.01144  0.02720
   0.04434  0.10156  0.10356  0.17350  0.17203  0.14158  0.09979  0.07177
   0.03157  0.01327  0.00157  0.00132  0.00094  0.00000  0.00031  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  #  1.00000
1994  1  3  0  0  751.2 0.00000  0.00062  0.00389  0.00608  0.00972  0.02288
   0.04906  0.08583  0.11953  0.15913  0.14435  0.16026  0.10826  0.06625
   0.03119  0.01611  0.00586  0.00751  0.00320  0.00026  0.00000  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  #  1.00000
1995  1  3  0  0  646.5 0.00000  0.00023  0.00026  0.00283  0.00755  0.02738
   0.04732  0.11106  0.14786  0.17037  0.16654  0.15114  0.08902  0.03970
   0.02269  0.01386  0.00193  0.00000  0.00023  0.00000  0.00000  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  #  1.00000
1996  1  3  0  0  625.6 0.00000  0.00000  0.00000  0.00132  0.01580  0.02497
   0.04551  0.11137  0.12748  0.15060  0.17028  0.15323  0.11340  0.05187
   0.02002  0.00894  0.00303  0.00000  0.00021  0.00196  0.00000  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  #  1.00000
1997  1  3  0  0  873.5 0.00000  0.00057  0.00112  0.00157  0.01069  0.02782
   0.05066  0.11359  0.17352  0.17016  0.14780  0.12583  0.09247  0.05334
   0.01769  0.00902  0.00179  0.00218  0.00000  0.00000  0.00019  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  #  1.00000
1998  1  3  0  0  1295.9   0.00000  0.00036  0.00051  0.00343  0.01378
   0.03196  0.05480  0.09139  0.13245  0.17028  0.17687  0.12861  0.10006
   0.05333  0.02541  0.01459  0.00159  0.00017  0.00041  0.00000  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  #  1.00000
1999  1  3  0  0  1496.5   0.00000  0.00000  0.00012  0.00082  0.00913
   0.03122  0.07128  0.13086  0.17282  0.18861  0.15258  0.11710  0.07509
   0.02807  0.01634  0.00356  0.00162  0.00029  0.00049  0.00000  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  #  1.00000
2000  1  3  0  0  1256.6   0.00000  0.00019  0.00136  0.00230  0.01125
   0.02237  0.05289  0.10804  0.17568  0.19486  0.17571  0.12231  0.07826
   0.03796  0.00946  0.00314  0.00096  0.00135  0.00000  0.00192  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  #  1.00000
2001  1  3  0  0  715.4 0.00000  0.00048  0.00048  0.00240  0.00914  0.01983
   0.03060  0.06294  0.14362  0.21845  0.20908  0.15112  0.08157  0.04326
   0.01329  0.00583  0.00572  0.00166  0.00029  0.00000  0.00000  0.00024
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  #  1.00000
2002  1  3  0  0  758.4 0.00000  0.00000  0.00000  0.00107  0.00826  0.01420
   0.03579  0.04554  0.09808  0.16682  0.22051  0.18479  0.12287  0.05972
   0.02559  0.00937  0.00480  0.00096  0.00086  0.00077  0.00000  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000
```

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   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  #  1.00000
#
#_OR_ORBS-1,_Garibaldi_only
1978  1  9  0  0  43.1  0.00000  0.00000  0.00000  0.00000  0.03090  0.05400
   0.06950  0.06560  0.11190  0.10430  0.14290  0.12740  0.05400  0.08490
   0.06950  0.05400  0.02710  0.00390  0.00000  0.00000  0.00000  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  #  0.99990
1979  1  9  0  0  21.0  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000
   0.00000  0.01590  0.06350  0.11900  0.14290  0.22220  0.22220  0.08730
   0.07940  0.02380  0.00790  0.00790  0.00790  0.00000  0.00000  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  #  0.99990
1980  1  9  0  0  8.3   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000
   0.02000  0.02000  0.12000  0.10000  0.16000  0.16000  0.32000  0.02000
   0.06000  0.02000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  #  1.00000
1981  1  9  0  0  11.5  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000
   0.01450  0.04350  0.07250  0.08700  0.13040  0.17390  0.24640  0.14490
   0.05800  0.02900  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  #  1.00010
1982  1  9  0  0  31.1  0.00000  0.00000  0.00000  0.00000  0.00000  0.00530
   0.00000  0.03210  0.05340  0.11760  0.08550  0.17110  0.18190  0.13900
   0.08560  0.05880  0.04810  0.02140  0.00000  0.00000  0.00000  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  #  0.99980
1983  1  9  0  0  16.8  0.00000  0.00000  0.00000  0.00000  0.00000  0.00990
   0.01980  0.09900  0.13860  0.18810  0.23760  0.16830  0.06930  0.02970
   0.01980  0.01980  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  #  0.99990
1984  1  9  0  0  130.1 0.00000  0.00000  0.00000  0.00130  0.00000  0.00510
   0.01410  0.05250  0.11390  0.14850  0.16900  0.15620  0.11780  0.10760
   0.04740  0.03970  0.01540  0.00760  0.00390  0.00000  0.00000  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  #  1.00000
1985  1  9  0  0  81.1  0.00000  0.00000  0.00000  0.00000  0.00210  0.00210
   0.00210  0.03290  0.05750  0.15200  0.21360  0.14580  0.16020  0.10680
   0.07590  0.03900  0.00830  0.00210  0.00000  0.00000  0.00000  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  #  1.00040
1986  1  9  0  0  132.3 0.00000  0.00000  0.00000  0.00000  0.00260  0.00250
   0.01770  0.01510  0.05040  0.11210  0.17380  0.17760  0.12850  0.11710
   0.09820  0.05290  0.03150  0.01010  0.00760  0.00260  0.00000  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  #  1.00030
1987  1  9  0  0  104.8 0.00000  0.00000  0.00000  0.00320  0.00480  0.00800
   0.01430  0.01740  0.05400  0.10330  0.15260  0.18760  0.16380  0.12250
```

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   0.08420  0.05240  0.02390  0.00640  0.00160  0.00000  0.00000  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  #  1.00000
1988  1  9  0  0  83.6  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000
   0.00600  0.02190  0.04180  0.05180  0.08960  0.13940  0.18320  0.16330
   0.13950  0.10360  0.03590  0.01990  0.00400  0.00000  0.00000  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  #  0.99990
1989  1  9  0  0  132.9 0.00000  0.00000  0.00000  0.00000  0.00000  0.00000
   0.00380  0.01130  0.03630  0.08020  0.11030  0.13160  0.18670  0.17540
   0.11030  0.07770  0.04630  0.02130  0.00880  0.00000  0.00000  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  #  1.00000
#_OR_ORBS-1,_state-wide
1990  1  9  3  0  349.6 0.00000  0.00000  0.00000  0.00000  0.00158  0.00845
   0.01147  0.02145  0.05969  0.09125  0.08232  0.07930  0.06453  0.04752
   0.03233  0.01766  0.00743  0.00161  0.00000  0.00000  0.00000  0.00000
   0.00000  0.00000  0.00000  0.00047  0.00836  0.00255  0.01713  0.02383
   0.06195  0.07894  0.07730  0.08956  0.05655  0.03587  0.00993  0.01001
   0.00098  0.00000  0.00000  0.00000  0.00000  0.00000  #  1.00000
1991  1  9  3  0  211.5 0.00000  0.00000  0.00000  0.00000  0.00001  0.01673
   0.03811  0.02972  0.03957  0.09579  0.11833  0.07486  0.09078  0.02000
   0.01805  0.00482  0.00009  0.00128  0.00025  0.00000  0.00000  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00772  0.00026  0.01208  0.05809
   0.09222  0.08638  0.05785  0.07507  0.03264  0.02119  0.00651  0.00156
   0.00001  0.00003  0.00000  0.00000  0.00000  0.00000  #  1.00001
1992  1  9  3  0  315.5 0.00000  0.00000  0.00000  0.00099  0.00265  0.00891
   0.00892  0.01802  0.04588  0.06855  0.09084  0.09577  0.05963  0.04455
   0.01785  0.01433  0.00121  0.00000  0.00000  0.00000  0.00000  0.00000
   0.00000  0.00000  0.00000  0.00093  0.00083  0.00994  0.01917  0.02675
   0.05415  0.09516  0.10388  0.09821  0.07029  0.03233  0.00656  0.00229
   0.00000  0.00109  0.00000  0.00033  0.00000  0.00000  #  1.00000
1993  1  9  3  0  219.0 0.00000  0.00000  0.00203  0.00239  0.00701  0.01205
   0.02017  0.02736  0.04540  0.05677  0.06900  0.06337  0.06234  0.04447
   0.02948  0.00935  0.00194  0.00065  0.00028  0.00000  0.00000  0.00000
   0.00000  0.00000  0.00067  0.00118  0.00802  0.01941  0.02332  0.03158
   0.04621  0.07552  0.12063  0.10168  0.08473  0.02121  0.00940  0.00239
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  #  1.00000
1994  1  9  3  0  530.0 0.00000  0.00090  0.00000  0.00066  0.00384  0.00929
   0.02079  0.04691  0.04426  0.05956  0.07760  0.07795  0.05746  0.04007
   0.02392  0.01512  0.00330  0.00051  0.00033  0.00000  0.00000  0.00000
   0.00000  0.00000  0.00014  0.00019  0.00370  0.00794  0.01845  0.03197
   0.05036  0.06093  0.09093  0.08704  0.08269  0.05398  0.02384  0.00344
   0.00111  0.00039  0.00005  0.00039  0.00000  0.00000  #  1.00000
1995  1  9  3  0  333.8 0.00000  0.00000  0.00058  0.00169  0.00294  0.01307
   0.02918  0.04877  0.06006  0.06522  0.08060  0.07935  0.04768  0.03050
   0.01819  0.00844  0.00206  0.00027  0.00095  0.00000  0.00000  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00245  0.01108  0.02816  0.04692
   0.08200  0.09294  0.08800  0.06591  0.05277  0.02366  0.01113  0.00188
   0.00256  0.00098  0.00000  0.00000  0.00000  0.00000  #  1.00000
1996  1  9  3  0  -273.7   0.00000  0.00000  0.00000  0.00198  0.00519
   0.01261  0.01962  0.04322  0.06642  0.08097  0.08293  0.06345  0.03681
   0.03094  0.00868  0.00379  0.00069  0.00000  0.00000  0.00000  0.00000
   0.00000  0.00000  0.00257  0.00000  0.00395  0.00794  0.01414  0.02598
   0.05145  0.09342  0.08775  0.10327  0.08278  0.05547  0.01092  0.00288
   0.00017  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  #  1.00000
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1997  1  9  3  0  -309.9   0.00000  0.00000  0.00000  0.00312  0.00163
   0.02095  0.03793  0.04320  0.07428  0.08007  0.08292  0.06964  0.04744
   0.02761  0.01785  0.01110  0.00317  0.00032  0.00060  0.00000  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00148  0.00151  0.00926  0.01759
   0.04868  0.07567  0.06800  0.08883  0.07084  0.04028  0.02379  0.02302
   0.00753  0.00169  0.00000  0.00000  0.00000  0.00000  0.00000  #  1.00000
1998  1  9  3  0  -275.6   0.00000  0.00000  0.00174  0.00632  0.00664
   0.01550  0.02278  0.05415  0.08329  0.09418  0.06518  0.04516  0.04069
   0.02521  0.01579  0.00648  0.00261  0.00064  0.00147  0.00021  0.00021
   0.00000  0.00000  0.00000  0.00341  0.00084  0.00872  0.00885  0.02127
   0.05260  0.09071  0.08978  0.08049  0.07479  0.03940  0.02017  0.01084
   0.00708  0.00230  0.00050  0.00000  0.00000  0.00000  0.00000  #  1.00000
1999  1  9  3  0  -571.1   0.00000  0.00000  0.00238  0.00043  0.00196
   0.00836  0.02810  0.05455  0.07806  0.08799  0.09568  0.06073  0.04129
   0.01903  0.01297  0.00781  0.00161  0.00052  0.00025  0.00000  0.00000
   0.00000  0.00000  0.00056  0.00066  0.00100  0.00104  0.00627  0.02555
   0.05303  0.07799  0.09668  0.08278  0.06200  0.04706  0.02296  0.01083
   0.00712  0.00219  0.00043  0.00018  0.00000  0.00000  0.00000  #  1.00000
2000  1  9  3  0  -812.1   0.00000  0.00000  0.00044  0.00164  0.00286
   0.00412  0.02240  0.04191  0.07527  0.10685  0.10394  0.06344  0.04084
   0.01745  0.00813  0.00309  0.00050  0.00000  0.00023  0.00000  0.00000
   0.00000  0.00000  0.00018  0.00091  0.00091  0.00181  0.00879  0.02754
   0.04738  0.10214  0.11644  0.09133  0.05958  0.03361  0.01164  0.00378
   0.00052  0.00032  0.00000  0.00000  0.00000  0.00000  0.00000  #  1.00000
2001  1  9  3  0  80.7  0.00000  0.00000  0.00000  0.00000  0.00200  0.00068
   0.00076  0.02367  0.06769  0.10920  0.09090  0.06402  0.06259  0.03472
   0.01887  0.00000  0.00200  0.00200  0.00000  0.00000  0.00000  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00179  0.00000  0.01626  0.02672
   0.10435  0.13178  0.07556  0.08125  0.04970  0.02030  0.01122  0.00000
   0.00200  0.00000  0.00000  0.00000  0.00000  0.00000  #  1.00000
2002  1  9  3  0  -624.0   0.00000  0.00030  0.00025  0.00153  0.00640
   0.01221  0.01245  0.02472  0.03749  0.05655  0.10127  0.11649  0.08219
   0.04272  0.02290  0.00557  0.00225  0.00030  0.00000  0.00020  0.00000
   0.00000  0.00000  0.00000  0.00019  0.00265  0.00830  0.01363  0.01264
   0.02462  0.05139  0.10574  0.12307  0.08338  0.03432  0.01124  0.00240
   0.00065  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  #  1.00000
2003  1  9  3  0  -587.4   0.00000  0.00000  0.00000  0.00102  0.00210
   0.00623  0.01775  0.02909  0.04137  0.06011  0.08225  0.08962  0.07821
   0.05070  0.02611  0.00913  0.00263  0.00200  0.00071  0.00035  0.00000
   0.00000  0.00000  0.00000  0.00061  0.00062  0.00470  0.00595  0.02345
   0.03994  0.05856  0.08280  0.12188  0.09026  0.04049  0.01954  0.00854
   0.00255  0.00035  0.00039  0.00000  0.00000  0.00000  0.00000  #  1.00000
2004  1  9  3  0  -528.9   0.00000  0.00000  0.00000  0.00069  0.00452
   0.00835  0.02343  0.03306  0.06711  0.06618  0.07349  0.07965  0.08148
   0.04292  0.01452  0.00796  0.00252  0.00048  0.00082  0.00000  0.00000
   0.00000  0.00000  0.00000  0.00061  0.00000  0.00318  0.00557  0.01578
   0.04689  0.07893  0.09588  0.11254  0.07942  0.03342  0.01431  0.00417
   0.00195  0.00018  0.00000  0.00000  0.00000  0.00000  0.00000  #  1.00000
2005  1  9  3  0  -571.3   0.00000  0.00000  0.00057  0.00000  0.00046
   0.00243  0.01184  0.03584  0.07689  0.08455  0.08078  0.07382  0.06518
   0.03928  0.01337  0.01003  0.00134  0.00082  0.00076  0.00000  0.00045
   0.00000  0.00000  0.00000  0.00000  0.00024  0.00045  0.00272  0.00947
   0.03065  0.05964  0.09361  0.11789  0.10243  0.05447  0.02189  0.00578
   0.00230  0.00005  0.00000  0.00000  0.00000  0.00000  0.00000  #  1.00000
#
#_OR_ORBS-2
2001  1  9  0  0  1282.6   0.00000  0.00024  0.00142  0.00169  0.00557
   0.01140  0.02813  0.04647  0.08604  0.19438  0.22438  0.18394  0.10499
   0.06176  0.03116  0.01031  0.00587  0.00139  0.00087  0.00000  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000
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   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  #  1.00000
2002  1  9  0  0  1115.1   0.00000  0.00000  0.00046  0.00907  0.00940
   0.01457  0.02959  0.03980  0.06281  0.13206  0.22187  0.20015  0.13223
   0.08231  0.03082  0.02008  0.00779  0.00381  0.00160  0.00147  0.00012
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  #  1.00000
2003  1  9  0  0  1155.1   0.00000  0.00000  0.00006  0.00458  0.00203
   0.01721  0.03565  0.06525  0.07991  0.12452  0.15604  0.17281  0.14686
   0.09570  0.04700  0.02546  0.01160  0.00715  0.00613  0.00052  0.00000
   0.00151  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  #  1.00000
2004  1  9  0  0  811.9 0.00000  0.00006  0.00006  0.00018  0.00394  0.00929
   0.02457  0.05704  0.12536  0.13075  0.15999  0.17144  0.13067  0.09863
   0.04499  0.02813  0.01114  0.00226  0.00114  0.00038  0.00000  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  #  1.00000
2005  1  9  0  0  1163.3   0.00000  0.00000  0.00000  0.00020  0.00160
   0.00357  0.02112  0.04001  0.11639  0.13466  0.19798  0.19369  0.13520
   0.07728  0.04849  0.01468  0.00676  0.00764  0.00000  0.00072  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  #  1.00000
2006  1  9  0  0  2103.6   0.00000  0.00000  0.00019  0.00017  0.00054
   0.00698  0.01687  0.05864  0.11339  0.15552  0.17491  0.18250  0.13692
   0.07889  0.03992  0.01432  0.00943  0.00571  0.00320  0.00014  0.00176
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  #  1.00000
#
#_CA_Commercial_HKL
1982  1  4  0  0  10.6  0.00000  0.00000  0.00000  0.00000  0.00000  0.01818
   0.01818  0.03636  0.03636  0.14545  0.03636  0.14545  0.12727  0.18182
   0.10909  0.07273  0.03636  0.01818  0.00000  0.01818  0.00000  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  #  1.00000
1983  1  4  0  0  12.8  0.00000  0.00000  0.00000  0.00000  0.00000  0.01408
   0.00000  0.00000  0.04225  0.01408  0.09859  0.16901  0.26761  0.14085
   0.12676  0.09859  0.02817  0.00000  0.00000  0.00000  0.00000  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  #  1.00000
1984  1  4  0  0  9.9   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000
   0.00000  0.00000  0.00000  0.10526  0.01754  0.07018  0.29825  0.22807
   0.17544  0.08772  0.01754  0.00000  0.00000  0.00000  0.00000  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  #  1.00000
1985  1  4  0  0  5.3   0.00000  0.00000  0.00000  0.00000  0.00000  0.03226
   0.03226  0.00000  0.06452  0.09677  0.09677  0.16129  0.19355  0.19355
   0.06452  0.06452  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  #  1.00000
1992  1  4  0  0  179.8 0.00000  0.00211  0.00211  0.01582  0.03481  0.02848
   0.05907  0.06646  0.07806  0.10021  0.15084  0.16878  0.10549  0.08755
```

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   0.05485  0.03692  0.00527  0.00105  0.00211  0.00000  0.00000  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  #  1.00000
1993  1  4  0  0  476.0 0.00000  0.00124  0.00124  0.01285  0.03523  0.05139
   0.06258  0.08910  0.10195  0.15126  0.16245  0.13676  0.09532  0.05512
   0.02238  0.01533  0.00290  0.00166  0.00041  0.00041  0.00041  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  #  1.00000
1994  1  4  0  0  523.6 0.00000  0.00106  0.00638  0.00956  0.02728  0.05172
   0.07722  0.10910  0.11229  0.12646  0.12150  0.12682  0.09458  0.06837
   0.03471  0.01736  0.01098  0.00248  0.00213  0.00000  0.00000  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  #  1.00000
1995  1  4  0  0  378.0 0.00000  0.00047  0.00047  0.00233  0.01399  0.04662
   0.09697  0.12028  0.13333  0.12634  0.14545  0.12308  0.08252  0.05548
   0.03497  0.00746  0.00606  0.00140  0.00280  0.00000  0.00000  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  #  1.00000
1996  1  4  0  0  337.5 0.00000  0.00256  0.00410  0.00717  0.01126  0.03584
   0.08397  0.11521  0.13518  0.13466  0.13466  0.12033  0.10036  0.06196
   0.03533  0.01024  0.00461  0.00256  0.00000  0.00000  0.00000  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  #  1.00000
1997  1  4  0  0  179.4 0.00000  0.00000  0.00103  0.00827  0.01448  0.03619
   0.07135  0.12823  0.17994  0.15098  0.12823  0.10755  0.07859  0.05481
   0.02275  0.01551  0.00207  0.00000  0.00000  0.00000  0.00000  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  #  1.00000
1998  1  4  0  0  61.4  0.00000  0.00000  0.00000  0.00000  0.00333  0.03000
   0.07000  0.12000  0.13000  0.14667  0.14333  0.15667  0.11000  0.04333
   0.02333  0.02000  0.00333  0.00000  0.00000  0.00000  0.00000  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  #  1.00000
1999  1  4  0  0  411.7 0.00000  0.00000  0.00042  0.00169  0.00339  0.01271
   0.04492  0.10339  0.18644  0.18559  0.16992  0.12754  0.08008  0.04110
   0.02288  0.01398  0.00466  0.00127  0.00000  0.00000  0.00000  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  #  1.00000
1999  1  4  0  0  411.7 0.00000  0.00000  0.00042  0.00169  0.00339  0.01271
   0.04492  0.10339  0.18644  0.18559  0.16992  0.12754  0.08008  0.04110
   0.02288  0.01398  0.00466  0.00127  0.00000  0.00000  0.00000  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  #  1.00000
2000  1  4  0  0  114.8 0.00000  0.00000  0.00000  0.00000  0.00876  0.02277
   0.04203  0.11734  0.14361  0.17688  0.16637  0.14361  0.09107  0.04904
   0.02452  0.00701  0.00350  0.00350  0.00000  0.00000  0.00000  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  #  1.00000
2001  1  4  0  0  181.4 0.00000  0.00000  0.00000  0.00000  0.00315  0.00840
   0.02731  0.07353  0.11975  0.20378  0.20273  0.16807  0.09874  0.04517
```

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   0.02941  0.01261  0.00630  0.00105  0.00000  0.00000  0.00000  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  #  1.00000
2002  1  4  0  0  115.9 0.00000  0.00000  0.00000  0.00000  0.00998  0.01997
   0.03161  0.07321  0.09983  0.17138  0.15973  0.13810  0.11980  0.07987
   0.05491  0.02662  0.00666  0.00832  0.00000  0.00000  0.00000  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  #  1.00000
2003  1  4  0  0  22.0  0.00000  0.00000  0.00000  0.01626  0.02439  0.08130
   0.06504  0.05691  0.06504  0.11382  0.12195  0.18699  0.13008  0.05691
   0.04878  0.01626  0.00000  0.01626  0.00000  0.00000  0.00000  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  #  1.00000
2004  1  4  0  0  49.5  0.00000  0.00000  0.00000  0.00389  0.01946  0.03113
   0.14008  0.11673  0.14786  0.10895  0.10506  0.10117  0.06615  0.08560
   0.04669  0.01556  0.00389  0.00778  0.00000  0.00000  0.00000  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  #  1.00000
2005  1  4  0  0  41.4  0.00000  0.00000  0.00000  0.00455  0.04091  0.02727
   0.09091  0.13636  0.19091  0.17273  0.10455  0.09091  0.06818  0.03636
   0.01818  0.01364  0.00455  0.00000  0.00000  0.00000  0.00000  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  #  1.00000
2006  1  4  0  0  119.5 0.00000  0.00000  0.00000  0.00000  0.01248  0.03276
   0.06708  0.13417  0.14977  0.15445  0.14041  0.10608  0.09204  0.05460
   0.03588  0.01404  0.00156  0.00156  0.00312  0.00000  0.00000  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  #  1.00000
#
#_CA_Commercial_TWL
1978  1  5  0  0  13.2  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000
   0.00000  0.00000  0.00000  0.05769  0.09615  0.15385  0.15385  0.15385
   0.07692  0.11538  0.03846  0.05769  0.01923  0.05769  0.01923  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  #  1.00000
1980  1  5  0  0  34.2  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000
   0.00000  0.00000  0.00758  0.01515  0.05303  0.08333  0.13636  0.16667
   0.21970  0.12121  0.03788  0.07576  0.05303  0.00758  0.02273  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  #  1.00000
1981  1  5  0  0  33.9  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000
   0.01538  0.02308  0.02308  0.04615  0.06154  0.06923  0.12308  0.12308
   0.16154  0.16923  0.08462  0.03077  0.04615  0.02308  0.00000  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  #  1.00000
1982  1  5  0  0  68.2  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000
   0.00000  0.00000  0.00319  0.03834  0.05112  0.11821  0.10543  0.22364
   0.13419  0.11502  0.11821  0.05112  0.03195  0.00958  0.00000  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  #  1.00000
```

```
1983  1  5  0  0  46.3  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000
   0.00000  0.00000  0.00472  0.00000  0.02830  0.08019  0.16509  0.17453
   0.17925  0.14623  0.08962  0.07075  0.03774  0.01887  0.00472  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  #  1.00000
1984  1  5  0  0  34.3  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000
   0.00000  0.00568  0.01705  0.00000  0.00000  0.07386  0.25000  0.19318
   0.19886  0.11932  0.06818  0.03977  0.01705  0.00568  0.00568  0.00568
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  #  1.00000
1985  1  5  0  0  30.7  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00637  0.04459  0.10828  0.24841
   0.22930  0.16561  0.09554  0.05096  0.05096  0.00000  0.00000  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  #  1.00000
1986  1  5  0  0  6.7   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00000  0.03704  0.18519  0.22222
   0.22222  0.11111  0.14815  0.07407  0.00000  0.00000  0.00000  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  #  1.00000
1987  1  5  0  0  33.4  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000
   0.00000  0.00000  0.00000  0.00000  0.02174  0.03804  0.06522  0.15217
   0.21196  0.25000  0.12500  0.06522  0.04348  0.02174  0.00543  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  #  1.00000
1988  1  5  0  0  11.7  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00000  0.01587  0.04762  0.09524
   0.14286  0.17460  0.15873  0.22222  0.11111  0.03175  0.00000  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  #  1.00000
1989  1  5  0  0  19.0  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000
   0.00000  0.00000  0.00000  0.01250  0.00000  0.05000  0.08750  0.05000
   0.15000  0.26250  0.17500  0.11250  0.07500  0.01250  0.01250  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  #  1.00000
1990  1  5  0  0  -1.7  0.00000  0.00000  0.00000  0.00000  0.00000  0.20000
   0.00000  0.00000  0.20000  0.60000  0.00000  0.00000  0.00000  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  #  1.00000
1991  1  5  0  0  7.0   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000
   0.00000  0.00000  0.05556  0.00000  0.05556  0.13889  0.08333  0.22222
   0.30556  0.08333  0.05556  0.00000  0.00000  0.00000  0.00000  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  #  1.00000
1992  1  5  0  0  12.0  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000
   0.00000  0.00000  0.00000  0.00000  0.09231  0.04615  0.24615  0.20000
   0.18462  0.16923  0.03077  0.01538  0.00000  0.00000  0.01538  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  #  1.00000
```

```
1996  1  5  0  0  4.5   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00000  0.12000  0.04000  0.16000
   0.20000  0.20000  0.12000  0.00000  0.08000  0.08000  0.00000  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  #  1.00000
1997  1  5  0  0  14.3  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000
   0.00000  0.00000  0.01220  0.07317  0.08537  0.09756  0.09756  0.15854
   0.17073  0.15854  0.06098  0.03659  0.04878  0.00000  0.00000  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  #  1.00000
1998  1  5  0  0  -1.8  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.16667
   0.50000  0.16667  0.00000  0.16667  0.00000  0.00000  0.00000  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  #  1.00000
1999  1  5  0  0  4.5   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000
   0.00000  0.00000  0.04000  0.00000  0.00000  0.04000  0.12000  0.16000
   0.24000  0.08000  0.16000  0.08000  0.00000  0.08000  0.00000  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  #  1.00000
2000  1  5  0  0  4.5   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000
   0.00000  0.00000  0.00000  0.04000  0.00000  0.00000  0.08000  0.20000
   0.28000  0.24000  0.12000  0.04000  0.00000  0.00000  0.00000  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  #  1.00000
2001  1  5  0  0  10.5  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000
   0.00000  0.00000  0.00000  0.06383  0.04255  0.06383  0.08511  0.12766
   0.17021  0.21277  0.04255  0.12766  0.02128  0.04255  0.00000  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  #  1.00000
2003  1  5  0  0  3.6   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000
   0.00000  0.00000  0.00000  0.00000  0.05263  0.00000  0.21053  0.15789
   0.21053  0.05263  0.15789  0.05263  0.10526  0.00000  0.00000  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  #  1.00000
2004  1  5  0  0  -2.2  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.22222  0.00000
   0.33333  0.00000  0.33333  0.00000  0.00000  0.00000  0.11111  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  #  1.00000
#
#_CA_RecFIN
1980  1  6  0  0  174.0 0.00000  0.00000  0.00148  0.01035  0.01314  0.04345
   0.06695  0.09012  0.10181  0.08877  0.10779  0.08764  0.10511  0.11601
   0.05805  0.06606  0.02379  0.01803  0.00000  0.00148  0.00000  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  #  1.00000
1981  1  6  0  0  162.6 0.00000  0.00000  0.00371  0.00551  0.00878  0.01992
   0.02239  0.06729  0.10645  0.13199  0.07787  0.11072  0.12985  0.10341
   0.11511  0.05862  0.02228  0.01317  0.00000  0.00293  0.00000  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000
```

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   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  #  1.00000
1982  1  6  0  0  203.0 0.00000  0.00221  0.00000  0.00277  0.00443  0.03333
   0.06798  0.10407  0.09322  0.07296  0.10153  0.11526  0.09754  0.08603
   0.09500  0.06566  0.03233  0.01683  0.00443  0.00443  0.00000  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  #  1.00000
1983  1  6  0  0  130.8 0.00000  0.00000  0.00504  0.00000  0.00630  0.02288
   0.06215  0.08776  0.07852  0.09007  0.11778  0.11064  0.10666  0.09091
   0.11589  0.08440  0.00840  0.00630  0.00210  0.00420  0.00000  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  #  1.00000
1984  1  6  0  0  233.4 0.00000  0.00099  0.01300  0.01369  0.04554  0.04148
   0.07769  0.07035  0.08037  0.06737  0.11222  0.10081  0.12860  0.11242
   0.05676  0.03850  0.01449  0.01330  0.00853  0.00387  0.00000  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  #  1.00000
1985  1  6  0  0  509.9 0.00000  0.00528  0.00611  0.01901  0.04452  0.09470
   0.12338  0.11550  0.08480  0.08052  0.08955  0.07621  0.08081  0.05963
   0.04740  0.04685  0.01506  0.00917  0.00150  0.00000  0.00000  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  #  1.00000
1986  1  6  0  0  393.7 0.00000  0.00355  0.00000  0.01364  0.02380  0.04163
   0.08339  0.11010  0.10605  0.10982  0.10257  0.11145  0.09724  0.05775
   0.07103  0.03232  0.02181  0.00575  0.00526  0.00213  0.00000  0.00071
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  #  1.00000
1987  1  6  0  0  154.5 0.00000  0.01124  0.01214  0.03777  0.06597  0.08014
   0.12600  0.11206  0.13532  0.11309  0.07259  0.03373  0.02226  0.05887
   0.05528  0.03880  0.01124  0.00675  0.00225  0.00225  0.00225  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  #  1.00000
1988  1  6  0  0  133.2 0.00000  0.01340  0.01340  0.03215  0.06109  0.08628
   0.12781  0.09164  0.15970  0.09352  0.09137  0.05386  0.03108  0.03805
   0.05145  0.02840  0.01474  0.00938  0.00000  0.00000  0.00268  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  #  1.00000
1989  1  6  0  0  147.2 0.00000  0.00000  0.02546  0.04261  0.08614  0.12278
   0.13288  0.15369  0.16728  0.08613  0.05085  0.03910  0.01791  0.03386
   0.02075  0.01835  0.00000  0.00000  0.00000  0.00000  0.00000  0.00218
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  #  1.00000
1993  1  6  0  0  558.9 0.00000  0.00557  0.01670  0.04202  0.07123  0.10012
   0.14554  0.11818  0.09251  0.08399  0.07429  0.07677  0.06746  0.04926
   0.03089  0.01066  0.01049  0.00000  0.00000  0.00434  0.00000  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  #  1.00000
1994  1  6  0  0  351.2 0.00000  0.00108  0.00954  0.02255  0.03839  0.11103
   0.14522  0.15358  0.13567  0.09871  0.07160  0.07374  0.05577  0.04069
   0.02964  0.00774  0.00361  0.00072  0.00000  0.00072  0.00000  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000
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   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  #  1.00000
1995  1  6  0  0  286.8 0.00000  0.00872  0.00939  0.03421  0.05500  0.13313
   0.19761  0.10800  0.08787  0.10451  0.07848  0.05044  0.04508  0.02898
   0.02281  0.00939  0.00894  0.00939  0.00268  0.00000  0.00000  0.00537
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  #  1.00000
1996  1  6  0  0  560.2 0.00000  0.00176  0.01383  0.01020  0.04087  0.08351
   0.13027  0.13062  0.11857  0.07947  0.10029  0.09277  0.07527  0.06042
   0.03718  0.01635  0.00352  0.00147  0.00281  0.00082  0.00000  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  #  1.00000
1997  1  6  0  0  317.2 0.00000  0.00994  0.03118  0.09106  0.12884  0.16876
   0.17420  0.12505  0.08438  0.06974  0.03301  0.03236  0.02025  0.02066
   0.00652  0.00280  0.00124  0.00000  0.00000  0.00000  0.00000  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  #  1.00000
1998  1  6  0  0  284.1 0.00000  0.00691  0.00576  0.02764  0.10862  0.17301
   0.17443  0.11741  0.04995  0.07337  0.06333  0.09823  0.03224  0.01958
   0.01727  0.00461  0.00806  0.01842  0.00115  0.00000  0.00000  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  #  1.00000
1999  1  6  0  0  -567.8   0.00000  0.00414  0.01202  0.03475  0.07621
   0.15859  0.28462  0.22850  0.12478  0.04486  0.01239  0.00881  0.00616
   0.00219  0.00066  0.00066  0.00066  0.00000  0.00000  0.00000  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  #  1.00000
2000  1  6  0  0  -396.3   0.00000  0.00339  0.00598  0.03090  0.06558
   0.18727  0.31424  0.22112  0.11412  0.01993  0.00787  0.00698  0.00688
   0.00498  0.00977  0.00100  0.00000  0.00000  0.00000  0.00000  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  #  1.00000
2001  1  6  0  0  379.7 0.00000  0.00431  0.01465  0.01776  0.05502  0.09667
   0.16577  0.20361  0.17196  0.08277  0.07868  0.04333  0.02961  0.00086
   0.01181  0.01975  0.00172  0.00000  0.00086  0.00086  0.00000  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  #  1.00000
2002  1  6  0  0  510.1 0.00000  0.00870  0.02545  0.05762  0.10278  0.09050
   0.13554  0.16991  0.19107  0.09626  0.04474  0.02167  0.02167  0.01180
   0.00915  0.00722  0.00303  0.00217  0.00000  0.00000  0.00072  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  #  1.00000
2003  1  6  0  0  983.6 0.00000  0.00279  0.01097  0.03272  0.10591  0.16376
   0.20318  0.12008  0.06997  0.04381  0.04911  0.05352  0.04777  0.03683
   0.03125  0.01531  0.00766  0.00310  0.00038  0.00075  0.00075  0.00038
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  #  1.00000
2004  1  6  0  0  1465.8   0.00000  0.00804  0.02817  0.04856  0.06509
   0.13024  0.17719  0.17243  0.12244  0.06070  0.03545  0.04532  0.01733
   0.03301  0.02016  0.01732  0.01084  0.00274  0.00214  0.00120  0.00140
   0.00020  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000
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   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  #  1.00000
2005  1  6  0  0  2303.7   0.00000  0.00275  0.00489  0.01819  0.03569
   0.07135  0.12322  0.12031  0.10753  0.09586  0.08716  0.11103  0.08620
   0.05902  0.03488  0.02430  0.00721  0.00601  0.00244  0.00158  0.00039
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  #  1.00000
2006  1  6  0  0  2504.8   0.00000  0.00108  0.00262  0.01189  0.03198
   0.06882  0.11669  0.13440  0.11468  0.08197  0.09468  0.08635  0.08609
   0.06823  0.04628  0.03046  0.01187  0.00690  0.00314  0.00178  0.00000
   0.00010  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  #  1.00000
#
#_CA_CPFV
1987  1  15 0  0  -8.6  0.00000  0.02083  0.00000  0.06250  0.10417  0.14583
   0.10417  0.18750  0.16667  0.16667  0.02083  0.00000  0.00000  0.02083
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  #  1.00000
1988  1  15 0  0  141.2 0.00000  0.00000  0.01351  0.04842  0.12162  0.06644
   0.06532  0.09685  0.13063  0.08333  0.06419  0.03041  0.03604  0.05743
   0.05856  0.06644  0.03378  0.01577  0.00676  0.00450  0.00000  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  #  1.00000
1989  1  15 0  0  141.2 0.00000  0.00000  0.00527  0.01477  0.02637  0.06646
   0.13713  0.18460  0.15401  0.10127  0.04325  0.04430  0.04958  0.04219
   0.05696  0.03586  0.01793  0.01266  0.00738  0.00000  0.00000  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  #  1.00000
1990  1  15 0  0  43.0  0.00000  0.00383  0.00766  0.06130  0.08429  0.08429
   0.22222  0.27586  0.17241  0.05747  0.01916  0.01149  0.00000  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  #  1.00000
1991  1  15 0  0  88.9  0.00000  0.00384  0.03455  0.03839  0.14203  0.19578
   0.18234  0.17850  0.12860  0.06718  0.01919  0.00000  0.00384  0.00192
   0.00192  0.00000  0.00000  0.00000  0.00000  0.00192  0.00000  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  #  1.00000
1992  1  15 0  0  77.0  0.00000  0.00000  0.00521  0.01042  0.05469  0.13021
   0.11979  0.21094  0.13802  0.10417  0.05729  0.04427  0.03646  0.02604
   0.03646  0.01563  0.00781  0.00260  0.00000  0.00000  0.00000  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  #  1.00000
1993  1  15 0  0  129.1 0.00000  0.00000  0.00563  0.03657  0.09142  0.12799
   0.15049  0.11814  0.09283  0.05204  0.04501  0.05907  0.07314  0.05204
   0.04219  0.02954  0.01266  0.00703  0.00422  0.00000  0.00000  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  #  1.00000
1994  1  15 0  0  176.3 0.00000  0.01369  0.01369  0.04692  0.10362  0.15738
   0.21994  0.18573  0.09482  0.06354  0.01857  0.01369  0.01857  0.01760
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   0.01369  0.01369  0.00293  0.00098  0.00098  0.00000  0.00000  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  #  1.00000
1995  1  15 0  0  136.9 0.00000  0.00119  0.01549  0.09535  0.21216  0.26460
   0.24553  0.12396  0.02503  0.00954  0.00119  0.00119  0.00000  0.00238
   0.00119  0.00000  0.00119  0.00000  0.00000  0.00000  0.00000  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  #  1.00000
1996  1  15 0  0  180.1 0.00000  0.00000  0.01746  0.03125  0.10018  0.18750
   0.22243  0.17371  0.11213  0.05423  0.02574  0.01838  0.01654  0.01471
   0.01011  0.01103  0.00092  0.00000  0.00368  0.00000  0.00000  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  #  1.00000
1997  1  15 0  0  297.1 0.00000  0.00222  0.02169  0.05951  0.15295  0.19299
   0.22247  0.14794  0.10122  0.05451  0.01835  0.01001  0.00389  0.00612
   0.00389  0.00111  0.00111  0.00000  0.00000  0.00000  0.00000  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  #  1.00000
1998  1  15 0  0  95.1  0.00000  0.00444  0.00667  0.04667  0.10889  0.23333
   0.23111  0.14222  0.06444  0.02222  0.01111  0.02222  0.01778  0.04222
   0.02667  0.01333  0.00444  0.00222  0.00000  0.00000  0.00000  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  #  1.00000
#_end_length_comps

25 #_Number_of_Age_Bins
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

1  #_Number_of_Aging_Error_Matrices
0.5   1.5   2.5   3.5   4.5   5.5   6.5   7.5   8.5   9.5   10.5  11.5  12.5
   13.5  14.5  15.5  16.5  17.5  18.5  19.5  20.5  21.5  22.5  23.5  24.5
   25.5  26.5  27.5  28.5  29.5  30.5  31.5  32.5  33.5  34.5  35.5  36.5
   37.5  38.5  39.5  40.5
0.056 0.169 0.281 0.393 0.506 0.618 0.731 0.843 0.955 1.068 1.180 1.293 1.405
   1.517 1.630 1.742 1.855 1.967 2.079 2.192 2.304 2.417 2.529 2.641 2.754
   2.866 2.979 3.091 3.203 3.316 3.428 3.541 3.653 3.765 3.878 3.990 4.103
   4.215 4.327 4.440 4.552

13 #_Age_Composition_Observations
#_OR_Commercial_HKL
2002  1  1  3  0  1  0  0  65.6  0.00000  0.00000  0.00000  0.00779  0.03396
   0.12116  0.05423  0.15233  0.06056  0.03320  0.02957  0.03025  0.00713
   0.01398  0.00490  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00431
   0.04213  0.06078  0.06602  0.09186  0.06687  0.02186  0.03689  0.01500
   0.01489  0.01612  0.00825  0.00000  0.00000  0.00000  0.00102  0.00000
   0.00490  0.00000  0.00000  0.00000  0.00000  #  0.99997
2003  1  1  3  0  1  0  0  90.8  0.00000  0.00000  0.00132  0.01441  0.04476
   0.07800  0.04873  0.09007  0.07764  0.04213  0.02866  0.01852  0.00348
   0.00231  0.00111  0.00330  0.00000  0.00000  0.00000  0.00000  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00681
   0.02134  0.05564  0.05300  0.08564  0.12446  0.05464  0.03306  0.05993
   0.01892  0.01291  0.01086  0.00267  0.00061  0.00443  0.00000  0.00000
   0.00000  0.00000  0.00000  0.00061  0.00000  #  0.99998
```

```
2004  1  1  3  0  1  0  0  72.1  0.00000  0.00000  0.00000  0.01556  0.09058
   0.07995  0.06373  0.05603  0.03062  0.05403  0.05100  0.01337  0.00896
   0.00657  0.00657  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.01175
   0.05923  0.03789  0.04777  0.03244  0.09914  0.08452  0.04473  0.05228
   0.00915  0.01731  0.00401  0.00247  0.00139  0.00284  0.00825  0.00000
   0.00657  0.00123  0.00000  0.00000  0.00000  #  0.99992
2005  1  1  3  0  1  0  0  55.8  0.00000  0.00000  0.00000  0.00000  0.12991
   0.12670  0.06015  0.03109  0.07340  0.00357  0.01994  0.00237  0.00490
   0.00359  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00360  0.02658
   0.11967  0.10232  0.05088  0.04103  0.05083  0.05181  0.02687  0.02847
   0.01919  0.01065  0.00895  0.00000  0.00370  0.00000  0.00000  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00000  #  1.00017
#
#_OR_ORBS-1
1996  1  9  3  0  1  0  0  103.9 0.00000  0.00500  0.05284  0.09372  0.10048
   0.08923  0.04836  0.02266  0.01132  0.00872  0.00842  0.00272  0.00333
   0.00000  0.00046  0.00046  0.00000  0.00000  0.00000  0.00000  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00530  0.02611  0.07717
   0.11905  0.11428  0.04602  0.03431  0.03381  0.02224  0.02142  0.01068
   0.00905  0.01337  0.00452  0.00046  0.00288  0.00379  0.00167  0.00524
   0.00000  0.00046  0.00046  0.00000  0.00000  #  1.00000
1997  1  9  3  0  1  0  0  76.1  0.00000  0.00000  0.01400  0.06933  0.12993
   0.10843  0.07373  0.04694  0.03711  0.01872  0.01395  0.00360  0.00261
   0.00130  0.00062  0.00000  0.00000  0.00068  0.00000  0.00000  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.01427  0.01820
   0.06842  0.11599  0.08982  0.06572  0.01425  0.01793  0.03132  0.00317
   0.00317  0.01681  0.00852  0.00130  0.00192  0.00068  0.00000  0.00068
   0.00267  0.00000  0.00130  0.00000  0.00291  #  1.00000
1998  1  9  3  0  1  0  0  94.0  0.00000  0.00000  0.03170  0.14336  0.13730
   0.09407  0.06606  0.04923  0.00875  0.01347  0.00233  0.00000  0.00306
   0.00000  0.00116  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.02980  0.04646
   0.10290  0.11408  0.05486  0.03809  0.03350  0.01536  0.00774  0.00555
   0.00116  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00000  #  1.00000
1999  1  9  3  0  1  0  0  282.8 0.00000  0.00000  0.00414  0.07658  0.11572
   0.11296  0.07387  0.05895  0.02404  0.02519  0.00809  0.00387  0.00416
   0.00146  0.00091  0.00000  0.00000  0.00000  0.00000  0.00011  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00036  0.00711  0.04774
   0.10318  0.07125  0.07903  0.06520  0.03851  0.01720  0.01903  0.01223
   0.00936  0.00685  0.00132  0.00112  0.00244  0.00093  0.00219  0.00187
   0.00209  0.00008  0.00000  0.00000  0.00084  #  1.00000
2000  1  9  3  0  1  0  0  411.2 0.00000  0.00000  0.00804  0.03951  0.13430
   0.12114  0.07936  0.05238  0.02839  0.01921  0.00906  0.00634  0.00305
   0.00259  0.00223  0.00000  0.00165  0.00074  0.00000  0.00000  0.00000
   0.00000  0.00022  0.00000  0.00000  0.00000  0.00104  0.00521  0.04700
   0.13492  0.11458  0.05548  0.03814  0.02562  0.02022  0.01528  0.01060
   0.00268  0.00469  0.00326  0.00560  0.00201  0.00213  0.00137  0.00022
   0.00077  0.00052  0.00022  0.00000  0.00022  #  1.00000
2002  1  9  3  0  1  0  0  571.8 0.00000  0.00055  0.01079  0.01629  0.04254
   0.08731  0.10767  0.09830  0.05252  0.03393  0.02876  0.01668  0.01296
   0.00404  0.00410  0.00367  0.00323  0.00172  0.00049  0.00088  0.00091
   0.00000  0.00013  0.00000  0.00068  0.00053  0.00030  0.01255  0.02001
   0.05537  0.07317  0.09369  0.06691  0.04097  0.02567  0.02398  0.01346
   0.00863  0.00630  0.00796  0.00541  0.00652  0.00261  0.00209  0.00188
   0.00137  0.00000  0.00016  0.00077  0.00154  #  1.00000
2003  1  9  3  0  1  0  0  422.7 0.00000  0.00000  0.00220  0.02453  0.06460
   0.07254  0.10105  0.09323  0.05298  0.03514  0.02266  0.01022  0.00937
```

```
   0.00421  0.00038  0.00052  0.00000  0.00000  0.00000  0.00000  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00242  0.02059
   0.07131  0.08470  0.08887  0.07131  0.04771  0.03925  0.02521  0.02502
   0.01043  0.00793  0.00669  0.00340  0.00116  0.00000  0.00000  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00038  #  1.00000
2004  1  9  3  0  1  0  0  397.9 0.00000  0.00000  0.00180  0.03034  0.09255
   0.08250  0.06786  0.06941  0.06739  0.03823  0.02678  0.01606  0.00839
   0.00365  0.00180  0.00125  0.00107  0.00000  0.00000  0.00000  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.02304
   0.10331  0.07844  0.06552  0.05334  0.05854  0.03964  0.01763  0.01893
   0.01126  0.00778  0.00536  0.00322  0.00101  0.00074  0.00107  0.00107
   0.00000  0.00051  0.00000  0.00000  0.00051  #  1.00000
2005  1  9  3  0  1  0  0  310.5 0.00000  0.00000  0.00000  0.00446  0.07884
   0.15817  0.06175  0.03688  0.06851  0.02329  0.02123  0.00524  0.01376
   0.00556  0.00259  0.00056  0.00275  0.00000  0.00000  0.00000  0.00000
   0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00134  0.00670
   0.06436  0.10960  0.07541  0.05483  0.03731  0.03885  0.02674  0.03484
   0.01327  0.01926  0.01220  0.00402  0.00132  0.00696  0.00271  0.00438
   0.00056  0.00121  0.00000  0.00000  0.00056  #  1.00000
#_end_age_comps

1  #_mean_length-at-age_(cm)              SampSiz Scalar =  0.75
#_Year   Season   Type  Gender   Partition   Age-Err  Nsamp
#_Composite_of_all_3_years
2004  1  9  3  0  1  1  10.00 20.00 28.39 32.31 35.32 37.47 39.61 41.00 42.15
   42.59 43.52 44.28 44.45 44.28 42.83 45.72 49.13 46.00 46.00 46.00 46.00
   46.00 46.00 46.00 46.00 46.00 46.00 28.50 31.91 34.82 36.41 38.22 38.94
   39.82 40.16 40.89 40.88 41.43 41.64 42.17 42.39 42.01 42.99 43.82 43.58
   44.80 44.05 43.00 43.00 42.60
                     0.00  0.00  6.00  91.50 347.25   437.25   376.50
   337.50   277.50   150.00   102.75   57.75 43.50 18.75 4.50  4.50  2.25
   0.00  0.00  0.00  0.00  0.00  0.00  0.00  0.00  0.00  0.00  6.00  80.25
   360.75   382.50   318.75   262.50   217.50   168.75   104.25   99.00 51.75
   48.00 37.50 17.25 8.25  6.00  4.50  3.75  0.75  1.50  0.00  0.00  1.50
#_end_mean_length-at-age

1  #_Number_of_Environmental_Variables
0  #_Environmental_Observations
999
```